technische universität dortmund

Dance Your Way through Entrepreneurial Irrationality, Errors, and Rejection: Unveiling Entrepreneurial Cognition, Decisions, and Learning under Complex Circumstances

DISSERTATION

In partial fulfillment of the requirements for the degree of

Doctor rerum politicarum (Dr. rer. pol.)

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Date of submission:	August 11, 2021
Submitted to:	Chair for Entrepreneurship and Economic Education
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To my parents and my brother

Bibliographic Information

1 Dinh, Anh and Liening, Andreas (2020). Entrepreneurial Relativity of Rationality: A Theoretical Analysis of Rationality in Entrepreneurship Education. *Journal of Entrepreneurship Education*, 23(4).

2 Dinh, Anh and Oberrauch, Luis and Liening, Andreas, The Window of Entrepreneurial Opportunity: Investigation of the Antecedents of Opportunity Recognition (July 30, 2021). Available at SSRN: https://ssrn.com/abstract=3911287 or http://dx.doi.org/10.2139/ssrn.3911287

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4 Dinh, Anh and Liening, Andreas, Errare Humanum Est: Epistemological Obstacles in Entrepreneurship Education (August 26, 2021). Available at SSRN: https://ssrn.com/abstract=3911875 or http://dx.doi.org/10.2139/ssrn.3911875

Acknowledgements

The entrepreneurial venture is often compared to the emotional ride on a rollercoaster. This also applies to my personal path of completing this doctoral dissertation. On this path, I have been fortunate enough to meet and work with many great people who inspired, supported, and motivated me in every aspect of my journey. It is a pleasure to express my deep sense of thanks and gratitude to my supervisor and mentor, Professor Dr. Andreas Liening. His dedication, epistemic curiosity, and genuine interest to help his doctoral students, his encouragement during challenging time, but mostly his effort to enable and guarantee his doctoral students' freedom of research substantially contributed to the completion of my dissertation. I want to express my utmost gratitude for creating an environment of trust and faith in which I could not only act entrepreneurially, but also flourish professionally and personally.

Moreover, I would like to express my sincere gratitude to Professor Dr. Ilona Ebbers. I met Prof. Ebbers at my very first scientific conference at the Annual Meeting of the Germany Association of Economic Education in 2016 and joined her working group Entrepreneurship Education. During this time, I have had the chance not only to learn from her, but also to receive valuable feedback on multiple occasions. Finally, I also want to express my deepest gratitude to Professor Dr. Andreas Hoffjan for his immediate readiness to be a member of the committee and herewith to support my doctoral dissertation.

A dissertation, particularly a cumulative dissertation, requires close collaboration with co-authors and colleagues. An exceptional gratitude goes to Jan-Martin Geiger, who supported and motivated me in every step of the way. I appreciate both your expertise and your kindness. Thank you for being a great colleague, an incredible friend, and the best office mate. I would also like to express my greatest thank to Luis Oberrauch, who, without any hesitation jumped in to support and collaborate with me on my project with the Lehigh@NasdaqCenter, in spite of his busy schedule. On this note, I would also like to thank Samantha Dewalt, Managing

Director of the Lehigh@NasdaqCenter, for enabling us to participate in the research study and helping us with the data collection, as well as for her insightful review of our paper.

Finally, I would like to thank profusely my colleagues at the Chair of Entrepreneurship and Economic Education. First and foremost, I feel a deep sense of gratitude towards Mario Holesch who not only supported me in realizing my dissertation, but also provided tireless support beyond this dissertation, whether in teaching activities or writing project proposals. I deeply appreciate our friendship! Furthermore, I would like to thank Tim Haarhaus, Laura Hering, Maria Ostrovski, Corinna Berg, Karin Niermann, and Susanne Schellong who accompanied me during my time at the chair. I will always cherish our time together and be grateful for your extraordinary support and team spirit.

As mentioned, a dissertation is an emotional rollercoaster. However, I had the great pleasure to be surrounded by a strong personal support system that encouraged and motivated me in every challenging situation. My greatest thanks go to my parents, my brother, Katie, and Malte, who have always supported me in my decisions. Their love and support were responsible for my entire education. It is therefore with love and infinite gratitude that I dedicate this dissertation to them.

Stuttgart, August 2021 Anh Phuong Dinh

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1 Introduction

1.1 Dissertation Motivation and Objectives

The success and survival of new business venturing depends on strategic entrepreneurial actions that includes making effective judgement calls and decisions to create value (Burgelman & Hitt, 2008; McMullen & Shepherd, 2006). Both entrepreneurship theory and practice have attested to this relationship. Thus, the nature and the effects of entrepreneurial decisions represent a prominent research topic investigated by entrepreneurship scholars (Caputo & Pellegrini, 2019; Sarasvathy & Berglund, 2010; Curşeu et al., 2008). Prior research has revealed an important link between entrepreneurial decisions and the entrepreneur's willingness to take venture-related actions by identifying, implementing, and pursuing market opportunities that lead to the formation of a new business (McMullen & Shepherd, 2006; Morris et al., 2013a; 2013b). This process is better known as *opportunity recognition*. There is no entrepreneurial activity without the detection of opportunities (Harms et al., 2009), which is why opportunity recognition is considered the first step of the entrepreneurial process (Bhave, 1994).

Opportunity recognition is defined as the process that enables the emergence of "new goods, services, raw materials, and organizing methods" (Shane & Venkataraman, 2000, p. 220). Baron (2004) conceptualizes opportunity recognition as the individual's cognitive ability to recognize emergent patterns of unrelated stimuli or events. This cognitive ability is demonstrated by connecting "the dots between changes in technology, demographics, markets, government policies and another factor" (Baron, 2006, p. 104). The cognitive process in which the individual identifies entrepreneurial opportunities is affected by both personal-psychological and context-related factors. Hence, two approaches for analyzing the factors affecting opportunity recognition have emerged in entrepreneurship research.

In an attempt to explain its emergence, the first approach focuses on the social context that influences opportunity recognition (Gaglio & Taub, 1992; Singh et al., 1999a). This approach includes examining the economic growth, social and political context, geographic location, or cultural values (see Arenius & Clerq, 2005; Hite, 2005; Shaw & Carter, 2007; Webb et al., 2011; Wiklund & Shepherd, 2003) as well as analyzing the characteristics of situations (e.g., risk, uncertainty) in which entrepreneurial actions and decisions take place (see Curşeu et al., 2008; Sarasvathy & Berglund, 2010; Shepherd et al., 2014). Researchers describe the entrepreneurial environment in which entrepreneurs recognize business opportunities as ill-structured, uncertain, competitive, and emotionally intense (Shepherd et al., 2014; Busenitz & Barney, 1997) and thus highly susceptible to hazards, setbacks, and turbulences (Morris et al., 2013b; Morris et al., 2012; Lichtenstein et al., 2007). A complex environment binds rationality; consequently, humans increasingly rely on cognitive shortcuts and judgmental heuristics (Sarasvathy & Berglund, 2010).

Rationality, in terms of the maximization of self-interest of homo economicus, which is a core idea of classical and neoclassical economics, reaches its limits in the field of entrepreneurship because deliberative planned and scripted behaviors cannot be easily adopted (Sarasvathy & Berglund, 2010). Therefore, researchers postulate that the venturing process is a complex and non-linear process subject to risks, uncertainties, entanglements, coincidences, and turbulences (Sarasvathy, 2001; Neck & Greene, 2011; Liening, 2017; Rauch et al., 2018). This makes the traditional linear, monocausal thinking (i.e., status quo thinking) that focuses on the causal chain obsolete; instead, a focus on problem networks (i.e., causality networks) is recommended (Dörner, 1997). A linear understanding of entrepreneurship with fixed and determined variables contradicts the realization of new opportunities, as key elements such as creativity and spontaneity, which are commonly considered necessary competencies for entrepreneurship, cannot be applied (Liening et al., 2016; Liening, 2017). While the literature on entrepreneurial bias and failure is growing, fundamental discussions on the prevailing

notions of rationality remain limited (McGuigan, 2016). Both the extent of rationality and irrationality in entrepreneurship (education) is required to better understand the nature of opportunity decisions. Therefore, in this research, *MANUSCRIPT I* investigates the situational conditions of entrepreneurial decisions. Thus, the characteristics of a complex situation, including rationality, are theoretically discussed and determined.

A second research stream focuses on the cognitive psychological aspects of opportunity recognition and investigates the personality traits and capabilities of the entrepreneur in order to explain the emergence of entrepreneurial opportunities (see Shane, 2003; Baron, 2006; George et al., 2016a) and to draw a distinction between entrepreneurs and non-entrepreneurs (Baron, 2004; 2006; Mitchell et al., 2007). Corbett (2005, p. 474) argues that "the cognitive body of research contributes to our understanding of entrepreneurship by helping to explain how each individual's mental makeup is related to his or her ability to identify and exploit an entrepreneurial opportunity." This cognitive approach aims at providing an explanation of entrepreneurial behavior and entrepreneurial success, and to subsequently explore inter-individual heterogeneity (e.g., different values, cognitive styles, knowledge structures) (Sánchez et al., 2011). A plethora of literature has investigated the factors influencing opportunity recognition, including risk-taking and perceived self-efficacy (see Krueger & Dickson, 1994), prior knowledge (see Ardichvili et al., 2003), creativity (see Ardichvili et al., 2003), entrepreneurial alertness (see Shane & Nicolaou, 2015), and tacit knowledge (see Baron, 2004). As a rationale for focusing on the cognitive perspective of the entrepreneur, Ko and Butler (2006, p. 5) argue that the specific thought processes that lead to novel ideas for products, services, or technologies can only be determined by examining the cognitive processes of entrepreneurs. Therefore, the cognitive psychological perspective is central to entrepreneurship research (Shane & Venkataraman, 2000), and scholars endorse investigations at the individual level (see Baron, 2004; 2006; Zahra et al., 2006; Acs et al., 2009). While many studies have investigated the cognitive psychological factors of opportunity recognition, numerous factors

remain unexplored; therefore, researchers have called for the advancement of opportunity recognition through investigations into additional individual characteristics (Grégoire et al., 2011; George et al., 2016b). Therefore, in this research, *MANUSCRIPT II* investigates the construct of opportunity recognition and the influencing factors that affect opportunity recognition.

Both the nature of the entrepreneurial individual and the entrepreneurial conditions in which they exist influence their opportunity decisions. However, the entrepreneurial judgments and decisions that enhance the creation of opportunities can be facilitated through two approaches; that is, through the incorporation of external feedback and entrepreneurship education. When confronted with a flood of information, entrepreneurs need to filter out valuable feedback. During the process of new venture formation, entrepreneurs not only rely on external feedback, but must also proactively request feedback in order to improve their businesses and reduce uncertainty. Seeking feedback is an instrumental response to goal realization (Ashford & Cummings, 1985). Feedback offers the opportunity for learning and improvement, increasing the likelihood of achieving defined goals. For instance, Xu (2018) suggests that crowdfunding is a source of early feedback regarding market demand; that is, feedback from the crowdfunding source increases entrepreneurs' opportunities to continue and even commercialize their venture projects (Xu, 2018). However, it is important to note that cognitive biases occur in the information perception, processing, and evaluation processes. Empirical evidence indicates a biased processing of information occurs during the judgment and decision-making process (Brownstein, 2003). More specifically, when faced with a complex situation, decision makers may engage in selective information exposure (Schulz-Hardt et al., 2000); that is, they may aim to avoid situations in which they have previously had unfavorable experiences and which evoke negative valenced emotions (Fraser-Mackenzie & Dror, 2009). Furthermore, the selective processing of information (Kardes et al., 2004) can lead to bias in the individual's judgment. While cognitive biases are portrayed as logical flaws, it is necessary to mention that "the

evaluative task is not whether the cognitive feature is accurate or logical, but rather how well it solves a particular problem" (Haselton et al., 2016, p. 968). So far, the construct of feedback has rarely been investigated in entrepreneurship, particularly in terms of the influence feedback has on opportunity decisions. People rely on available information to make their decisions. On the one hand, information has to be perceived as credible for it to have an effect on people's decisions (Liu, 2004). On the other hand, "the choice and design of visual presentation is determined by information structure, decision environment, the decision-maker, and the task/decision" (Meyer, 1997, p. 276). While the credibility and design of feedback have been explored in a wide range of disciplines (e.g., journalism, health sciences, marketing, educational sciences), both constructs remain relatively unexplored in relation to entrepreneurship. Therefore, in *MANUSCRIPT III*, the influence of feedback on the decision to terminate or continue pursuing an entrepreneurial opportunity is investigated. In particular, the influence of the feedback source (high vs. low perceived credibility of the feedback provider) and the feedback types (cognitive and outcome feedback) on the opportunity decision are examined.

Opportunity decisions can also be promoted through entrepreneurship education. Opportunity recognition is conceptualized as a cognitive ability that is acquired through entrepreneurial experience and learning processes. The knowledge structure of human beings influences the decision-making and cognition process. However, the knowledge structure is shaped and affected by the learning process (Cacciolatti & Lee, 2015). Corbett (2005, p. 474) points out that "the cognitive perspective on entrepreneurship is valuable and has helped us understand a great deal about how individuals identify and exploit opportunities. However, it needs to be fortified by investigations of the process of learning." As an explanation, Corbett (2005) argues that the individual's knowledge structure is a static concept that can be activated through action, whereas learning is a social process that allows the transformation of experience into knowledge creation. Therefore, although entrepreneurial learning is a growing research

area (Politis, 2005; Harrison & Leitch, 2005), research on entrepreneurial cognition and entrepreneurial learning are frequently examined in isolation from one another.

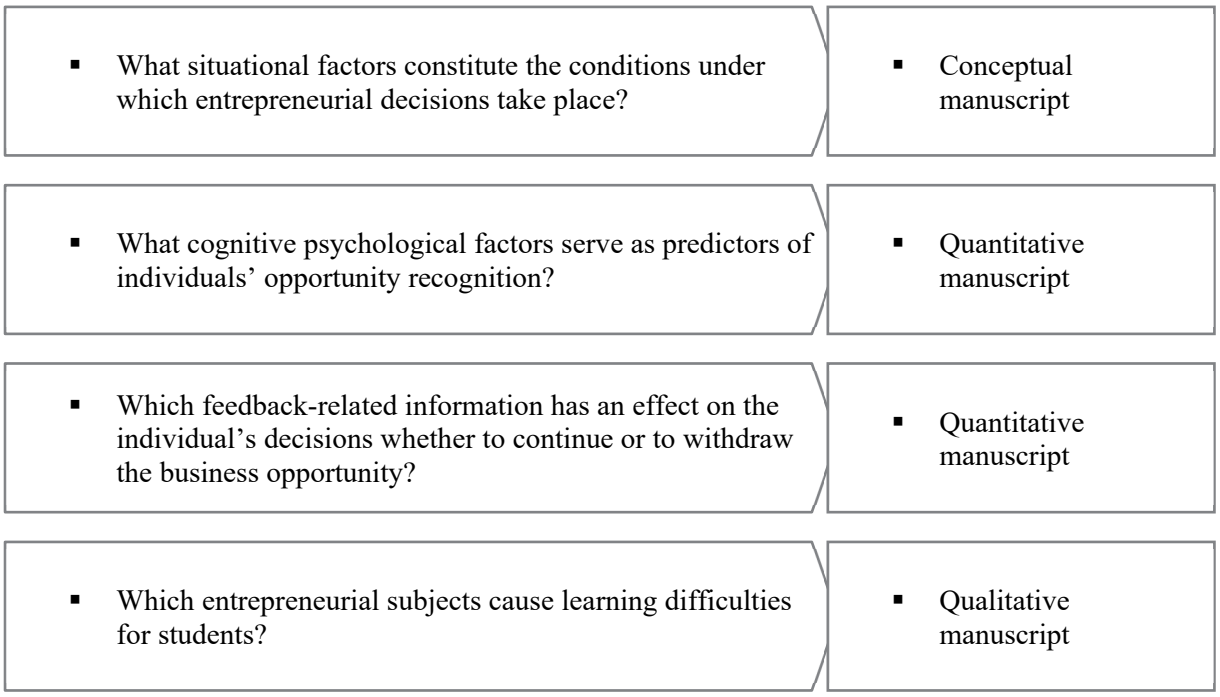
Entrepreneurship education bears the potential to equipped future entrepreneurs with the entrepreneurship-related competencies required to deal with challenging situations during the venturing process (Boyles, 2012; Marques & Albuquerque, 2012). This includes sensitizing would-be-entrepreneurs towards critical situations that limit information processing and helping future entrepreneurs make more effective opportunity decisions. For instance, simulation-based learning, as one teaching method, enables the "creation of an uncertain and ambiguous context encouraging students to step outside taken-for-granted assumptions" (Pittaway & Cope, 2007a, p. 213). Additionally, entrepreneurial learning allows entrepreneurs to address conceptually troublesome subjects that are difficult to understand and that can cause misconceptions. For instance, the concept of opportunity recognition is often misunderstood as a "one-time cognitive breakthrough resulting from an enlightenment experience" (Hills & Singh, 2004, p. 261). However, opportunity recognition is a process that can initiate both the creation of a new business and the improvement of an existing business (Gaglio & Taub, 1992; Hills & Singh, 2004). This means that opportunity recognition is a continuous process rather than a one-time momentum.

In the educational sciences, learning difficulties with domain-specific subjects are also understood as *troublesome concepts*. This means that a learning subject exhibits learning difficulties. Entrepreneurship education not only has the potential to introduce and teach these novel domain-specific concepts, but also to correct learners' misconceptions and transform their knowledge. Currently, little is known about students' learning process with entrepreneurship subjects including troublesome concepts (Hatt, 2019). Knowledge about how learners perceive, process, and evaluate entrepreneurial subjects can help educators address and approach such subjects in an effective didactical way (Meyer & Land, 2005). Therefore, in this research, *MANUSCRIPT IV* investigates troublesome knowledge in entrepreneurship education

in order to provide practical implications on learning difficulties and provide teachers with recommendations for dealing with these obstacles.

In sum, the overall objective of this thesis is to investigate the psychological perspective of entrepreneurs to derive implications for both practitioners and scholars of entrepreneurship. Focusing on cognition and decision-making processes, this dissertation aims to provide answers to the four overarching research questions, which are illustrated in Figure 1.

Figure 1: Overview of the Studies



1.2 Dissertation Content and Structure

To answer the four overarching research questions, this dissertation proceeds as follows: Chapter One outlines the motivations, objectives, and contributions of this research. Chapter Two introduces *MANUSCRIPT I*, theoretical conceptual study in which a theoretical literature review of the term "rationality" is conducted from an economic perspective as well as a cognitive learning perspective. Furthermore, factors relevant to the teaching and learning of

entrepreneurship are evaluated in order to discuss the extent of rationality within entrepreneurship and entrepreneurship education.

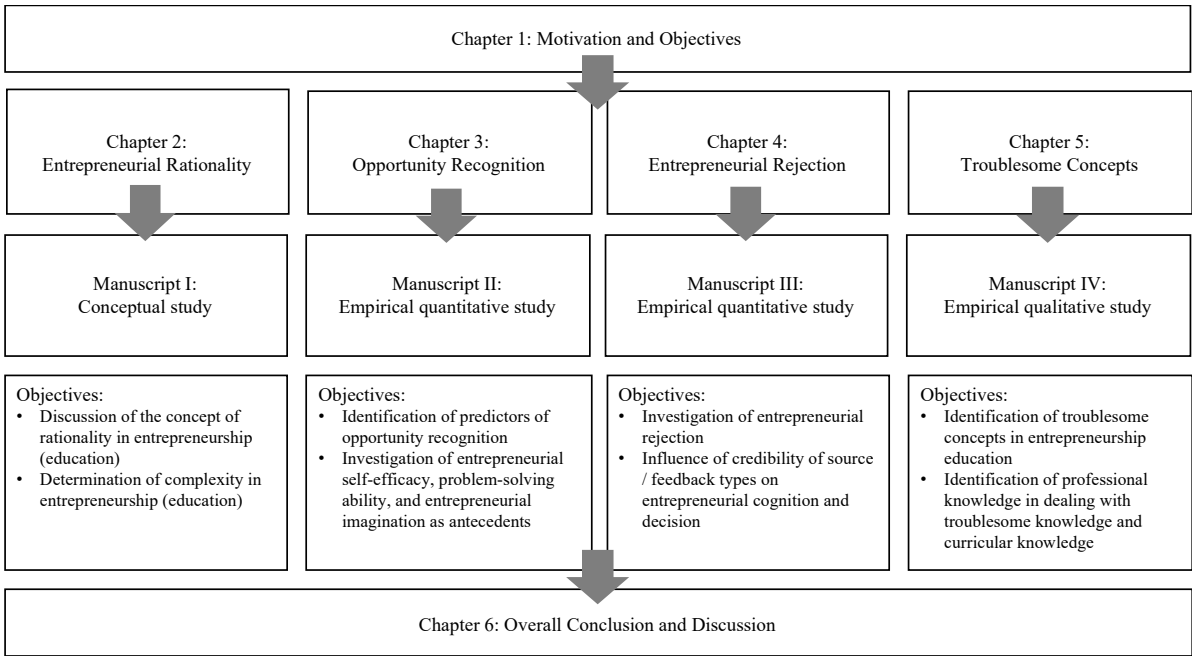
Chapter Three presents *MANUSCRIPT II*, which investigates the traits and capabilities affecting opportunity recognition. *MANUSCRIPT II* proposes that entrepreneurial self-efficacy, problem-solving capability, and entrepreneurial imaginativeness have an effect on opportunity recognition. In this empirical study, a structural equation model is used to investigate the relationship between opportunity recognition and its suggested antecedents, as well as the interacting effects between these factors.

Chapter Four presents empirical *MANUSCRIPT III*, which investigates how the type of feedback and the perceived credibility of the feedback source influence behavioral and cognitive responses to entrepreneurial rejection using two consecutive experiments. First, the impact of rejection on entrepreneurial decision-making and the attribution of the cause of rejection are assessed through an online experiment. Second, the effects of rejection on individuals' perception and retention of feedback are assessed through an eye-tracking experiment.

The fourth and final *MANUSCRIPT IV* is presented in Chapter Five. This is an empirical qualitative study that focuses on troublesome concepts to provide future directions for entrepreneurship education research, as well as didactical implications for practical entrepreneurship education. This empirical study suggests that student errors are an indicator of troublesome knowledge. Through the use of in-depth episodic interviews, this study explores teachers' content, pedagogical content, and curricular knowledge on student errors in entrepreneurship courses.

Finally, Chapter Six discusses the results and limitations of all four studies and identifies compelling avenues for both future entrepreneurship research and practical entrepreneurship. The structure of this dissertation is illustrated in Figure 2.

Figure 2: Structure of the Dissertation



2 Manuscript I: Entrepreneurial Relativity of Rationality: A Theoretical Analysis of Rationality in Entrepreneurship Education

2.1 Abstract

Rationality in terms of maximizing self-interest is at the core of classical and neoclassical economics. However, researchers have questioned the narrow view of homo oeconomicus. Notably in complex problem-solving situations, human beings depend on cognitive shortcuts and judgmental heuristics, which bound rationality and can lead to irrational and erroneous decisions. Severe and undetected errors can generate crisis and cause irreversible failure. Entrepreneurial failures in terms of business shutdowns are real phenomena in practical entrepreneurship. The entrepreneurial environment is characterized by non-linearity, uncertainty, complexity, and the involvement of intense emotional attachment.

In this environment, entrepreneurs are primarily confronted with complex situations and, therefore, are forced to rely on cognitive shortcuts rather than rationally planned and scripted behaviors. Despite the substantial growing corpus of studies on entrepreneurial bias and failure, fundamental discussion of prevalent notions of rationality has been limited. This paper analyzes the extent of rationality in entrepreneurship and entrepreneurship education, draws on the imperfect entrepreneurial environment. Furthermore, we discuss the learning potential of illogical and erroneous momentums.

2.2 Introduction

The creation of an idea and its transformation into a functioning business requires decisions and actions from entrepreneurs (Morris et al., 2013a; 2013b). However, for the circumstances under which these decisions are made and actions are executed, existing efficient algorithms are missing (Mitchell et al., 2007). Therefore, entrepreneurial activities are often susceptible to biases, which can eventually result in erroneous judgements and decisions. Unfortunately, it is

not a rarity that such erroneous judgements and decisions lead to entrepreneurial struggle and failure (Shepherd, 2003; Amjad, 2020). Historical data in the U.S. Great or Britain show that within the first three years after business launching more than half of entrepreneurial ventures fail (Shane, 2012; Stout, 2012). A growing body of entrepreneurship studies has focused on entrepreneurial bias and failure (e.g., Busenitz & Barney, 1997; Baron, 2004; Zhang & Cueto, 2017). Financial losses, social stigmatization, psychological effects (e.g., depression, stress), and physiological consequences (e.g., sleep deprivation, addiction) are the substantial aftermath of entrepreneurial failure (Cardon et al., 2011; Cardon & Patel, 2015; Kollmann et al., 2019). Research on entrepreneurial bias, have identified a strong tendency in entrepreneurs toward *overconfidence* (e.g., Busenitz & Barney, 1997; Baron, 2004). Other studies have examined the causation between biases and prevalent constructs of entrepreneurship, for instance, *the perception of risk*, *entrepreneurial intention* or *opportunity recognition* and *exploitation* (Keh et al., 2007; Wu & Knott, 2006).

On the basis of these research corpuses, we identified a particular issue for investigation. There is a normative understanding of *bias*, which is defined as systematic deviation from descriptive rationality or norms (Zhang & Cueto, 2017). A scientific discipline is characterized by an "elaborate and logically well-constructed system of theories" (Popper, 2002, p. 50) with an established consensus as to what constitutes rational and irrational behavior. Entrepreneurship has been considered an ill-structured environment, however neither a consensus on rationality and irrationality in has yet been achieved yet nor what theories should be taught in entrepreneurship education (McGuigan, 2016). In contrast, studies of entrepreneurial failure have provided insight into the ramifications of failure and crisis, but the discussion on entrepreneurial errors are limited. Artinger and Powell (2016, p. 1048) point out that studies have not investigated if "entrepreneurial failure stems mainly from random errors under uncertainty." From an educational point of view, errors are typically considered in terms of learning potential (Cope, 2011) instead of external evaluation of the extent to which the

entrepreneur was responsible for the error and what could have been done to prevent it. Thus, the learning potential of an error defines a distinction between "good" and "bad" errors (Oser et al., 2012).

Our purpose is to contribute to the emerging body of literature on research bias and entrepreneurial failure by conceptualizing the notions of rationality in entrepreneurship and entrepreneurship education. For this purpose, we use a twofold approach: (1) conducting a theoretical review (Boote & Beile, 2005) of relevant constructs (e.g., *rationality*, *irrationality*, *bias*, *error, decision-making in complex situations*) and (2) evaluating relevant aspects for the teaching and learning of entrepreneurship by synthesizing "existing theories and related concepts and empirical research, to develop a foundation for new theory development" (Rocco & Plakhotnik, 2009, p. 127).

"As a scientific discipline grows, its body of knowledge also grows;" however, a discipline faces challenges "when a field of study is unable to identify or develop a consensus within its body of knowledge as to what constitutes the research program's set of formal theories" (Turner et al., 2018, p. 35). Furthermore, the emerging canon of rationality defined in terms of optimal choices ties the role of psychology to diagnosis and explanation, and the role of education to the training of rational behavior and prevention of irrationality. This leads to the following questions, which this study intends to answer: What formal and normative notions of rationality are expedient for entrepreneurship and entrepreneurship education? In a domain where errors are inevitable, is a change of paradigm required? What implications can be drawn from complexity theory for coping with ill-structured systems?

2.3 Literature Review

2.3.1 Rationality and Reason

Ancient Greek thinkers characterized rationality in terms of insight into human nature. Rationality, which entails the intellectual capacity to develop schemas, defines the human species (Korsgaard, 2008). Most of our behaviors involve reason, motivation, and intention—"people have reasons for what they do" (Simon, 1986, p. S210). What is rational and reasonable is determined by the context in which human behavior takes place, deviance from goal achievement, and the availability of means (Simon, 1986). Reason and rationality are already acknowledged in the Bible, which states that "in the beginning was the *logos*" and this enables the existence of *everything* (John, p. 1.1, 1.3). "Logic" has its semantic roots in the Greek word *logos*, later translated by the English word "reason" (Cellucci, 2012, p. 199). Logic constitutes rationality and has typically been understood in a prescriptive and objective manner. This means that human rationality represents "our cognitive capacity for logic" (Hanna, 2006, p. 113) and that human behaviors diverging from the laws of logic are condemned as irrational.

Other theories of rationality have emphasized the relevance of putting action, means, and ends into perspective (Rescher, 1988). According to such an approach, "reason is the capability of choosing appropriate means for ends which are conformable to human nature" (Cellucci, 2012, p. 204), and irrationality is the inability to use reason in this way (Amoretti & Vassallo, 2012). In alignment with this perspective, Korsgaard (2008, p. 23) declares reason as the "active capacity of the mind," that enables the contrast to sensation / perception and passion / desire.

Baudin (1954, p. 487) characterized rationality as a "conscious and logical adaptation of means to coherent ends." Amoretti and Vassallo (2012, p. 10) defined rationality in its simplest form as the "exercise of reason in exploring, investigating, understanding, controlling, and manipulating both the natural and social worlds," which is "based on rules of logic, probability theory and so forth" (Stein, 1996, p. 4). A different approach distinguishes between theoretical and practical reason. Theoretical reason is concerned with beliefs as well as with as reasoning

and prediction, while practical reason is focused on values, intentions, and the desirability of action (Amoretti & Vassallo, 2012). Kahneman (2000) took yet another approach: there is *coherence-rationality*, which concerns a set of beliefs and preferences, and there is *process-rationality*, which concerns the process of forming beliefs and decisions. In his works *Economy and Society* and *Collected Essays in the Sociology of Religion*, the German sociologist Max Weber promoted the idea of rationality and "rationalization" in the economy and in the societal and civilizational process (Kalberg, 1980, p. 1145). Weber's conception of rationality implies a systematization of the entire societal process, culminating in a high degree of bureaucratization and a corresponding "increasing lack of freedom" (Kalberg, 1980, p. 1146).

Rationality endows the formation of "modern businessman" (Kalberg, 1980, p. 1148). Amoretti and Vassallo argued that the "sciences may be seen as the best product of reason, its highest apex" (2012, p. 17). What counts as absence of reason and rationality has proved harder to agree on. While the development of "general principles or norms of rationality" is pivotal for science and epistemology, it does not work satisfactorily for certain domains, where aesthetic elements play a crucial role (Amoretti & Vassallo, 2012, p. 11). Aesthetic also applies to the discipline of entrepreneurship.

2.3.2 Rationality and Irrationality

"Life is complex and, often times, multiple forces exert their influences upon us" (Chitpin, 2017, p. 150) and, hence, fully rational behaviors are subject to challenge. Deviations from rationality are not entirely random, but appear to be systematic patterns (Fehr & Tyran, 2005). Although human beings behave irrationally at times, they are capable of learning from mistakes. There is even an economic argument that "interactions in markets will correct or offset individually anomalous behavior" (Fehr & Tyran, 2005, p. 43). In other words, individual irrationality will be corrected at an aggregate level.

"Understanding irrationality is important for our everyday actions and decisions in that it offers the hope of overcoming this irrationality when making decisions" (Chitpin, 2017, p. 151). Rationality and irrationality are often associated with deviation from the norm (Reason, 1990; Senders & Moray, 1991). Bias, on the other hand, is a systematic deviation from rationality (Zhang & Cueto, 2017). However, "there is a natural tendency to consider as irrational whoever does not conform to the logic commonly accepted in our society. In other words, we tend to confuse nonconformist with irrationality" (Baudin, 1954, p. 488). Consequently, Baudin points out an important fact: people "speak of irrationality because they are unaware of the *relativity of rationalities*" (1954, p. 488, original emphasis). Rationality is bounded by the perspective of each involved individual's evolution (belief, mental model, perception, etc.). The individual is susceptible to cognitive biases and illusions that are highly dependent on heuristics and intuition as coping strategies; however, these strategies are prone to error. Such comprehensions of rationality and bias bind the definitions of those terms to descriptive norms decided by society at the macroscopic level. One microscopic approach that puts the focus on the individual's perspective is error theory.

2.3.3 Rationality and Errors

Error theory focuses on the nature of human performance and is rooted primarily in the limitations of human cognition (Reason, 1990). On the assumption that human cognition is subject to rationality, "errors were attributed either to irrationality or to unawareness on the part of the perceiver" (Reason, 1990, p. 37). Errors, therefore, could be predicted by employing statistical theory (e.g., Bayes' theorem). *Error* is used as a generic term to encapsulate all situations where a "deviation from intention, expectation, or desirability" takes place (Senders & Moray, 1991, p. 25; see also Reason, 1990). It can be defined as a "human action that fails to meet an implicit or explicit standard" and that occurs when a "planned series of actions fails to achieve its desired outcome" (Senders & Moray, 1991, p. 20). However, as Reason

highlighted, the failure to achieve an intended result does not happen by chance, but is caused by human action in a mental or physical way (Reason, 1990). This entails that the outcome is "not intended by the actor" (Senders & Moray, 1991, p. 25). Furthermore, as Billett (2012) points out, an error is marked by the perspective of the acting person and by the situation it occurs in. This makes *error* a subjective construct. Billet argues that "individuals may or may not view a particular action as being an error, and that error may or may not be recognized as such in the setting in which it is enacted" (2012, p. 19). Hence, the perception of an error always depends on the characteristics of its personal and social dimensions.

From a pedagogical point of view, Billet concluded that the acquisition of new knowledge is often based on experiencing and dealing with errors, thereby "discovering the inadequacy of our existing knowledge" (Billet, 2012, p. 18). Thus, "deliberate efforts to avoid errors" have a significant influence on intentional learning (Billet, 2012, p. 18). This emphasizes the relevance of including errors in learning settings, since reflection on errors adds to intentional learning. Based on the norms of logic and reasoning, utility and probability theory, and rational decision theory (Polonioli, 2016, p. 789), a bias exists when human behavior systematically deviates from, or violates, the predefined norm (Wilke & Mata, 2012). In contrast, the definition of an error is more closely related to subjective intentions and personal goals than to standardized norms (Reason, 1990). In short, the definition of bias is rule-based, whereas the definition of error is goal-based. Adaptive rationalists claim that bias research has focused on rule-based rationality; however, bias research is more heterogeneous than this suggests and has taken into account a range of biases (Polonioli, 2016, p. 794).

2.4 Rationality from the Cognitive Learning Theory

There is a discrepancy between "perfect human rationality" and "the reality of human behavior observed in economic life" (Simon, 1992, p. 3). Simon points out that in a given objective world—the real world and the world of the decision-maker are identical—rational decisions are

predictable and analysis of perceptions, the reasoning process, and modes of calculation are dispensable (Simon, 1986, p. S211). “Economics has almost uniformly treated human behavior as rational” (Simon, 1986, p. S209) and considers rationality as a dilemma of choices, while psychology focuses on both rational and irrational human behavior. Neoclassical economics elaborates on rationality on the basis of an objective and a substantive theoretical point of view (Simon, 1986, p. S211). Rationality in psychology is more concerned with procedural rationality in terms of making reasonable decisions “in the light of the available knowledge and means of computation” (Simon, 1986, p. S211). Cognitive psychology is more invested in constructing a theory and testing it empirically, which requires knowledge of the decision-making process and “the subjective representation of the decision problem” at a micro level (Simon, 1986, p. S211).

Cognitive learning theories also embrace procedural rationality at a micro level and draws attention to the representation of the mental model and schema (Van Merriënboer et al., 2003). It proposes that the limitations of the human mind, notably, in the work on *cognitive load theory*, enable one to “empirically replicate studies that describe the human cognitive process” (Mostyn, 2012, p. 228) and has investigated instructional techniques to enhance the learning of complex tasks (Sweller, 1994). Cognitive load theory “identifies specific functional elements [data input] of the processes that involve data process sequencing, types of memory used, and universal limiting parameters” (Mostyn, 2012, p. 227). These elements also represent constraints that lead to cognitive loading (Mostyn, 2012, p. 228).

Cognitive load theory has its roots in cognitivism, a learning approach that mainly focuses on the (re)construction of mental models by describing the mental activities involved in learning (Mostyn, 2012, p. 231). Learning and intellectual mastery are secured if “the schema acquisition and the transfer of learned procedures from controlled to automatic processing” are achieved (Sweller, 1994, p. 296). The function of learning is to achieve the storage and organization of elements of information (schemas) in long-term memory. “Schemas are critical to learning and

problem solving" (Sweller, 1994, p. 299). However, schema acquisition and the transfer thereof reduce the capacity of our working memory, which is responsible for storing and processing items (Sweller, 1994, p. 299). Working memory is able to process "no more than a few discrete items at any given time" (Sweller, 1994, p. 299); however, it is able to "access and treat even large and complex schema as a single element," which can be recalled if required (Mostyn, 2012, p. 232). Schema formation occurs in the working memory when limited, complex, and related schema elements are processed (e.g., storage, analysis, synthetization). Repetition of schemas enables the transfer to the long-term memory, which maintains a great number of complex mental constructs (schemas) for a long period (Chi et al., 1982). The transferred schema is either "a new schema" or "an addition to and/or modification of an existing related schema" (Mostyn, 2012, p. 232). The change in existing schema and addition of new schema can be interpreted as a learning process that ultimately leads to changes in long-term memory and "represents development of some level of expertise; that is, long-term memory schema development creates the difference between novices and experts" (Mostyn, 2012, p. 232).

Learning in entrepreneurship education focuses on the change of learners' mindset. Understanding cognitive changes requires thinking-centered learning, which is characterized by situated learning and the connection between new knowledge and prior knowledge (Krueger, 2009).

2.5 Types of Errors and their Learning Potentials

Making errors are inevitable, but errors also offer learning opportunities. Learning through experiencing mistakes are vital for developing expertise. However, for positive outcomes such as productive learning to happen, it requires reflection of committed mistakes. The reflection upon mistakes entails deep analysis of errors including classification of errors and its causes. The classification of error has been attempted by many researchers (e.g., Rasmussen, 1982; Reason, 1990; Senders & Moray, 1991). One of the most common classifications analyzes

errors from the behavioral, conceptual, and contextual perspectives. The behavioral classification describes errors in phenomenological terms, drawing on observable actions that the actor(s) carried out and that did not meet the desired end. Behavioral classification is rather superficial and cannot account for cognitive failure (Reason, 1990); it captures formal characteristics or directly visible consequences, and is therefore best suited to verbal and action errors (Reason, 1990). The conceptual classification is more complex. It goes beyond the formal characteristics of an error to focus on the assumptions and conjectures behind it. This classification is suited to explaining errors that are caused by "cognitive mechanisms involved in error production" (Reason, 1990, p. 12).

Both the behavioral and conceptual classifications focus on the actor, thus providing an endogenous perspective on error (Senders & Moray, 1991). The contextual level, however, looks beyond the formal error (Reason, 1990). It focuses on the conditions of the system, such as the task-related and situational characteristics (internal and external surrounding circumstances) in which the actor is operating (Reason, 1990). Unlike the behavioral and conceptual classifications, the contextual classification provides an exogenous view of error, and where error is detected, a reconsideration of the system design is required (Senders & Moray, 1991).

Since this research focuses on human fallibility, endogenous errors are relevant for further consideration. Furthermore, endogenous errors can be prevented through training and education. The design of training concepts needs to be considered carefully, and the construct of motivation must be placed under careful scrutiny. Conducting a deeper analysis on endogenous errors, Reason has shown that there is a specific algorithm for distinguishing different types of error, including mistakes, slips, and lapses. In this context, the notion of intention and, accordingly, intentional behavior comes into play (Reason, 1990). Whether an error is a slip or a lapse depends on prior intention to act; actions can be spontaneous (e.g., bumping into someone while walking inattentively) or involuntary (e.g., bumping into someone

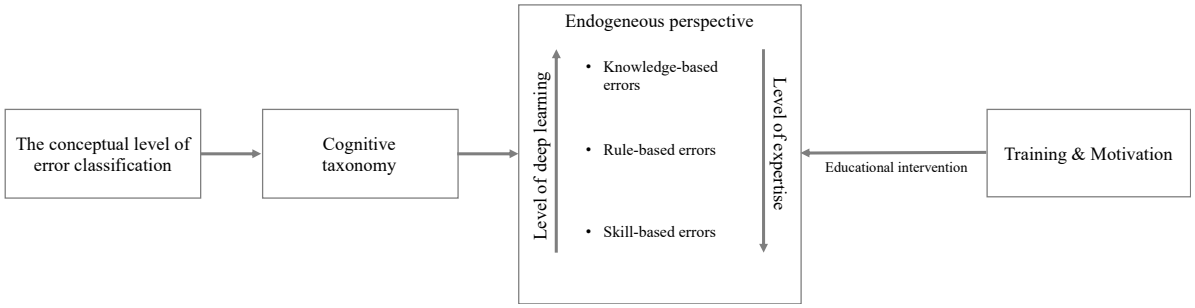
while suffering an epileptic fit). According to Reason, two elements are required for intention: "an expression of the end-state to be attained, and an indication of the means by which it is to be achieved" (1990, p. 5). If an action does not proceed as planned, then the result is an unintentional action, also called a slip or a lapse. However, when an action proceeds as planned but does not achieve the desired goal, we call it a mistake (intentional).

Slips or lapses are typically caused by poor execution, and can thus be considered lower-level errors involving routine tasks and the achievement of skilled status ("familiarity with the environment or task") (Reason, 1990, p. 43). These are also referred to as *skill-based errors*. Mistakes, however, are caused by cognitive planning procedures, and can thus be considered higher-level errors. Two forms of mistake can be distinguished. First, there are mistakes caused by failure of expertise in the sense that using stored rules for problem-solving situations does not achieve the desired end (i.e., there is a lack of storage). This type of failure can arise from the misapplication of the right rules or from the application of the wrong rules; therefore, such mistakes are also known as *rule-based errors*. Second, there are mistakes caused by a lack of expertise in the sense of planning errors. "Planning refers to the process concerned with identifying a goal and deciding upon the means to achieve it" (Reason, 1990, p. 12). This happens in unfamiliar problem-solving situations in which the actor cannot retrieve prior knowledge or past experience; there is no script, and the actor depends on heuristic principles (rules of thumb). Such mistakes are also known as *knowledge-based errors*.

Following the skill–rule–knowledge framework (Rasmussen, 1982; Reason, 1990), these three modes regard the actor as starting in a novel situation in which knowledge-based errors are likely. With increasing familiarity and with the acquisition of expertise in the situation, the actor moves up to the skill-based level (Reason, 1990). Erroneous momentum at the knowledge-based level entails the highest potential for deep learning (see Figure 3). At this level, the problem-solving situation is most unfamiliar to the actor and therefore the level of expertise is low. However, the acquisition of novel knowledge (development of mental models) and the

revision of naïve theories are mostly to occur at this stage. The more the actor is confronted with the situation (repetition of schemas), the more expertise can be developed. This means that errors at the knowledge-based-level provides implications for the rule-based and skill-based levels, and thereby foster the transformation from novice to expert status. Since the error classification is based on a cognitive and endogenous perspective, error correction and learning from mistakes can be achieved through an intervention in terms of training and motivation is required. For entrepreneurship education, this means that learning settings should include the enabling of error-making, notably the frequent confrontations with knowledge-based problems in order to establish routine handling of complex situations. For entrepreneurship education, educators also postulate a focus on experience-based, simulation-based, and problem-based learning (Yen & Lin, 2020).

Figure 3: Error Classification and Learning Potentials



Source: Based on Reason (1990)

2.6 Imperfect Entrepreneurship

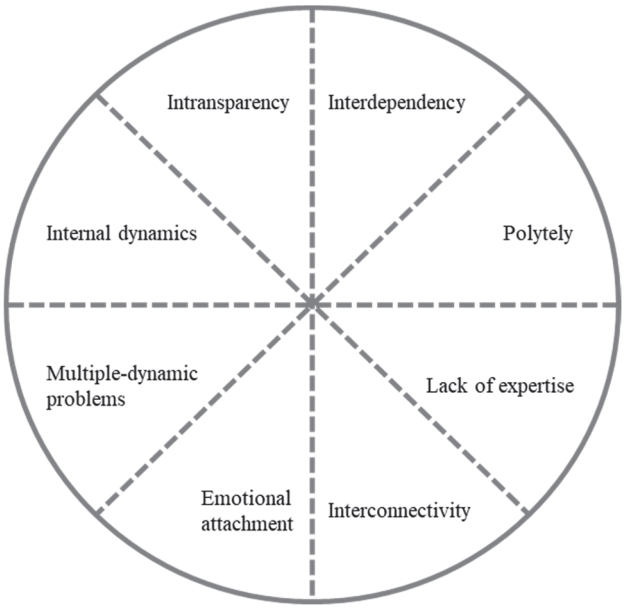
Critical decisions are often made under arduous circumstances, perhaps in a non-linear environment driven by *uncertainty* and *complexity* (Neck & Greene, 2011). There are several components in play in such circumstances, and one of them is *risk*. In the business venturing process, *risk* is frequently claimed to be omnipresent (Lichtenstein et al., 2007; Bandera et al., 2018). The notions of risk and uncertainty apply particularly to start-ups, since they have to

deal with unknown circumstances, internal as well as external, and concerning the present as well as the future of the business. Internal strategies have to be developed and tested in terms of the management of the newly founded company. Moreover, although the external market situation can be evaluated on the basis of its present state, its reaction toward the new remains unknown. As Dörner argued, the entrepreneur operates in a *non-transparent* context (Dörner, 1997). The non-transparency of a situation consists of a lack of information, restricted access to the information available, and the possibility of having incorrect information. In addition, a complex situation is caused by the presence of *interdependency*, from external and internal corporation partners as well as from dependency on decisions. Dörner (1997) asserts that the entrepreneur's environment is connected in a complex way, and the structure of the system is mostly unknown. The complexity of the situation is also triggered by its *internal dynamics*. This means that the situation itself is active and does not depend on the entrepreneur's decisions (Dörner, 1997). The market is in continual movement, regardless of what the entrepreneur may decide. The entrepreneur is an active element in a complex system of active and passive elements. An active element can change its state without external influences, while a passive element is externally determined; the relations of these elements are certainly also deterministic (Dörner, 1997). In this context, "lack of knowledge" describes the state of not being aware of the existence of certain variables. Non-transparency, in contrast, refers to the awareness that variables entail certain conditions combined with the inability to define these conditions. "Unknowingness" should not be used interchangeably with a distinct "lack of knowledge." Rather, it implies that the clarification concerning a part of a system is too abstract (Dörner, 1997); similarly, the multiple active elements have a complex interconnection. A further factor that contributes to the complexity of a situation is the plurality of goals (*polytely*), a problem situation for which multiple solutions and goals exist. An entrepreneur can have more than one goal, and these goals may be pursued simultaneously and may be partially contradictory. Monitoring all goals is a challenge, but an even greater challenge is balancing conflicting goals,

if necessary sacrificing certain subgoals in order to achieve others. In this context, the set of goals may fluctuate, hence, the goals can be refined, eliminated, or postponed, and new goals can be set. Zhang and Cueto (2017) point out: the entrepreneur himself, whose actions are not necessarily aligned to the nature of a *homo oeconomicus*.

In conclusion, the entrepreneur operates in an imperfect environment that makes rational decision-making especially challenging. In the course of any action, mistakes and errors are common; a particular error may be an "inconvenience (often it is not even noticed)" or it may be "a genuine catastrophe" (Senders & Moray, 1991, p. 1). Based on Dörner's (1997) conception of complexity, error theory (Reason, 1990), and the emotional attachment involved in entrepreneurship, we propose that entrepreneurial complexity comprises a number of components, as set out in Figure 4.

Figure 4: Components of Entrepreneurial Complexity



Source: Dörner (1997); Reason (1990)

2.7 Compatibility of Rationality and Entrepreneurship (Education)

Rationality provides orientation; it follows rules and is therefore predictable. Besides the advantages of pure rationality and bounded rationality (Simon, 1986; 1992), both "reflect a limited view of organizing, one defined by patriarchy as a dominant value system" (Mumby & Putnam, 1992, p. 469). Bounded rationality separates decisions from actions and in order to reduce, structure, and control complexity; the actor is required to simplify and fragment decisions, which leads to the compartmentalization of choices (Mumby & Putnam, 1992). Bounded rationality remains a relevant concept for management education (e.g., organizational theory) (Mumby & Putnam, 1992; Jayasinghe & Wickramasinghe, 2008).

According to Roberts (1996), there is dominance of Weber's technical and instrumental rationality—"the restless calculation of means in relation to ends"—at business schools, which Weber interprets as "progressive rationalization" (Roberts, 1996, p. 55). Roberts (1996, p. 54, original emphasis) criticizes such conduct that leaves "students' 'practical consciousness'—the usually tacit and habitual knowledge that informs actual practice—both unquestioned and unreformed." The process of rationalization takes the practical understanding of action, what Giddens (1977) refers to as "practical consciousness" in his structuration theory, for granted. He defines this as "what actors know tacitly about the conditions of their own action but cannot articulate" (Bryant & Jary, 1991, p. 8). Teaching routinized managerial techniques that students might be able to undertake leads them to believe that "understanding has been realized if only knowledge can be repeated or regurgitated;" in reality, however, this "reinforces the lack of critical reflection" (Roberts, 1996, p. 61). This approach alludes to the idea of the "rhetoric of objective rationality, while leaving their practical rationality both unexplored and unreformed" (Roberts, 1996, p. 61).

Other authors are concerned with the separation of the roles of teacher and student that the concept of bounded rationality alludes to (Clegg & Ross-Smith, 2017). They emphasize the distinction between the science of object and the science of subject. The latter is considered

more appropriate for management education, since it encourages coping with discursive plurality (Clegg & Ross-Smith, 2017). In relation to this notion, entrepreneurship (education) is certainly more related to the science of the subject. But how is rationality compatible with entrepreneurship? Sen (1987) states two prerequisites for rational behavior: *consistent choice* and *self-interest maximization*. Rationality based on the behavioral assumptions of orthodox economics is challenged in the context of entrepreneurship (De Bruin & Dupuis, 2000). Due to the influences of economics, psychology, and sociology, rationality is a *modus operandi* in management education. Mainstream entrepreneurship research is based on the traditional Schumpeterian and Kirznerian views, which typically characterize the entrepreneur as a "rational, calculating maximiser attempting to maximise profits through continuous innovation in a process of 'creative destruction' of the equilibrium of the market and the flow of commercial activities" (Jayasinghe & Wickramasinghe, 2008, p. 243, original emphasis). Both the Schumpeterian and Kirznerian views have coined the term entrepreneurship (Jayasinghe & Wickramasinghe, 2008). While Schumpeter viewed the entrepreneur as an independent actor whose ideas emerge internally (De Jong & Marsili, 2010), who is primarily economically motivated, and is therefore the main driver of the capitalist economy (Jayasinghe & Wickramasinghe, 2008), Kirzner compared the entrepreneur with an arbitrageur who explores opportunities based on information asymmetries (De Jong & Marsili, 2010). Schumpeter and Kirzner had a rather functionalist understanding of entrepreneurship, which neglects the complex interwoven relationships in which the entrepreneur operates (Jayasinghe & Wickramasinghe, 2008).

The orthodox perspective of logical economic rationalism and the functionalist approach assumes the existence of "objective" reality and thus provides an explanation for social structures, but it neglects to provide an explanation of the causes of behavior (Bruyat & Julien, 2001). Hence, teaching entrepreneurship is reduced to educating students about these "objective explanations," and obstacles to entrepreneurship seem to be avoidable through education

(Jayasinghe & Wickramasinghe, 2008, p. 244). Contemporary entrepreneurship researchers distance themselves from the traditional view on entrepreneurship and acknowledge the entrepreneur's emotions (Baron, 2008), socio-cultural networks (Jayasinghe & Wickramasinghe, 2008) and ecosystem (Audretsch et al., 2019), and entrepreneurial competences (Morris et al., 2013b). For a holistic analysis of the entrepreneur, rationality and bounded rationality are not satisfactory tools (Jayasinghe & Wickramasinghe, 2008, p. 250). As an alternative framework to bounded rationality (Simon, 1986; 1992), researchers propose the concept of *bounded emotionality* (Mumby & Putnam, 1992; Jayasinghe & Wickramasinghe, 2008). This concept emphasizes the "emotional aspect of entrepreneurial behavior that operates outside the consciousness of individual agency" (Jayasinghe & Wickramasinghe, 2008, p. 243) and neglects the contribution of emotions to practical consciousness.

Bounded emotionality emphasizes the feeling as well as the expression of emotions (Jayasinghe & Wickramasinghe, 2008). On the contrary, the concept of bounded rationality "isolates and suppresses the emotional/physical self from the organising" process to reach a decision (Jayasinghe & Wickramasinghe, 2008, p. 246). Bounded emotionality was initially employed by Mumby and Putnam (1992, p. 470) in the context of organizational theory. Mumby and Putnam's (1992) bounded emotionality provides an understanding of human emotions, competences, and limitations. Jayasinghe and Wickramasinghe (2008) apply this idea in entrepreneurship theory with an appreciation of the entrepreneur's expression of emotions and his or her emotional involvement in interpersonal relationships. The latter is a central aspect in the entrepreneurial setting, since entrepreneurs rely on others—family and micro and small businesses are affected by interpersonal relationships. The expression of emotions is crucial due to the coexistence of multiple and contradictory feelings (anxiety, stress, joy, fulfillment, etc.) (Jayasinghe & Wickramasinghe, 2008).

A generic approach to overcoming irrationality is introduced by Chitpin (2017), who takes the philosophical approach provided by Popper (1957). The Popperian approach holds that through the search for and elimination of errors, knowledge construction takes place (Chitpin, 2017). “In other words, we can improve our present answers by identifying their inadequacies. Once we uncover an inadequacy, we can eliminate it by modifying or refining the original answer. Thus, we improve our answer through criticism” (Chitpin, 2017, p. 149). Rooted in human fallibility, the Popperian approach brings the centrality of criticism in the focus. Individuals cope with problem-solving through criticism—“It is through criticism that we can revise or replace our ideas so as to improve them” (Chitpin, 2017, p. 149). The critical approach requires a prior “recognition of some error or inadequacy;” only this allows us “critically to refine, change, alter, modify or abandon what exists in order to eliminate a recognized bad habit or irrationality” (Chitpin, 2017, p. 149). The problem-solving process starts with the identification of a *problem*, which the individual then tries to solve by applying a *tentative theory*. The correctness or incorrectness of the theory is part of the *error elimination process*, which will result in the creation of a *new problem* that requires a *new explanatio*n (Chitpin, 2017, p. 152). In contrast to concepts developed to overcome irrationality, there are approaches that embrace irrational or erroneous decisions and interpret them as providing momentum for learning (Cope, 2011; Pittaway & Cope, 2007a; 2007b). From a learning perspective, errors and the recognition of them can trigger cognitive conflicts. Dealing with such conflict is crucial for learning and the development of knowledge.

In entrepreneurship studies, failure is mostly viewed negatively and depicted as painful experience. There are researchers who value entrepreneurial failure and see its potential for learning and knowledge (Shepherd, 2003; Shepherd & Patzelt, 2017). Learning from past mistakes, such as critical and discontinuous events during the business venture process, fosters a range of higher-level learning due to its “transformational” character (Cope, 2003). The handling of opportunities and the overcoming of crises during the entrepreneurial process

represent discontinuous learning events that initiate a distinctive form of higher-levels learning (Cope, 2003, p. 431). Cope identifies various features of lower-level and higher-level learning derived from theorists (2003, p. 434). For instance, some researchers ascribe the term "adaptive learning" to lower-level learning (Appelbaum & Goransson, 1997) and "generative learning" to higher-level learning. Argyris and Schön (1978) describe higher-level learning as *double-loop learning* and lower-level learning as *single-loop learning*. Other researchers consider higher-level learning as the potential for "transformative or transformational learning" (Appelbaum & Goransson, 1997). Thus, many researchers plead for *experiential learning* and *reflective practice* (Kassean et al., 2015) or *simulation-oriented learning* (Pittaway & Cope, 2007a) to deal with entrepreneurial failure in class. These didactical methods offer room for coping with uncertainty, ambiguity, and emotional exposure (Cope, 2003; Pittaway & Cope, 2007a) and reflection-in-action, which is critical to fostering professional practice, which is required in complex and novel situations.

2.8 Discussions and Implications for Future Research

This paper narrows the discussion of internal malfunctions in human behavior to the individual level; however, the integration of an external view at the organizational level, in terms of the malfunctioning of the system (Reason, 1990; Rasmussen, 1989), can provide further insight into the redesigning of erroneous systems and into the implications for designing a less error-prone system. Further theoretical research is encouraged to explore irrational and erroneous decisions at a macroscopic (contextual) level and to contribute to the interdependency of a complex system. Due to high levels of interdependence, entrepreneurial decisions are usually made collectively; there are even claims for the collective cognition for entrepreneurial teams (West, 2007) and for complex interplay with agents outside a system (i.e., investors) that affect modification of the system. Methodologically, emerging empirical methods, such as networking theories from social sciences, can be employed for these purposes.

Furthermore, an integration of emotion-related decisions is a prevalent aspect of entrepreneurship (Baron, 2008). There is a relation between complexity and emotions. Complexity causes fear and fear in turn affects certain behavior (e.g., fight or flight mode). Fear acts as a mediator between complexity and behavior (Dörner, 1980). In the context of entrepreneurship, this relation can be investigated in terms of entrepreneurial crisis and failure. Additionally, in the context of complex systems, fear causes the securing of competences or seeking of competences. The securing of competences can lead to *affirmative information collection*, that can in turn lead to the encapsulation of reality (Dörner & Gerdes, 2012) and selective perception may occur. Moreover, Dörner (1980, p. 93) sees a negative relationship between one's own assessment of one's ability to act and fear of failure, which can in turn lead to an individual's perception of *loss of control*. From this perspective, an investigation of complex situations, cognitive biases and entrepreneurial competences is recommended, particularly to derive implications for entrepreneurship education.

Furthermore, despite sound work in these fields, bias and error research take a rather empirical character. Kruglanski and Ajzen point out that bias and error lack an "articulated theory and … are not explicitly defined" (1983, p. 2). Contemporary research on errors has developed conceptual work that has contributed to the lack of theorization (e.g., Rasmussen, 1982; 1989; Reason, 1990). Nevertheless, such research can be considered a metatheory that can specifically be adapted to entrepreneurship. For this purpose, the entrepreneur's erroneous judgment and decision-making process require empirical investigation. In addition, complexity models and concept, e.g., *synergetics* (Liening et al., 2016) or *cybernetics* (Schwaninger, 2009), provide useful strategies to handle complex situations. We recommend an adaption of complexity theory to entrepreneurship, drawing a distinction between different types of ill-structured situations (e.g., risk, uncertainty, complexity) under the consideration of the coping strategies and including the discussion of a heuristic-oriented approach and a strategically calculated approach.

From an educational perspective, learning from mistakes can be implemented through experience-based learning (Mandel & Noyes, 2016) to enforce problem-solving and reflection competences (Boyles, 2012), and to cultivate a learning-oriented mistake culture within entrepreneurial classrooms. A first educational approach for learning from failure in the entrepreneurship are proposed by Cope (2011). Educational research should also include simulation-oriented teaching (McGuigan, 2016). Studies of simulation games provide essential knowledge about the genesis of and reasons for problems in complex situations (Reason, 1990). Moreover, some studies have demonstrated advances in learning: retrospective verbalization of the learning process or the development of heuristics. Entrepreneurship has developed various instruments and techniques (the business model canvas, the lean start-up, the minimal viable product, etc.) for founding and running a business; these can be the basis for the creation of computer-simulated microworlds of business ventures.

3 Manuscript II: The Window of Entrepreneurial Opportunity: Investigation of the Antecedents of Opportunity Recognition

3.1 Abstract

This paper investigates traits and capabilities affecting an individual's opportunity recognition. We propose three categories of individual antecedents: entrepreneurial self-efficacy, problem-solving ability, and entrepreneurial imaginativeness. Using a dataset of more than 300 students, we examine correlations between these latent constructs as well as heterogeneity across observable student characteristics. Our findings indicate that students' perceived entrepreneurial self-efficacy and entrepreneurial imaginativeness promote opportunity recognition. Moreover, the three antecedents show positive correlations among one another. Regarding socio-demographic characteristics, our results show that opportunity recognition is significantly lower among female students and those who did not attend entrepreneurship courses. The article ends with presenting the conclusions of the results, an overview of research limitations, and insights into future research.

3.2 Introduction

"*Trying to understand the entrepreneurial process without considering entrepreneurs is like trying to bake bread without yeast*" (Baron, 2004, p. 222).

The recognition of an opportunity initiates the process of new venture creation (e.g., Venkataraman, 1997; Singh et al., 1999b; Shane & Venkataraman, 2000; Baron, 2004; Ozgen, 2011). Entrepreneurial opportunity is defined as a situation in which an individual creates a new means-ends framework for recombining and mobilizing resources that the person believes to be socially and financially profitable (Shane, 2003, p.18). An entrepreneurial opportunity has to meet criteria for desirability, novelty, and economic value (Baron, 2004). The recognition of

opportunity is a cognitive process of perceiving patterns (e.g., stimuli, events); in line with this idea, Morris et al. (2013, p. 358b) define opportunity recognition as an entrepreneurial competence, or "the capacity to perceive changed conditions or overlooked possibilities in the environment that represent potential sources of profit or return to a venture." This particular competence helps entrepreneurs navigate the entrepreneurial landscape.

Kirzner introduces the term "opportunity" as part of equilibrium theory, according to which the entrepreneur benefits from the imperfect knowledge of market agents (information asymmetries; 1973; 1999). According to the Kirznerian view, the discovery of opportunities is determined by entrepreneurs' alertness that is visible when an entrepreneur is "able to perceive opportunities for entrepreneurial profits; that is, they are able to see where a good can be sold at a price higher than that for which it can be bought" (Kirzner, 1973, p. 14). With Kirzner's conceptualization of opportunity recognition, two mainstream research approaches emerged: a microscopic analysis addressing the entrepreneur and a macroscopic analysis focusing on the contextual and environmental conditions of the entrepreneur. Environmental factors that influence the identification and creation of opportunities (Gaglio & Taub, 1992) include, for example, society's economic growth, social and political contexts, or cultural values (George et al., 2016a); governmental regulations (Weaver et al., 2012); network ties (Hite, 2005; Shaw & Carter, 2007); education system (Arenius & Clercq, 2005); market circumstances (McMullan & Long, 1990; Shane, 2000); industrial conditions (Glaeser & Kerr, 2009); technological advancement (Webb et al., 2011); and environmental dynamics (Wiklund & Shepherd, 2003).

Krueger et al. (2000, p. 414) argue that "predicting entrepreneurial activities by modeling only exogenous factors often results in disappointingly small explanatory power." Thus, other scholars have explained the influences on the entrepreneurs' ability to form entrepreneurial opportunities through a cognitive psychological approach (Shane, 2003; George et al., 2016b). Ko and Butler (2006) state that the creative cognition approach enables an individual to identify a novel idea for a product, service, or technology. Beyond revealing intraindividual differences,

the cognitive approach is able to answer "how, when, and why some individuals can recognize opportunities whereas others cannot" in order to measure interindividual differences (George et al., 2016b, p. 310). Opening the "black box" of entrepreneurial opportunity is "the most challenging" research matter of entrepreneurship "that needs to be resolved" (Ko & Butler, 2006, p. 5). Thus, various research studies on entrepreneurial opportunity have focused on cognitive abilities (Baron, 2006; Shane, 2009), prior knowledge (Acs et al., 2009; Audretsch & Keilbach, 2007), individual traits (Zahra et al., 2006; Baron & Tang, 2011), self-efficacy (Hmieleski & Baron, 2008; Tominc & Rebernik, 2007), creativity (Ardichvili et al., 2003; Baron, 2006), risk propensity (Baron, 2006), and locus of control (Tumasjan & Braun, 2011). However, studies also recommend that future research investigate additional aspects of opportunity recognition in relation to different theoretical approaches to identify other prominent antecedents of this construct (Grégoire et al., 2011; George et al., 2016b). George et al. (2016b) encourage future research to combine knowledge- and personality-related factors as well as to explore cognitive differences to study individual opportunity recognition and its influence on the opportunity recognition process.

The attempt to answer the question of why some entrepreneurs are able to recognize or create opportunities while others fail to identify them (Baron, 2004; 2007; Shane, 2003) includes consideration of heterogeneity among individuals. We acknowledge that individual differences determine the degree of opportunity recognition and exploitation. Opportunity recognition is a popular subject in entrepreneurship research, but Tuomisalo (2019, p. 336) argues that "in this respect, one of the areas requiring further research is the period before the official establishment of a firm" because entrepreneurial activities also take place before the creation of a business (Tuomisalo, 2019; Hewerdine & Welch, 2013). This is also known as the pre-launch stage, which can be understood "as the activities and processes that precede, and lead up to, the choice or decision to start a business" (Atherton, 2007, p. 406). To fill this gap,

this study investigated opportunity recognition and its antecedents by focusing on the pre-launch period among college students.

However, studies show varying degrees of engagement in entrepreneurial activities among college students (Patzelt & Shepherd, 2008; Ozgen & Minsky, 2013). Plenty of research has shown that entrepreneurial learning or growing up in an entrepreneurial environment increases the likelihood that one will engage in new venture creation activities (Scherer et al., 1989; Chlosta et al., 2012; Lindquist et al., 2012). Entrepreneurial activities start before business ideas emerge. Research on the early stages of start-up activity that include college students can trace the motivations for their decisions to become involved in entrepreneurial activities, including their recognition of opportunities (Reynolds et al., 2000; Shane, 2000). Furthermore, academic spinoffs or faculty- and student-founded business ventures are "disproportionately" high-performing entities (Shane, 2004, p. 20). They have the potential to generate knowledge-intensive university spinoffs and contribute to local economic development (e.g., creating jobs). Although analysis of young people in school and university identifies the influence of university experiences on individuals' attitudes toward entrepreneurship (Gibb, 1993) and their engagement in business venturing activities (Atherton, 2007), entrepreneurship research that investigates the emergence of opportunities among college students is limited and inconclusive (Beyhan & Findik, 2018). Opportunity recognition is conceptualized as the stage before entrepreneurial intention is developed. The recognition of profitable business opportunities initiates the entrepreneurial founding process. Thus, it is useful to focus on the pre-launch stage when considering students as a highly valuable target group for becoming entrepreneurs.

The contribution of this paper is threefold. Firstly, the study follows an intention-based approach. Intentional behaviors "offer critical insights into underlying processes such as opportunity recognition" and therefore "increase our ability to explain—and predict—entrepreneurial activity" (Krueger et al., 2000, p. 414). Exploring antecedents of opportunity recognition helps to advance understanding of not only the emergence of entrepreneurial

opportunities but also the intentional behavior of new venture formation, such as entrepreneurial intention (Krueger, 1993; Krueger et al., 2000).

Secondly, in response to previous suggestions (George et al., 2016b; Grégoire et al., 2011), this manuscript aims to contribute to the literature by providing insights into promising antecedents of opportunity recognition from different cognitive-psychological perspectives. Hence, we examine prevalent antecedents of opportunity recognition through the individual components of *cognitive estimation* and *cognitive abilities*. Additionally, we investigate the existing interaction effects between these antecedents. As a key predictor of new venture intention (McGee et al., 2009), *entrepreneurial self-efficacy* is considered as a cognitive estimation of a person's capability to successfully perform entrepreneurial activities (Chen et al., 1998). Furthermore, we believe that opportunity recognition is shaped by an individual's cognitive abilities for *problem-solving* and *entrepreneurial imaginativeness* (Baron, 2006).

Thirdly, focusing on the pre-launch stage of the venturing process, we examined opportunity recognition as a key element of venture activities (Venkataraman, 1997; Gaglio, 1997) among American and German college students to explore national differences in recognizing entrepreneurial opportunities; this approach enables the development of additional hypotheses and future directions for cross-national comparative research. This paper focuses on cognitive differences by analyzing the three antecedents (entrepreneurial self-efficacy, problem-solving, and entrepreneurial imaginativeness) and personal differences (e.g., gender, nationality) through the heterogeneity statistics of the sample.

This article is structured in the following manner. We start by introducing the model and discussing the three proposed antecedents of opportunity recognition. We develop a structural equation model to test the interaction effects between the antecedents and opportunity recognition. Our results indicate that the traits of *entrepreneurial self-efficacy* and *entrepreneurial imaginativeness* are significantly correlated with opportunity recognition. As part of our structural equation model, we establish the construct validity of the relevant

constructs using a confirmatory factor analysis and identify both entrepreneurial self-efficacy and entrepreneurial imaginativeness as relevant predictors for opportunity recognition. Although problem-solving does not achieve significance in the structural equation model, removing this trait from the model would slightly decrease overall model fit. Furthermore, a heterogeneity analysis reveals a national gap in which US students scored higher in opportunity recognition compared to German students, which supports previous studies (see Naktiyok et al., 2010; Jung et al., 2001). Our study also identifies a gender gap in favor of male students, which corresponds with existing findings (see Dempsey & Jennings, 2014; Zhao et al., 2005). Moreover, our results show higher values for students with prior knowledge on entrepreneurship, which is consistent with other empirical studies and indicates that entrepreneurship education has a significant effect on entrepreneurial self-efficacy (see Maritz & Brown, 2013; Piperopoulos & Dimov, 2015). The effect of entrepreneurship education on self-efficacy is also found to be stronger for women than for men (Wilson et al., 2007).

3.3 Theoretical Context and Hypothesis Development

3.3.1 An Intention-Based Model of Opportunity Recognition

Human intentions serve as a predictor of planned behavior (Bagozzi et al., 1989). Many entrepreneurial activities are the result of intentionally planned behavior (Krueger, 1993; Krueger et al., 2000; Carter et al., 2003), and so "the use of well thought-out and research-tested intention models should provide a good means of examining the precursors to business start-up" (Krueger et al., 2000, p. 414). To observe rare and difficult phenomena within ill-structured domains such as entrepreneurship (Ajzen, 1991; MacMillan & Katz, 1992), exploring human intentions has proven to be valuable (Krueger et al., 2000, p. 413). Krueger et al. point out that entrepreneurial "intentions serve as important mediating variables between the act of starting a business venture and potential exogenous influences" (Krueger et al., 2000, p. 413). They also note that to "understand the consequences of intentions—particularly actions—requires that we

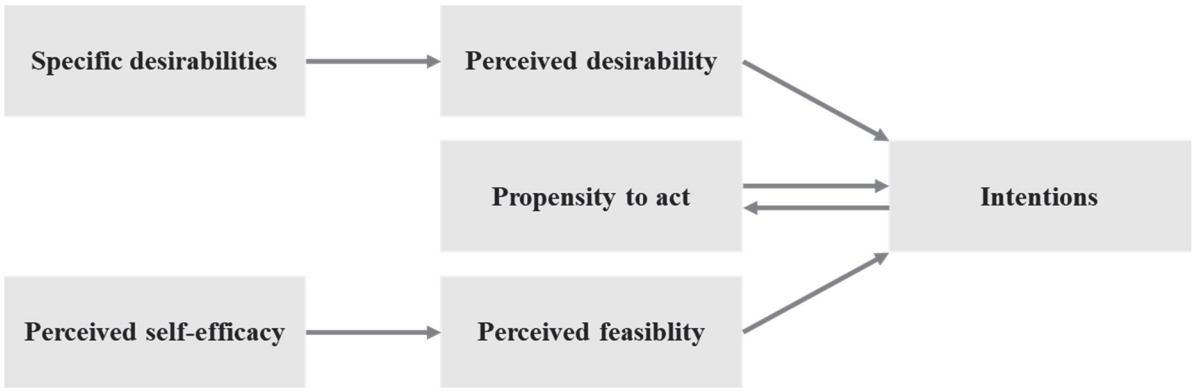
understand the antecedents of intention" (Krueger et al., 2000, p. 414). Krueger et al. (2000) suggest two intention-based models that can serve as an umbrella theory for understanding the emergence of entrepreneurial opportunities: Azjen's (1991) *theory of planned behavior* and Shapero and Sokol's (1982) *model of the entrepreneurial event*. While the first theory is rooted in social psychology, the second model was developed for the domain of entrepreneurship research (Krueger et al., 2000). Given that Shapero and Sokol's model is specific to the entrepreneurial domain (Shapero & Sokol, 1982), this article uses the model to explain the selected antecedents for investigating opportunity recognition.

Entrepreneurial opportunity is a prerequisite for the venturing process, but the identification of opportunity depends on an individual's intention to act and behavior (Krueger et al., 2000). Thus, there is a strong interplay between an individual's cognition and behavior that requires the combination of cognition and decision theories (Krueger et al., 2000). The model of the entrepreneurial event (see Figure 5) postulates that human behavior is "interrupted" or "displaced" by certain events such as job loss or receiving an inheritance (Krueger et al., 2000; Shapero & Sokol, 1982). However, the perception of these events depends on the individual's perception of desirability and feasibility (Krueger et al., 2000). The model proposes that perceived desirability and feasibility as well as the propensity to pursue opportunities determine entrepreneurial intention (Shapero & Sokol, 1982).

Perceived desirability is defined as the individual's personal perception of the attractiveness of starting a venture. This variable is influenced by specific desirabilities (Shapero & Sokol, 1982). Within our study, specific desirabilities are exemplified by factors such as profitability or the value of the business opportunity. Perceived feasibility is understood as the individual's estimation of the personal capabilities needed to start a venture (Krueger et al., 2000; Liñán et al., 2011). The propensity to act represents one's personal volition to carry out the decision to start a venture but also "the desire to gain control by taking action" (Krueger et al., 2000, p. 419).

Furthermore, Shapero and Sokol's model defines specific desirabilities as an antecedent to perceived desirability, while perceived self-efficacy is an antecedent to perceived feasibility (1982). Scholars have acknowledged that the perceived desirability and perceived feasibility of entrepreneurial opportunity can function as antecedents of entrepreneurial intentions (Krueger, 1993; Krueger & Brazeal, 1994; Krueger & Carsud, 1993; Krueger et al., 2000). Perceived self-efficacy affects the intention to start a business because it motivates entrepreneurial behavior (Carr & Sequeira, 2007). Thus, perceived self-efficacy can function as an antecedent of opportunity recognition. We believe that perceived self-efficacy has to a certain extent an effect on one's volition to act upon the decision that has been made (e.g., starting a business).

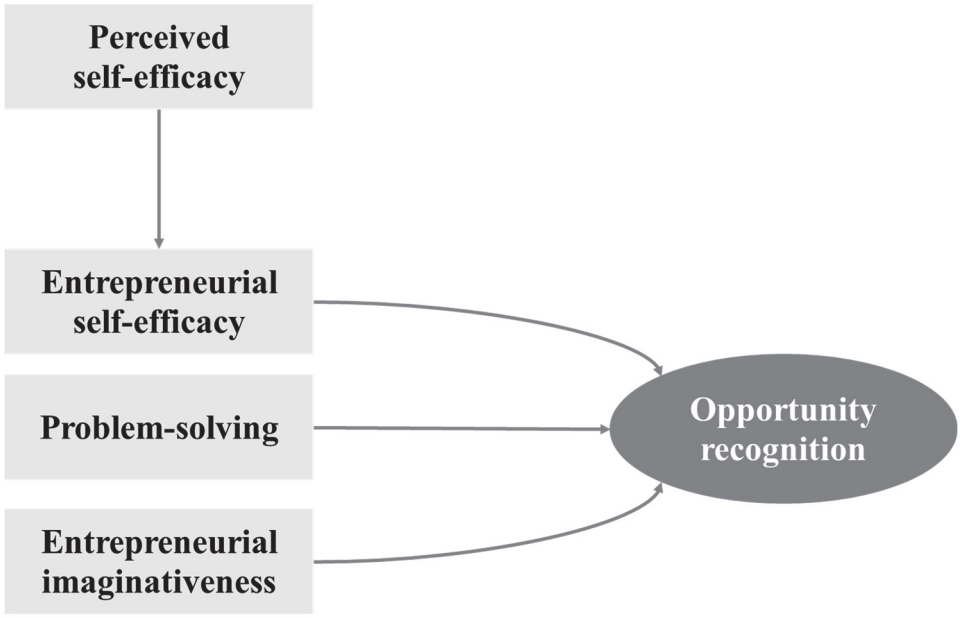
Figure 5: Model of the Entrepreneurial Event



There are two approaches describing the emergence of business opportunities: *discovery theory* and *creation theory* (Alvarez & Barney, 2007). While the first theory emphasizes the analytical search for existing opportunities, the second maintains that previously non-existing opportunities emerge through creativity. Assuming that both approaches are not only possible but also are realized simultaneously, analytical skills and creative-innovative abilities are required for the emergence of opportunities. Two constructs have only received minor attention in the entrepreneurship research: the ability to solve problems (Ko & Butler, 2007) and entrepreneurial imaginativeness (Kier & McMullen, 2018). To our best knowledge, these two

constructs have not been analyzed within a framework of opportunity recognition using an intention-based model to reflect on behavioral decisions. In addition to entrepreneurial self-efficacy, we believe that problem-solving and entrepreneurial imaginativeness are crucial for entrepreneurial opportunities, and we anticipate interaction between problem-solving, entrepreneurial imaginativeness, and perceived self-efficacy (see Figure 6). In the next sections, the interplay between the constructs will be discussed and hypotheses are proposed.

Figure 6: Conceptual Model of Opportunity Recognition



3.3.2 Opportunity Recognition and Entrepreneurial Self-Efficacy

Opportunity recognition and entrepreneurial self-efficacy are cognitive processes that have received considerable attention in recent years (Tumasjan & Braun, 2011). Scholars investigating the role of entrepreneurial self-efficacy in the process of opportunity recognition and exploitation (Gibbs, 2009; Ozgen & Baron, 2007) have often characterized entrepreneurial self-efficacy as an antecedent of opportunity recognition and exploitation. The interplay between opportunity recognition and entrepreneurial self-efficacy has been examined but has hitherto remained fragmented (Tumasjan & Braun, 2011).

Self-efficacy is a central cognitive construct of social learning theory (Bandura, 1977). General self-efficacy is understood as an individual's judgment of their capability of achieving a desired goal or outcome by performing specific behaviors (Bandura, 1977; 1989; Barone et al., 1997), including the mobilization of motivation, "cognitive resources, and courses of action needed to exercise control over task demands" (Bandura, 1990, p. 316). Self-efficacy is not considered a personality trait but rather refers to a "specific cognition in specific situations or domains" (Barone et al., 1997, p. 290) for the cognitive process of estimation (e.g., Chen et al., 1998). It has a significant effect on the self-regulation processes of setting goals, goal-directed activities including effort and persistence, efficiency and effectiveness of goal-directed activities (e.g., problem-solving and decision-making), and selections of activities (Barone et al., 1997, p. 291).

Entrepreneurs' self-regulation (i.e., entrepreneurial self-efficacy) is a crucial factor in the process of opportunity recognition (Boyd & Vozikis, 1994; Baron, 2002; 2004; McMullen & Shepherd, 2003; Zhao et al., 2005; Ozgen & Baron, 2007; Tominc & Rebernik, 2007; Hmieleski & Baron, 2008; Gibbs, 2009; Tumasjan & Braun, 2011). Entrepreneurial self-efficacy is the cognitive estimation of the chances of performing venture creation-related tasks successfully (Chen et al., 1998); this includes the setting of venturing goals (e.g., developing a business model, creating a prototype, interviewing potential customers, searching for financial resources). Self-efficacy not only determines the efficiency and effectiveness of entrepreneurial activities but also regulates "actions, thoughts, and emotions to achieve some desired outcome" and, subsequently, the formation of goals (Barone et al., 1997, p. 289). Goal-setting theory relies on the assumption that human behavior is purposeful (Latham & Locke, 1991, p. 212). Goal-directed action comprises three attributes: *self-generation, value-significance*, and *goal-causation* (Binswanger, 1990). Self-generation describes the generation and mobilization of energy, which is integral for action, value-significance means that actions are essential for an organism's survival, and goal-causation describes the causation between an action and a goal

(Latham & Locke, 1991). Thus, we expect the process of opportunity recognition to be intentional and purposeful. The entrepreneur mobilizes energy (e.g., human capital, social capital, financial resources) to achieve a certain goal; this goal has such a high value that it is necessary for the firm's survival, thus triggering entrepreneurial actions (Latham & Locke, 1991).

Entrepreneurial self-efficacy is a cognitive construct that also affects motivation. Bandura (1977) argues that efficacious individuals set more challenging goals, are more persistent in pursuing goals, more resistant when facing obstacles and adversity, and better able to cope with impending failures. Individuals pursue goals they ascribe a high personal control to and avoid goals they feel low personal control over (Bandura, 1977; Wood & Bandura, 1989). Founders with high entrepreneurial self-efficacy are willing to set more challenging goals. Chen et al. (1998) posit that individuals with high self-efficacy are more intrinsically motivated, invest more effort, and perform more effectively. Empirical studies have shown that entrepreneurs who tend to be higher in self-efficacy also perform better in terms of company growth and profitability compared to entrepreneurs with lower entrepreneurial self-efficacy (Hmieleski & Baron, 2008). There is mutual reinforcement between performance and self-efficacy: "self-efficacy affects performance through interest, motivation, and perseverance, whereas performance provides feedback information, on the basis of which self-efficacy is further evaluated and modified" (Chen et al., 1998, p. 298). Boyd and Vozikis (1994) also point out strong interplay between entrepreneurial self-efficacy, behavior, and behavioral intention that surfaces in situations of risk and uncertainty. Thus, entrepreneurial self-efficacy is a predictor of "entrepreneurs' behavior choice, persistence, and effectiveness" (Chen et al., 1998, p. 301). Moreover, entrepreneurial self-efficacy is considered a key antecedent of an entrepreneurial career choice (Boyd & Vozikis, 1994) and particularly for entrepreneurial intention (Chen et al., 1998). Based on the above points, we formulate our first hypothesis as follows:

- **Hypothesis 1.** Perceived entrepreneurial self-efficacy positively correlates with perceived opportunity recognition.

3.3.3 Opportunity Recognition and Problem-Solving

The cognitive-psychological approach investigates individual differences in the opportunity recognition process (George et al., 2016b) by emphasizing the mental processes "through which we acquire store, transform, and use information" (Baron, 2004, p. 221). Theories such as *regulatory focus theory* or *the concept of mental representation* offer insights into the perception of opportunity recognition, the decision to become an entrepreneur, and entrepreneurial success and failure (Baron, 2004). Opportunity recognition is highly dependent on individual differences in volition and capability (Shane & Venkatamaran, 2000; Shane, 2000; 2003).

Some scholars have argued that opportunity recognition is a cognitive process initiated by the entrepreneur's identification of an object or pattern of patterns (Baron, 2006; Baron & Ensley, 2006). This understanding of opportunity recognition corresponds with the *discovery theory* (Baron, 2004; Hsieh et al., 2007; Alvarez & Barney, 2007; Liening et al., 2016; Liening, 2017), which defines opportunities as "objective in nature" and ready to be identified and exploited (Alvarez & Barney, 2007, p. 14). Thus, venture creation depends on the entrepreneur's ability to discover opportunities using existing data collection techniques and then to exploit these using given strategies.

According to Baron, opportunities are "some kind of stimulus or stimulus configuration" perceived by individuals (Baron, 2004, p. 207). Baron (2004) uses *feature analysis* or the *prototype model* to demonstrate the process of opportunity recognition. Feature analysis proposes that entrepreneurs encounter stimuli (e.g., objects or complex patterns of objects or events) that they select by identifying distinctive characteristics (e.g., newness, novelty, uniqueness, practicality), store in memory, and compare with existing knowledge (Baron, 2004). For example, both nascent and experienced entrepreneurs "compare new ideas with an

existing concept of 'newness' stored in memory in order to determine whether a new stimulus configuration should be identified as an opportunity" (Baron, 2004, p. 228, original emphasis). Prototype models relate to the idea that human beings mostly possess a mental representation of objects or patterns (Baron, 2004; Baron & Ensley, 2006; Baron, 2006). In the prototyping model, the task for entrepreneurs is to compare business ideas with their "existing prototype for opportunity;" the closer the match, the more likely it is that the opportunity will be considered worth pursuing (Baron, 2004, p. 228). This model strongly relies on experience and expertise to increase the entrepreneur's mental schema. Schemas demonstrate the repertoire of an individual's experience, expertise, learning, and feelings according to the individual's perception and interpretations (Ko, 2004). Both models are based on discovery theory, and there are two distinct activities involved to identify business opportunities: "Entrepreneurs deliberately select or otherwise stumble upon problems to solve" (Hsieh et al., 2007, p. 1256). The discovery of opportunities is initiated through the deliberated process of searching for solutions to an identified problem. Effective entrepreneurs are capable of identifying valuable problems and managing an efficient solving process (Hsieh et al., 2007).

Scholars have often related the discovery of opportunity to entrepreneurs' problem-solving skills (Ko, 2004; Hsieh et al., 2007). Studies of organizational management postulate problem-solving style as a crucial determinant of an individual's innovative behavior (Scott & Bruce, 1994). Stevenson and Jarillo (1990) consider problem-solving a basic entrepreneurial skill, while Shane (2003) compares the discovery of opportunities with solving puzzles, where finding a new piece of information to address a missing element can realize the overall picture of a business opportunity. Due to the precarious circumstances of business venturing (e.g., incomplete information, unexpected challenges and obstacles, liabilities of newness and smallness), entrepreneurs must find innovative solutions to various problems (Sarasvathy, 2001; Steyaert, 2007). Moreover, most business models are the product of existing problems that are developed into valuable, profitable, and scalable business ideas by entrepreneurs. Thus,

entrepreneurial behavior is rooted in the identification of solutions to societal problems (Kirzner, 2009). Whether problems are intentionally sought out or unconsciously stumbled upon, finding a solution requires a set of decisions and choices involving a "matching process and opportunities related to unique valuable problem-solution pairings" (Hsieh et al., 2007, p. 1257).

Regarding problem-solving, Koestler (1964) introduced two conceptual modes of thinking: *associative thinking* and *bisociative thinking*. While associative thinking denotes habits or set routines used in everyday life, bisociative thinking denotes nonhabitual thoughts (Robben, 1999). Associative thinking is also called single-minded or mono-disciplined thinking, and bisociative thinking is referred to as a "double-minded transitory thinking of unstable equilibrium" (Jabri, 1991, p. 976). Bisociative thinking requires creativity "to combine hitherto unrelated and perhaps conflicting, information in a new way" (Pettersen et al., 2017, p. 5). While associative thinking does not generate novel ideas, bisociative thinking enables an individual to deal with chaos and contradicting information (Dubitzky et al., 2012). For these reasons, Ko (2004) incorporates bisociative thinking into the context of opportunity identification by arguing that this mode of thinking is more likely to produce more innovative and original business ideas (Ko, 2004). Ko and Butler's studies indicate a positive correlation between bisociative thinking and opportunity identification (Ko & Butler, 2006; 2007). Consistent with this finding, Shane (2003) also identified cognitive abilities, along with intelligence and absorptive capacity, to be beneficial for opportunity recognition.

According to discovery theory, "everyone could potentially become aware of and exploit an opportunity" (Alvarez & Barney, 2007, p. 14). However, there is the striking difference that some individuals are capable of recognizing and exploiting opportunities while others are not. According to Alvarez and Barney, this distinction is rooted in individual differences in capability. Entrepreneurs who can discover opportunities are significantly different in their ability to identify entrepreneurial opportunities (Alvarez & Barney, 2007). Based on studies on

the relationship between the formation of opportunities and problem-solving capability, we believe that problem-solving ability will positively correlate with the recognition of entrepreneurial opportunities. As such, we suggest the following hypothesis:

- **Hypothesis 2.** Problem-solving ability positively correlates with perceived opportunity recognition.

3.3.4 Opportunity Recognition and Imaginativeness

An alternative to discovery theory is *creation theory* (Sarasvathy, 2001; Baron, 2004; Baker & Nelson, 2005; Hsieh et al., 2007; Alvarez & Barney, 2005; 2007; Liening et al., 2017), which suggests that opportunities are created by entrepreneurs' actions rather than discovered. Creation theory proposes that the "'seeds' of opportunities" which enable the generation of new products or services are not rooted in existing industries or markets (Alvarez & Barney, 2007, p. 15, original emphasis). Hence, the task of the entrepreneur is to create entrepreneurial opportunities, while searching for existing opportunities plays a subordinate role. Whereas opportunities in discovery theory exist independently from entrepreneurs and can emerge through exogenous shocks, the nature of opportunities in creation theory is highly dependent on "the actions, reactions, and enactment of entrepreneurs" (Alvarez & Barney, 2007, p. 15). Therefore, the entrepreneur is the source of business opportunities.

Building something out of nothing requires creativity, which has been linked to entrepreneurial opportunities (Ardichvili et al., 2003; Dimov, 2007; Hansen et al., 2011; Fillis & Rentschler, 2010; Gielnik et al., 2012). Having a creative mindset is crucial for entrepreneurship (Baker & Nelson, 2005; Mumford, 2003; Ward, 2004; Fillis & Rentschler, 2010). Creativity enables competitive advantages for the venturing process (Ko & Butler, 2007) and serves as a foundation for innovation and business growth (Heunks, 1998; Fillis & Rentschler, 2010; Weinberger et al., 2018). Studies show a higher level of creativity for entrepreneurs and positive correlations between creativity and the capacities for flexibility and adaptive thinking (Baron, 2006; Kirby, 2004; Solomon & Winslow, 1988). Additionally,

creative people tend to have higher levels of domain-specific knowledge, intelligence, and sensitivity towards problems and are more tolerant of ambiguity (Heunks, 1998). Creativity enables the generation of novel ideas (Amabile, 1988; 1997; Ardichvili et al., 2003) by handling "opportunities in ways which can result in competitive advantage for the organization" (Fillis & Rentschler, 2010, p. 50).

Creativity is a multifaceted and highly complex construct (Mumford & Gustafson, 1988) that has been discussed either as a personality trait of entrepreneurs or as an outcome of the entrepreneurial process (Walton, 2003). As a personality trait, creativity is related to optimism and self-efficacy (Ardichvili et al., 2003; Ward, 2004). When considered in relation to outcomes, creativity is associated with divergent thinking (Walton, 2003; Dimov, 2007; Covin & Wales, 2012). Creativity is usually linked to *imaginativeness* (Fillis & Rentschler, 2006; 2010; McMullen & Kier, 2017). According to Seelig, "all great ventures begin with imagination" (Seelig, 2015, p. 56). Imagination is the *catalytic element* for opportunity recognition (Suddaby et al., 2015) that enables new connections and combinations (McMullen & Kier, 2017). Imaginativeness is understood as the mental simulation of "images, stories, and projections of things" (Taylor et al., 1998, p. 429) employed to form novel business ideas (Kier & McMullen, 2018). Kier and McMullen (2018, p. 2268) conceptualize imaginativeness as a cognitive ability "mixed with the knowledge needed to mentally simulate various task-related scenarios in entrepreneurship," and they note that creative, social, and practical imaginativeness can be measured. All types of imaginativeness represent the cognitive ability to envision something that is not observable. Whilst creative imaginativeness describes envisioning directed at creating novel, original, artistic, or innovative business opportunities, social imaginativeness is targeted at adopting the perspective of others (e.g., desires, intentions, beliefs, and emotions). Practical imaginativeness aims to envision concrete actions such as planning or managing information or resources (Kier & McMullen, 2018). The creation of entrepreneurial opportunities and the level of the creativity of these opportunities depend on

entrepreneurs' imaginations (Cornelissen & Clarke, 2010; Seelig, 2015). Imaginativeness is the source of innovation, which is in turn a source for "ideas, process, products or procedures" (West & Farr, 1990, p., 9), and imagination is necessary "to predict, project, or forecast what will likely be in the future" (Kier & McMullen, 2018, p. 2268). Studies have shown a positive impact of innovativeness on venture performance and entrepreneurial success (Utsch & Rauch, 2000; Rauch & Frese, 2000; Wiklund, 1998). As such, we propose the following hypothesis:

- **Hypothesis 3.** Entrepreneurial imaginativeness positively correlates with perceived opportunity recognition.

3.3.5 Interplay between the Antecedents of Opportunity Recognition

As previously discussed, entrepreneurial self-efficacy has a motivational function; serves as a strong predictor for behavior (Maddux et al., 1986); and determines goal setting, goal pursuit, the initiation of coping behavior, and a person's persistence in the face of obstacles and adversity (Bandura, 1977; 1997). Problems represent a type of obstacle and are generally described as something that triggers discomfort or causes difficulty that needs to be overcome. Research focusing on problem-solving distinguishes between well-defined (i.e., having a single, certain solution) and ill-defined (i.e., having multiple, uncertain solutions) problems. Geifman and Raban (2015) emphasize that problems can neither be categorized as exclusively well-defined nor ill-defined and instead range within the continuum of well-defined and ill-defined problems. The ability to solve problems does not only rely on domain-specific knowledge but also on the problem-solver's self-efficacy (Schraw et al., 1995; Looney et al., 2006; Geifman & Raban, 2015). In problem-solving situations, self-efficacy is the belief in one's ability to successfully solve a given problem. Problems that individuals perceive themselves as capable of controlling are addressed, while problems perceived to be difficult to control are avoided (Bandura, 1977; Wood & Bandura, 1989). Some prior research has demonstrated a relationship between perceived self-efficacy and the complexity of tasks (Looney et al., 2006; Greifman & Raban, 2015). Other results have indicated that efficacious

individuals are better at problem-solving (Wood & Bandura, 1989; Bouffard-Bouchard et al., 1991; Kruger, 1997). Thus, we assume that perceived entrepreneurial self-efficacy will positively correlate with problem-solving ability.

The process of problem-solving involves cognitive flexibility and creative thoughts to overcome "functional fixedness" and to capture the elements of creativity (Koestler, 1964). Creativity, including imagination, has been related to problem-solving and problem identification (Runco & Pina, 2013), yielding the term *creative problem-solving* (Isen et al., 1987; Kaufmann, 1988; Jackson, 1991). Creative problem-solving describes an effective type of iterative thinking that is cooperative and productive (Lumsdaine & Lumsdaine, 1995), generating "novel solutions to ill-defined problems" (Puccio, 1999, p. 171). Solving problems requires more than domain-specific knowledge. Literature even argued that domain-specific expertise alone is incapable of solving novel problems (Gentner & Block, 1983). Creativity has the potential to boost cognitive flexibility to generate solutions to unknown problems (Mumford et al., 1994). As mentioned, creativity involves imagination. Gaut and Livingston (2003) argue that "imaginative" and "creative" are nearly synonymous. Imagination and creativity have both been linked to cognitive and behavioral responses (Camargo-Borges, 2018), but more importantly, both constructs involve thinking that is distanced from reality (Runco & Pina, 2013) yet not related to unreality, which would become fantasy (Mellou, 1995). Whilst imagination has been associated with mind wandering, counterfactual thinking, and transformational activity, creativity has been associated with cognitive adaptability and divergent thinking (Runco & Pina, 2013). Mellou (1995) posits that the key link between imagination and creativity is that imagination enables innovation, changes, and new opportunities. Thus, imaginativeness is central for new venture ideation (Kier & McMullen, 2018) and the process of resource mobilization and development (Keating & McLoughlin, 2010). Imagination is associated with creative problem-solving and is a driving force for

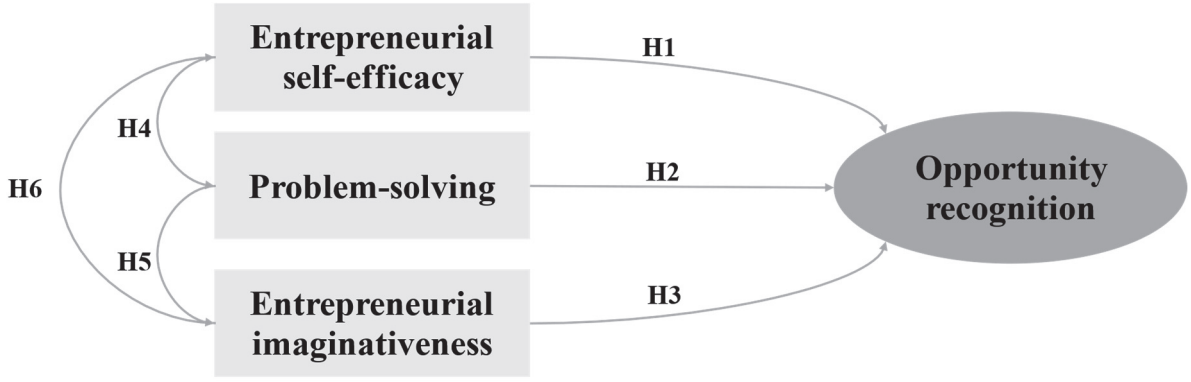
entrepreneurial action, including opportunity recognition. As such, we propose that problem-solving and entrepreneurial imaginativeness will have a positive correlation.

Kier and McMullen (2018) consider entrepreneurial imaginativeness a cognitive ability. Entrepreneurial imaginativeness encompasses the imagination of required resources as well as the actions needed to develop the new venture's resource bundle over time (Keating & McLoughlin, 2010). This ability to demonstrate creative performance depends not only on domain-specific knowledge but also on entrepreneurial self-efficacy, which is referred to as a source for individual creative performance and for the development of novel knowledge (Ford, 1996; Bandura, 1997; Mathisen & Bronnick, 2009). The construct of *creative self-efficacy* is defined as "the belief one has the ability to produce creative outcomes" (Tierney & Farmer, 2002, p. 1138). Bandura (1997, p. 239) argues that "innovativeness requires an unshakable sense of efficacy to persist in creative endeavors when they demand prolonged investment of time and effort, progress is discouragingly slow, the outcome is highly uncertain, and creations are socially devalued when they are too incongruent with pre-existing ways." Tierney and Farmer (2002; 2011) posit that creative self-efficacy influences creative effort due to positive changes in self-views resulting from creative efficacy and leads to creative performance. Imagination and creativity manifested in an individual's excellence or virtue (Gaut & Livingston, 2003) are observable through the generation of novel and valuable business ideas (Mumford et al., 1994). Given the link between creative self-efficacy and creative behavior and performance, as well as the links between creative behavior and imaginativeness, we expect that belief in one's creative abilities has an effect on imaginative ability. In conclusion, we suggest the following hypotheses:

- **Hypothesis 4.** Perceived entrepreneurial self-efficacy positively correlates with problem-solving ability.
- **Hypothesis 5.** Problem-solving ability positively correlates with entrepreneurial imaginativeness.
- **Hypothesis 6.** Entrepreneurial imaginativeness positively correlates with perceived entrepreneurial self-efficacy.

Based on the theoretical and empirical insights, we propose the following antecedents in the model of opportunity recognition (Figure 7). The conceptual model of opportunity recognition uses the cognitive-psychological perspective suggested by scholars to test which antecedents influence opportunity recognition. We propose two categories of antecedents that influence opportunity recognition: *cognitive estimation*, measured through entrepreneurial self-efficacy, and *cognitive abilities*, measured through problem-solving skills and entrepreneurial imaginativeness.

Figure 7: Hypotheses Development



3.4 Methodology

3.4.1 Research Design and Procedure

To test the hypotheses, an online survey questionnaire was made to investigate the relationship between opportunity recognition and its antecedents. We were also interested in exploring the relationship among the antecedents; thus, the questionnaire contained scales measuring the

theoretical constructs based on a review of previous literature (see the *Measures* section) as well as of the demographic variables (e.g., age, sex, prior knowledge, entrepreneurial role model). As a statistical method, we used a structural equation model. Structural equation modeling has been a popular method since the 1970s (MacCallum & Austin, 2000) and is a multivariate statistical technique used simultaneously for factor analysis and path analysis (Xiong et al., 2015). Structural equation modeling can test hypotheses about relations between manifest variables (observed) and latent variables (unobserved; Zampetakis & Moustakis, 2006; Xiong et al., 2015). To develop a structural equation model, a prior model must be specified to test the hypotheses (Kline, 2005); in this study, R statistical software (version 4.0.3) was used to test the hypotheses (Fox, 2006).

3.4.2 Sample

A sample of 302 undergraduate and graduate students at American and German universities took part in the study. The participants were recruited from a joint American-German research collaboration on entrepreneurial mindsets. Our sample consisted of both university entrepreneurship students and students without prior knowledge of entrepreneurship. We captured demographic data at the individual level, as shown in Table 1. A total of 49.3% of the sample was female. We used five categories for students' age: 18–20 (14.9%), 21–23 (17.9%), 24–26 (28.1%), 27–29 (25.2%) and above 30 years (13.9%). With regard to family background, 89.7% reported being single, while 8.6% reported being married; 7.3% of all participants reported having children. In terms of degree type, 51.3% held a bachelor's degree, 9.9% a master's, and 3.1% a PhD. Students also reported which semester they are currently enrolled in. The mean value of this variable is 5.96 with a standard deviation of 4.03. We also asked students whether they had a paid job (68.2% replied affirmatively). Entrepreneurial background was assessed by asking participants whether there were entrepreneurs among their family and

relatives (39.1%) and whether they had an entrepreneurial role model (69.6%). A total of 54.3% of participants reported having taken an entrepreneurship or entrepreneurship-related course.

Table 1: Sample Characteristics

	N	Mean	SD	Min	Max
Female	302	0.493	0.501	0	1
US sample	302	0.152		0	1
Age					
18-20	302	0.149	0.357	0	1
21-23	302	0.179	0.384	0	1
24-26	302	0.281	0.45	0	1
27-29	302	0.252	0.43	0	1
>30	302	0.139	0.347	0	1
Family background					
Single	302	0.897	0.304	0	1
Married	302	0.086	0.281	0	1
Divorced	302	0.007	0.081	0	1
Kids	302	0.073	0.26	0	1
Degree					
Bachelor	302	0.513	0.501	0	1
Master	302	0.099	0.3	0	1
PhD	302	0.031	0.173	0	1
Semester	302	5.957	4.027	0	30
Job	302	0.682	0.466	0	1
Entrepreneurs among siblings*	302	0.391	0.493	0	1
Entrepreneurial role model	302	0.696	0.465	0	1
Entrepreneurial course	302	0.543	0.504	0	1

* Entrepreneurial siblings include family members and relatives that are entrepreneurs.

3.4.3 Measures

Opportunity recognition. This construct was measured using the instrument developed by Kuckertz et al. (2017), wherein pretests and retests show the robustness of the reliability and validity of the developed scales (Kuckertz et al., 2017). The measure comprises five items for the subscale of *opportunity recognition* and four items for the subscale of *opportunity*

exploitation. Opportunity exploitation includes items that require the active pursuit of opportunities (i.e., where venture-related actions have been taken). Given our focus on the pre-launch stage, we only employed the opportunity recognition scale (e.g., "*I research potential markets to identify business opportunities*"). The respondents rated their level of agreement using a 7-point Likert scale (*1 = strongly disagree, 7 = strongly agree*).

Entrepreneurial self-efficacy. We employed the entrepreneurial self-efficacy scale developed by McGee et al. (2009). The measure identifies five dimensions of entrepreneurial self-efficacy consisting of 19 items: (1) *searching,* (2) *planning,* (3) *marshaling,* (4) *implementing-people,* (5) *implementing-financial* (McGee et al., 2009). An example question from this scale is "*How much confidence do you have in your ability to identify the need for a new product or service?*"). For this measure, a 7-point Likert scale was also applied.

Problem-solving. To measure cognitive ability, we adopted Jabri's (1991) problem-solving scale. The scale has two dimensions: *associative thinking* and *bisociative thinking*. For this study, the scales measuring bisociative thinking (e.g., "*Pursuing a problem, particularly if it takes me into areas I don't know much about*") had nine items and were applied using a 7-point Likert scale.

Entrepreneurial imaginativeness. To measure entrepreneurial imaginativeness, which was expected to influence opportunity recognition, we used the discussed imaginativeness scale developed by Kier and McMullen (2018). This scale has 18 items, which are divided into *creative*, *social*, and *practical imaginativeness* (e.g., "*Being creative is a large part of who I am*").

3.5 Results

3.5.1 Descriptive Statistics

To aggregate multiple related outcomes from multi-item scales into index measures, we followed the method proposed in Kling et al. (2007) wherein the index measure represents an equally weighted average index of its single components. Table 2 shows summary statistics for all relevant outcome domains. Our data reveal a relatively low level of opportunity recognition, with a mean of 3.27 and a standard deviation of 1.67; the main predictor constructs (entrepreneurial self-efficacy, problem-solving, entrepreneurial imaginativeness) show higher average scores ranging from 4.58 to 4.9. With regard to reliability, most multi-item scales showed alpha coefficients (Cronbach, 1951) above 0.7, indicating sufficient internal consistency within the scales (see Appendix 1).

Table 2: Descriptive Statistics

	N	Mean	SD	Min	Max	Alpha
Opportunity recognition	301	3.269	1.672	1	7	0.935
Entrepreneurial self-efficacy	301	4.847	1.002	1	7	0.941
Problem-solving	302	4.581	1.038	1	7	0.911
Entrepreneurial imaginativeness	301	4.968	0.829	1	7	0.891

To test the hypotheses, we investigated bivariate correlations (Pearson's r) between all outcome domains; the results are shown in Table 3. Regarding opportunity recognition, our data reveal moderate and significant correlations, with entrepreneurial self-efficacy, problem-solving, and entrepreneurial imaginativeness accounting for 15.4–19.5% of total variance. Next, investigating correlations between the latent predictors proposed in Table 3, our data reveal meaningful correlations between entrepreneurial self-efficacy and problem-solving and between entrepreneurial self-efficacy and entrepreneurial imaginativeness that account for

almost one third of total variance. We observed a similar relationship between problem-solving and entrepreneurial imaginativeness ($r = 0.532, p < 0.01$).

Table 3: Bivariate Correlations

	(1)	(2)	(3)
(1) Opportunity recognition			
(2) Entrepreneurial self-efficacy	0.442***		
(3) Problem-solving	0.393***	0.534***	
(4) Entrepreneurial imaginativeness	0.419***	0.535***	0.532***

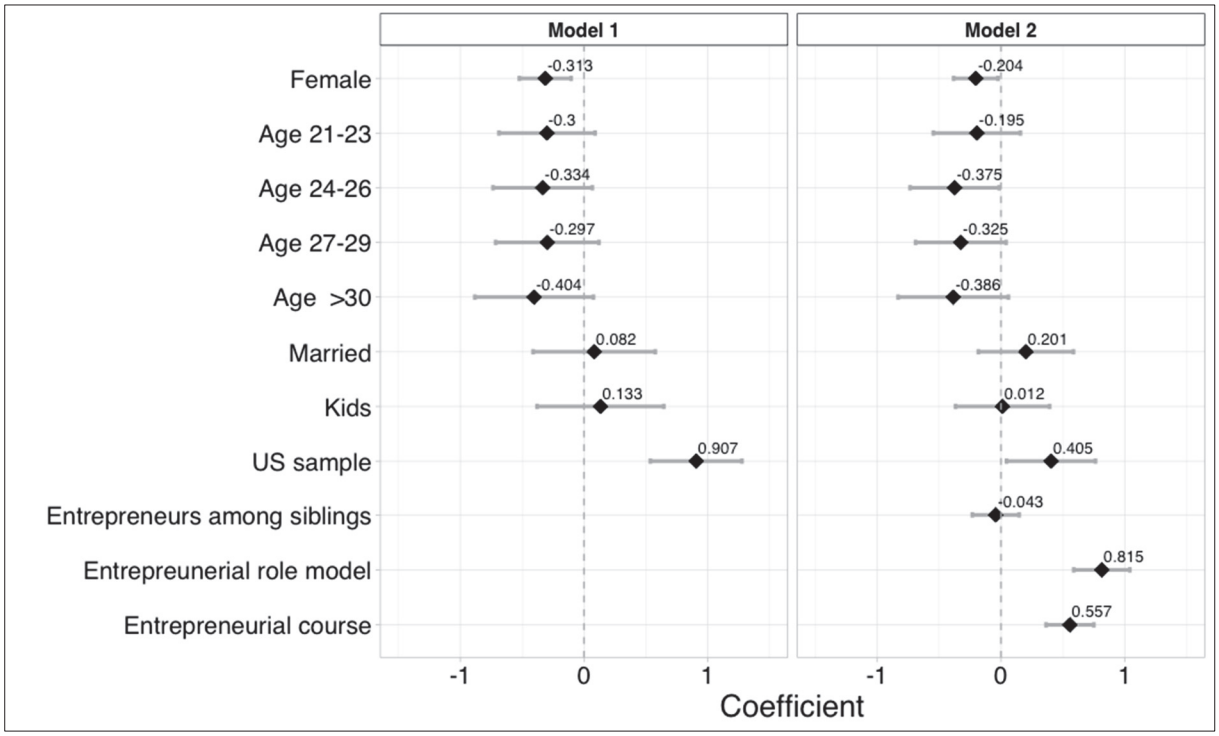
3.5.2 Socio-Demographic Determinants of Opportunity Recognition

In this section, we investigate the socio-demographic predictors of opportunity recognition by means of multiple regressions (with standard errors clustered at class level), with the results shown in Figure 8. For this purpose, we used the z-standardized weighed summary index. Maximum variance inflation factors (VIF) are below 5 for both models, indicating that multicollinearity is not an issue. Non-binary indicators are mean-centered.

Model (1) shows a moderate and significant gender gap in favor of male students by almost one third of a standard deviation, which corresponds with previously published findings in Dempsey and Jennings (2014) and Zhao et al. (2005). However, after controlling for entrepreneurship-related variables, the effect size shrinks to 0.2 standard deviation. Next, age is negatively associated with opportunity recognition. However, no age cohorts achieve significance on a 5% level. The analysis of country affiliation shows the strongest overall effect for participants visiting an American university, with a net effect of more than one third of a standard deviation. This national difference was also observed by Naktiyok et al. (2010) and Jung et al. (2001). With respect to entrepreneurship-related variables in Model (2), participants who had an entrepreneurial role model showed a higher average approval for opportunity recognition by a 0.282 standard deviation. Finally, respondents who had completed an

entrepreneurship course showed higher approval rates by more than half of a standard deviation, underlining the importance and effectiveness of entrepreneurship education. Our results correspond with the findings in Maritz and Brown (2013) and Piperopoulos and Dimov (2015). Wilson et al. (2007) found that the effect of entrepreneurship education on self-efficacy was stronger for women than for men.

Figure 8: Socio-Demographic Determinants of Opportunity Recognition (OLS)

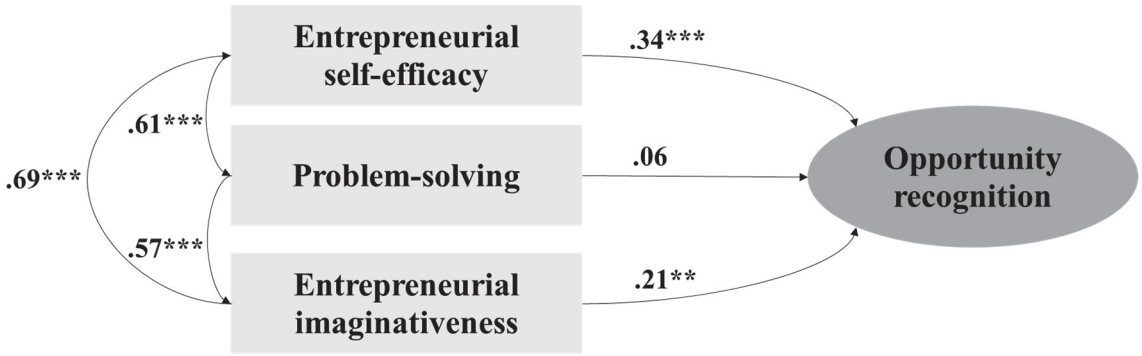


Note: This figure shows multiple regressions on the opportunity recognition summary index (z-score) with 95% CIs at estimated intercepts of 0.282 (Model 1) and -0.100 (Model 2). Effects of age categories are relative to the base category with age of 18-20. Standard errors are clustered at university course level. Number of observations is N=301. Adjusted R-squared is 0.226 (Model 1) and 0.386 (Model 2).

3.5.3 Structural Equation Model

To combine path analysis with measurement models that included the latent variables, we tested a structural equation model. Following Anderson and Gerbing (1988), we first performed a confirmatory factor analysis to ensure that the manifest items were satisfactorily associated with the latent construct, and the items and factor loadings are shown in Appendix 2. Due to insufficient factor loadings, we removed six items from the entrepreneurial imaginativeness scale and one item from the set predicting entrepreneurial self-efficacy. All remaining items show factor loadings > 0.6. After fitting the confirmatory factor analysis, we employed a structural model in which entrepreneurial self-efficacy, entrepreneurial imaginativeness, and problem-solving are predictors for opportunity recognition (results shown in Figure 9).

Figure 9: Structural Equation Model



Note: Structural equation model with interaction terms for the hole sample (n=301). Self-efficacy and imaginativeness predict opportunity recognition. Standardized solution. Loadings of indicator variables are omitted and shown separately in Appendix 2. *p<0.1, **p<0.05, ***p<0.01

Regarding model fit evaluation, the discrepancy χ^2 is significant at $p < 0.05$ for the baseline model without interaction effects as well as for the complete model, indicating that the covariance matrix predicted by the two models significantly deviates from the observed matrix. However, as Arbuckle and Wothke (1999) pointed out, the discrepancy χ^2 may be highly

sensitive to sample size, which is why the root mean square error of approximation (RMSEA; Steiger, 1990) is commonly proposed. The RMSEA for the complete model is 0.078, which is within an acceptable range according to standard guidelines (Schumacker & Lomax, 1996).

In both models, entrepreneurial self-efficacy and entrepreneurial imaginativeness are significantly positively related to opportunity recognition, supporting hypotheses 1 and 3. Although the path from problem-solving to opportunity recognition was not significant, removing this path decreased the model's overall fit. While the bivariate analysis shows a positive relationship between problem-solving and opportunity recognition, our structural equation model does not support hypothesis 2. Furthermore, as hypothesized in the theoretical path model, all three predictor scales (entrepreneurial self-efficacy, problem-solving, and entrepreneurial imaginativeness) are significantly correlated with each other, supporting hypotheses 4, 5, and 6.

3.6 Discussions

3.6.1 Discussion of Opportunity Recognition and Its Antecedents

The goal of this study was to propose a model of the opportunity recognition process and to test a model that illustrates the relationship between opportunity recognition and its related antecedents (entrepreneurial self-efficacy, problem-solving, and entrepreneurial imaginativeness). Additionally, we tested the relationship between the antecedents. Based on an analysis of existing literature, we developed a theoretical model and our hypotheses. Perceived entrepreneurial self-efficacy has been linked to opportunity recognition in the past. Krueger and Dickson (1994) assume that cognitive and behavioral activities are closely related to one's perceptions of a situation and perceived competence to perform a task successfully and achieve a desired outcome. Perceived entrepreneurial self-efficacy impacts aspiration levels, goal setting, and goal achievement (Krueger & Dickson, 1994). Moreover, studies have indicated that cognitive ability has a central role in recognizing and exploiting opportunities

(Lumpkin & Dess, 2004). Cognitive ability can be manifested as behavior and enforced through a learning process (Kim et al., 2018). Referring to creation theory, an entrepreneur's cognitive ability plays a central role in the emergence of business opportunities opportunity recognition. We were also interested in exploring the relationship among the factors influencing opportunity recognition, and researchers have also observed that problem-solving ability can induce innovative behavior (Scott & Bruce, 1994). More importantly, it has been argued that innovative tendencies are generally highly relevant in the emergence of new opportunities (Paine & Organ, 2000). Based on these findings, we structured our model of opportunity recognition antecedents.

Although problem-solving does not show significance to opportunity recognition, the discovery of opportunities involves problem-solving skills, including the systematic search and observation of existing opportunities. According to the bivariate analysis, our findings revealed that the three proposed factors are positively correlated with opportunity recognition.

With respect to the three factors, perceived entrepreneurial self-efficacy shows a positive significant correlation with opportunity recognition ($r = 0.34$, $p < 0.01$). Although Krueger (1989) investigated the role of perceived entrepreneurial self-efficacy as an antecedent of opportunity recognition, only a few later studies have explored this relationship. Previous findings have shown that perceived entrepreneurial self-efficacy serves as an antecedent of opportunity recognition (Tumasjan & Braun, 2011; Krueger & Dickson, 1994). As Krueger (1989) states, perceived entrepreneurial self-efficacy is a prerequisite to perceived opportunity (Krueger, 1989, p. 29), and this study confirms the positive correlation between opportunity recognition and perceived entrepreneurial self-efficacy.

Prior work emphasized the positive effect of creativity on opportunity recognition (Shane & Nicolaou, 2015). Kier and McMullen (2018) proposed that new venture ideation can be improved through entrepreneurial imaginativeness. In line with this, our model confirms that people with a creative personality, as measured through entrepreneurial imaginativeness, tend

to score higher on the opportunity recognition scale. Moreover, entrepreneurial imaginativeness also shows a high correlation with both entrepreneurial self-efficacy and problem-solving. To our best knowledge, entrepreneurial imaginativeness at the individual level has remained mostly unexplored (Kier & McMullen, 2020).

Regarding problem-solving, our model does not show an effect on opportunity recognition. However, we also considered the relationship between problem-solving and the effective factors (entrepreneurial self-efficacy and entrepreneurial imaginativeness). As per Kier and McMullen's (2018) conceptualization of entrepreneurial imaginativeness through the lens of creative problem-solving, our structural equation model shows strong correlations between problem-solving and imaginativeness. The structural equation model also confirms a positive relationship between problem-solving and entrepreneurial self-efficacy. As prior research has demonstrated, entrepreneurial self-efficacy is positively related to entrepreneurial intention (Boyd & Vozikis, 1994; Chen et al., 1998), while overconfidence is more strongly identified in entrepreneurs than managers (Busenitz & Barney, 1997).

3.6.2 Discussion of Heterogeneity Differences

The demographic heterogeneity of the sample has implications for the development of hypotheses for future research. In this section, we discuss identified socio-demographic differences to give direction to future studies within the field of opportunity recognition research.

One central socio-demographic finding of this study is that US students showed a significantly higher tendency towards opportunity recognition compared to German students. Previous studies have explained this country-affiliated difference through the cultural dimensions of Hofstede (Naktiyok et al., 2010; Jung et al., 2001). The USA is particularly dominated by individualism and uncertainty avoidance, which may explain the positive perception of entrepreneurial self-efficacy and entrepreneurial intention in the US sample of

previous studies. This might also be an explanation for the statistics of high entrepreneurial activity rates in the USA (Bosma et al., 2021). Furthermore, US students have higher levels of experience with entrepreneurship education, which might also contribute to their capacity for opportunity recognition. Prior knowledge and learning experience with entrepreneurship education positively correlate with opportunity recognition and thus serve as a predictor.

Other studies have likewise suggested a positive correlation between entrepreneurship education and entrepreneurial intentions (Bae et al., 2014). Corbett (2005) analyzes the influence of entrepreneurial learning on opportunity identification and exploitation. Previous studies have also shown a relation between prior entrepreneurial knowledge and opportunity recognition (Hajizadeh & Zali, 2016; Ardichvili & Cardozo, 2000). Prior knowledge is conceptualized as a cognitive resource (Khin & Lim, 2018) or as a cognitive framework (Baron, 2006) acquired through experience and learning. Entrepreneurship education promotes the development of such cognitive resources or frameworks, which enables individuals to perceive patterns that lead to business opportunities (Baron, 2006).

As with prior knowledge and entrepreneurship, studies have suggested a causality between the existence of a role model and entrepreneurial intention. Having an entrepreneurial role model affects one's entrepreneurial intention (Karimi et al., 2014). Close role models (e.g., family and friends) especially are strong predictors for entrepreneurial activities (Van Auken et al., 2006; Chlosta et al., 2012; Lindquist et al., 2012). The present study confirms that individuals with an entrepreneurial role model also showed a higher score for opportunity recognition.

Results regarding entrepreneurial self-efficacy revealed a gender gap. Female college students scored lower in entrepreneurial self-efficacy compared to male college students; this difference can be attributed to exposure to entrepreneurship education. Wilson et al. (2007) showed that females participating in entrepreneurship education programs had higher entrepreneurial self-efficacy among MBA students and for early-career stage women. Dempsey

and Jennings (2014) reinforced these findings and attribute lower entrepreneurial self-efficacy among women to limited entrepreneurial education or the higher expectation of receiving negative feedback. However, Shinnar et al. (2014) contradict this link with findings that entrepreneurial self-efficacy is statistically significant among male but not female students. The inconsistent results regarding gender's impact on entrepreneurial self-efficacy necessitates further empirical investigation.

3.7 Limitations and Future Research Directions

Although this study covers a broad population of US and German students, due to the high number of items in each scale, future studies would benefit from a larger sample size. Additionally, further investigation is necessary to better interpret the results. We encourage future studies to generalize the findings. In this respect, we note that the limitation that the revealed associations do not confirm causality. Therefore, implications about the direction of the relationship need to be viewed with caution. Future studies might address these concerns by using randomized exposure to entrepreneurial courses or longitudinal data.

Furthermore, our sample was a convenience sample randomly selected from entrepreneurship and non-entrepreneurship courses. Future studies could include nascent entrepreneurs. Given the research sample, the focus of this study was on the pre-launch stage of the venturing process. Therefore, we only measured opportunity recognition in our study. The venturing journey is initiated by identifying and exploring a business opportunity; however, exploiting a business opportunity is a required milestone towards realizing and creating a venture (Block & MacMillan, 1985; Choi & Shepherd, 2004; Choi et al., 2008). The decision to exploit a business opportunity depends on the entrepreneur's decision context (Choi et al., 2008). Future studies should address the post-launch stage of the venturing process by analyzing opportunity exploitation and its antecedents.

These findings of the study are based on self-report scales. Although this approach is one of the most common assessment instruments in various empirical research fields (Chan, 2009; Demetriou et al., 2015), there are certain limitations to self-reported data. Some researchers have identified specific issues—such as wording, order of items, or social desirability—that can compromise the validity of the data (Cronbach, 1946; Nisbett & Wilson, 1977) and thus might mitigate "the intended substantive inferences to be drawn from such data" (Chan, 2009, p. 309). Opportunity recognition as a cognitive ability can also be measured using cognitive creativity methodologies. For instance, several empirical studies have applied hypothetical exercises to assess opportunity recognition (see Grégoire et al., 2010; Gielnik et al., 2012).

Another limitation of this study is its focus on imaginativeness alone as a cognitive ability. Imaginativeness is underrepresented in entrepreneurship research, and we followed the recommendation of McMullen and Kier (2017) to test this construct in the context of opportunity recognition. However, creativity includes more characteristics than imaginativeness, such as entrepreneurial curiosity (Jeraj & Antoncic, 2013) and innovation (i.e., innovative behavior; Schumpeter, 1934; 1942; Drucker, 1985; Matthews, 2010; Marcati et al., 2008; Linton, 2019). Innovation has also been linked to opportunity recognition in the past (Utsch & Rauch, 2000). According to Lumpkin and Dess (2001, p. 431), "innovativeness refers to a willingness to support creativity and experimentation in introducing new products/services, and novelty, technological leadership and R&D in developing new processes." Innovation is a source for "ideas, process, products or procedure" (West & Farr, 1990, p., 9) and is considered a specific behavior, "such as daily effort to improve one's work procedure" that goes beyond "an interest in innovation" (Utsch & Rauch, 2000, p. 48). Studies showed a positive impact from innovativeness on venture performance and entrepreneurial success (Utsch & Rauch, 2000; Rauch & Frese, 2000; Wiklund, 1998). Hence, we encourage future studies to investigate this construct within opportunity recognition.

A further limitation is the failure to include individual attributes such as *risk tolerance*, *ambiguity tolerance*, *overconfidence*, or *loss aversion* as control variables. Future research should investigate the mediating effects of these constructs, such as the relationship between opportunity recognition and risk tolerance. Alvarez and Barney (2007) claim that the decision-making within the context of discovery theory is risky. Thus, risk tolerance can have a moderating effect that could be investigated not only using gambling experiments (e.g., Barsky et al., 1997) but also through real monetary incentives. In the case of creation theory, creativity-related skills such as imaginativeness and innovativeness are necessary to create opportunities. Since creation theory considers the entrepreneurial context to be ambivalent and uncertain, we recommend that future research investigates the interplay between ambiguity tolerance, creative personality traits, and opportunity recognition.

Moderation effects might also exist for overconfidence and loss aversion. Studies have identified a higher level of overconfidence among entrepreneurs (Busenitz & Barney, 1997; Simon et al., 2000; Simon & Houghton, 2003; Hayward et al., 2006; Koellinger et al., 2007). Forbes (2005) proposes a positive correlation between entrepreneurial self-efficacy and overconfidence in entrepreneurs. Whilst confidence is related to strength of belief, self-efficacy refers to a belief in one's specific capabilities to execute a specific task (Zhang & Cueto, 2017). Both constructs can drive persistence and resilience when facing obstacles. Self-efficacy levels positively affect a venture's performance (e.g., revenue, growth; Drnovšek et al., 2010; Baum & Locke, 2004; Cooper & Artz, 1995). However, prior work indicates that overly high self-efficacy might reduce motivation and performance level. Thus, overconfidence can lead to a negative correlation between self-efficacy and performance (Moores & Chang, 2009). For example, Hmieleski and Baron (2008) identified that in dynamic environments, high self-efficacy contributes to complacency and overconfidence, which causes negative effects for firm performance. Future research should investigate the relationship between entrepreneurial self-efficacy and overconfidence and how this impacts opportunity recognition and exploitation.

Loss aversion is a prominent concept in entrepreneurship. The pursuit of an opportunity that does not pay off leads to a money-losing business. The feeling of loss and the experience with business failures is inherent to entrepreneurship (McGrath, 1999; Shepherd, 2003; Cardon et al., 2011; Cope, 2011; Ucbasaran et al., 2013). As Tversky and Kahneman wrote (1991, p. 1039), "Losses loom larger than corresponding gains." Yet the examination of loss aversion in entrepreneurship remains largely unexplored; to our knowledge, only Morgan and Sisak (2013) have investigated the relationship between employment wages and entrepreneurial effort. Enduring losses presents higher stakes and experiencing such losses is more painful compared to equivalent gains (Morgan & Sisak, 2013). Loss aversion could hamper the initiation of the business venturing process due to the fear of losing investments or resources. This relationship should be examined in future research.

3.8 Conclusion

The entrepreneurial process is primarily characterized by the sub-processes of recognizing and exploiting a business opportunity, which are carried out by the entrepreneur (Shane & Venkataraman, 2000; Shane, 2003). Discovering and pursuing an opportunity distinguishes an entrepreneur from a non-entrepreneur (Shane & Venkataraman, 2000). Studies have also pointed out individual differences in the ability to recognize opportunities and to form an innovative venture (Dyer et al., 2008; Krueger & Dickson, 1994; Ardichvili et al., 2003; Tang, 2009; Tang et al., 2012; Corbett, 2007; Kim et al., 2018). Personal characteristics (e.g., personality-related characteristics, prior knowledge, cognitive characteristics) are essential to understanding the opportunity recognition process (Shane, 2000; Shane & Venkataraman, 2000; Shepherd & Patzelt, 2018). As such, this study sought to shed light on the individual characteristics that determine the extent of opportunity recognition by developing a model highlighting personal characteristics in relation to opportunity recognition.

Based on the confirmatory factor analysis, the proposed relationships between the constructs support our conceptual model, and all constructs correlate with each other. In summary, the results indicate that the investigated personal characteristics serve as predictors for opportunity recognition. The structural analysis demonstrates that perceived entrepreneurial self-efficacy and entrepreneurial imaginativeness in particular positively correlate with opportunity recognition.

Additional Note: A prior version of this paper, co-authored by Luis Oberrauch (Univerity of Tübingen) and Andreas Liening (TU Dortmund University); Dinh, A., Oberrauch, L. & Liening, A.: "The Window of Entrepreneurial Opportunity: Investigation of the Antecedents of Opportunity Recognition" has been presented and discussed at the Annual Conference of the European Academy of Management (2021).

4 Manuscript III: Rejected, What's Next? The Impact of Entrepreneurial Rejection on Cognitive and Behavioral Responses

4.1 Abstract

Entrepreneurial rejection is a commonly encountered challenge for entrepreneurs that has received minor attention yet. Building on two consecutive experiments, this study investigates how the type of feedback and the perceived credibility of feedback source influence the cognitive and behavioral responses to entrepreneurial rejection. First, the impact of entrepreneurial rejection on business venturing decisions was assessed through an online experiment with a sample of 125 students of entrepreneurship. Second, the effects on individuals' perception and recollection of feedback were assessed through an eye-tracking experiment with a sample of 38 subjects. Our findings indicate that rejection is better accepted when it comes from sources perceived as highly credible, and it is more likely to result in the entrepreneur's decision to terminate the business venture. Furthermore, feedback from sources perceived to be highly credible attracts more attention and is more memorable. In addition, cognitive feedback also shows higher acceptance and is more likely to be remembered than outcome feedback. The results of this research contribute to entrepreneurial cognition and decision-making research, as we reveal how the way negative feedback is presented affects recipients' perception, processing, and decision-making. Since new venture creation depends on the incorporation of feedback, the results of this research also offer stakeholders practical suggestions for delivering effective feedback.

4.2 Introduction

The entrepreneurial process is paved with obstacles (Van Gelderen et al., 2011), and being rejected by investors, customers, business partners, or co-founders is a common phenomenon (Mason et al., 2017). Entrepreneurs are not spared from rejection. From a social-psychological

perspective, rejection is painful regardless of who it comes from (Shapiro et al., 2010), and it affects one's emotions, thinking, behaviors, and physical health (DeWall & Bushman, 2011; Weir, 2012). Thus, being rejected has emotional and psychological repercussions (Leary, 2015) that lead to lower self-esteem (DeWall & Bushman, 2011) and feelings of aggression, hostility, emotional unavailability, solitude, or social anxiety (London et al., 2007; Wiesenfeld et al., 2008).

Rejection cognitively interferes with the execution of intellectual tasks, while physically, rejection can lead to insomnia or influences one's immune system (Weir, 2012). Day (2011) argued that rejection in an academic context threatens one's social identity, while other researchers have reported a feeling of physical and affective numbness after being rejected (Gerber & Wheeler, 2009).

Within this research, we seek to understand the entrepreneurial cognitive processing and decisions of student entrepreneurs after receiving rejections from key financial sources. Insufficient resources represent a pivotal barrier in business venturing (Robertson et al., 2003; Kollmann et al., 2017) and is the primary reason for the failure of young firms (Atsan, 2016). Therefore, raising capital is critical to beginning the venturing process (Buttner & Rosen, 1992). However, most entrepreneurs fail to receive monetary support from investors (Mason & Harrison, 1996; 2003), and empirical studies have reported that female entrepreneurs face a higher rejection rate (Pellegrino & Reece, 1982; Buttner & Rosen, 1992). Therefore, the present study focuses on the consequences of financial rejection.

Rejection is referred to "'bad news' messages" (Jablin & Krone, 1984, p. 388, original emphasis). We conceptualize entrepreneurial rejection as the communication of negative feedback regarding a business opportunity by a key source. Negative feedback entails the information that a goal has not been achieved (Klein, 1989). Other studies have implied that repeated failure to meet standards will result in the withdrawal of goals (Campion & Lord, 1982). Prior work on feedback has revealed its impact on self-efficacy (Bandura, 1986; Karl et

al., 1993), self-identity (Sutton & Gill, 2010; Martins & Carvalho, 2013), self-esteem (Brockner et al., 1987), attention (Carver & Scheier, 1981), attributional style (Liden & Mitchell, 1985), cognitive processing (Ingram, 1984), and action strategies (Ilgen & Davis, 2000). A body of literature has also argued that the triggering effects of feedback, particularly negative feedback, depend on two central factors: the *source* and the *type* of feedback. The perceived credibility of the feedback source determines the feedback's acceptance (Ilgen et al., 1979): the higher the credibility of the feedback provider, the stronger the feedback's effects on the recipient's satisfaction and performance (Podsakoff & Farh, 1989). Past research has also examined the relevance of how feedback is designed. For instance, Shepherd and Zacharakis (2002, p. 15) emphasized the potential of cognitive feedback and argued that venture capitalists (VCs) "rarely use cognitive feedback and are thus missing opportunities. With more and more applicable research, we might be able to establish the benefits from cognitive feedback to VCs and thereby encourage its use in their training programs."

Only isolated studies have examined entrepreneurial rejection. Previous studies have investigated the rejection female entrepreneurs face, including gender bias in the funding decisions of loan officers (Pellegrino & Reese, 1982; Buttner & Rosen, 1992), while other studies have examined the criteria business angels use for determining whether an opportunity is rejected (Carpentier & Suret, 2015; Mason & Harrison, 1996; Croce et al., 2017). This study focuses on the recipients of rejection from a financial source. We consider this study to be an addition to the previous discourse, since we analyze how entrepreneurs perceive rejection received from venture capitalists and how this rejection affects the continuing process of opportunity exploitation. Although rejection is a common experience in practical entrepreneurship, to the best of our knowledge, this concept has yet to be explored within entrepreneurship research. Therefore, with this research, we hope to make four contributions.

First, our study examines entrepreneurial rejection, which has only received minor attention in entrepreneurship research, as a form of negative feedback and discusses this subject using feedback theory (Ilgen et al., 1979; Balzer et al., 1989; Brehmer, 1995). While the discourse of entrepreneurship research on cognition and decision includes entrepreneurial crises and obstacles (e.g., Cope, 2011; Björklund et al., 2020; Brown & Rocha, 2020), rejection as an obstacle in the venturing process has not been included in the discussion. Thus, we aim to initiate both the discussion on entrepreneurial rejection, in general, and to help identify the promoting and hindering factors on the process of opportunity recognition and exploitation.

Second, the discussion of rejection within the socio-psychological domain, which often focuses on peer rejection, has a negative connotation. In this manuscript, we reflect on rejection from a learning-based perspective. This perspective allows us to interpret rejection as performance-related information that offers learning opportunities, and we hope it opens novel research possibilities. With our research, we further aim to contribute to the field of entrepreneurial rejection by shedding more light on individuals' cognitive and behavioral responses.

Third, we intend to make practical contributions to entrepreneurship. We intend to provide insight into how to prepare constructive feedback, even if it is of a negative nature, that is perceived by the recipient as a learning opportunity and that remains in one's memory. Furthermore, our findings provide an explanation of how source credibility and feedback type can generate acceptance and affect causal attribution. We hope that these results are insightful to educators and teachers of entrepreneurship, as well as investors and accelerator programs.

Fourth, this study contributes to entrepreneurship education research by exploring the entrepreneurial responses of student entrepreneurs. Entrepreneurial education programs at higher institutions aim to sensitize students and faculty-led start-ups toward entrepreneurship, as well as to equip them with entrepreneurial skills (Bae et al., 2014; Oosterbeek et al., 2010), and are a central contributor to economic growth and social development (Maniam & Everett,

2017). However, “despite its importance, student and graduate entrepreneurship at universities has received limited scholarly attention” (Beyhan & Findik, 2018, p. 1346). Studies have also revealed that focusing on entrepreneurial education provides implications to the building of entrepreneurial intention (Zhang et al., 2014; Dutta, et al., 2011).

To address these issues, we conducted two consecutive experiments. First, we analyzed the impact of perceived source credibility and feedback type on entrepreneurial decisions and attribution using an online experiment with a sample of 125 respondents. Second, we examined their effects on individuals’ perceptions and retentions of feedback through an eye-tracking experiment with a sample of 38 participants. In both experiments, students of entrepreneurship were selected as participants. The venture creation process starts from the moment a person invests time and resources into creating a business. Engaging in entrepreneurial activities (e.g., opportunity recognition and exploitation) is fundamental for nascent entrepreneurs (Wagner, 2006). A relevant group of nascent entrepreneurs are academic-led start-ups founded by students and faculty members of higher institutions (Drnovšek & Glas, 2002). Hemmasi and Hoelscher (2005) argue that students serve as proxies for actual entrepreneurs and their findings suggest that those students identified as having high entrepreneurial inclinations show similarity to actual entrepreneurs. Therefore, students of entrepreneurship are a promising group for entrepreneurship research. Entrepreneurship education at higher education institutions has the potential to promote pre-launch-related activities by offering students a setting to develop and test their business ideas. However, the literature also postulates that those entrepreneurs in the pre-launch stage of the venture process face rejection more frequently.

Our results reveal that the perceived credibility of sources impacts behavioral responses. Respondents who received cognitive feedback showed a higher acceptance of feedback. Participants who perceived the source of feedback to be credible were more likely to accept the rejection and withdraw the business opportunity. Furthermore, these participants also tended to use internal attribution to explain the rejection. The results regarding perception and retention

reveal that participants pay more attention to feedback sources with higher credibility. Additionally, the retention of cognitive feedback was higher compared to that of outcome feedback.

4.3 Theoretical Foundations and Hypothesis Development

4.3.1 Credibility of Source

4.3.1.1 Effects on Entrepreneurial Cognition and Decisions

Mainstream entrepreneurship research investigates factors that promote the entrepreneurs' decision to exploit business opportunities (Choi & Shepherd, 2004), and minor attention has been paid to factors that hinder the exploitation of opportunities. Constant rejection represents an impediment that may affect the decision to withdraw a business opportunity. The nature of the behavioral response to (negative) feedback depends on whether the recipients perceive the feedback source as credible or not. Feedback is given by "one's superior or peer," and its acceptance depends greatly upon its perceived credibility (Ilgen et al., 1979). Existing literature documents the influence of the perceived credibility of the feedback provider on the recipient's cognitive, emotional, and behavioral responses (Podsakoff & Farh, 1989, p. 46). While positive feedback is perceived as accurate and triggers a feeling of satisfaction (Stone & Stone, 1985), negative feedback causes dissatisfaction and is perceived by the recipient as less accurate (Ilgen et al., 1979; Taylor et al., 1984).

To form an impression and judgment, people rely on cues that prompt them "to attribute expertise to a source, regardless of the quality of the information he or she offers" (Willemsen et al., 2012, p. 18). The recipient of the feedback "combines information provided by one or more sources to make an overall evaluation or judgment" (Birnbaum & Stegner, 1979, p. 48). The pragmatic problem is to effectively evaluate who can provide the most reliable and valid information about those aspects of the world that one cannot directly experience by his or herself. Researchers have shown that people lean on experts' conclusions in issues beyond their

abilities (Petty et al., 1981; Ashford, 1986; Ashford & Tsui, 1991). Recipients tend to evaluate sources' expertise based on their skills, competences, knowledge, and experience to form a judgment and make a decision (Ohanian, 1990). Willemsen et al. (2012) also argued that having (formal) training or a hobby relevant to a subject increases the source's likelihood of being perceived as an expert. Studies have shown that peripheral cues, such as source characteristics (e.g., trustworthiness, expertise), also have persuasive effects (Sternthal et al., 1978a; 1978b; Wiener & Mowen, 1986; Smart & Fejer, 1972; Lupia, 2000). Birnbaum and Stegner (1979) understood credibility as "believability," which depends on expertise, bias, and perspective. People seek guidance from sources that they perceive to be credible (Botero et al., 2015), and credibility is mostly defined by qualifications (Smart & Fejer, 1972), in terms of expertise (Lupia, 2000). Besides expertise, the factor of source trustworthiness is central to credibility, but it is also more difficult to assess and is usually "determined by attributions about the motives of a source to share particular information" and defined through causal inferences (Willemsen et al., 2012, p. 18). Past research has suggested that feedback and the credibility of feedback providers affect individuals' affective states, goal determinations, and eventually, performances (Podsakoff & Farh, 1989). Other studies have even shown that source credibility has a strong impact on attitude changes (Andersen & Clevenger, 1963; Schulman & Worrall, 1970).

In entrepreneurship, business angels' expertise and experience are highly relevant factors affecting the entrepreneur's decision of who to choose as a mentor, an investor, and a business partner (Macht & Robinson, 2009; Ramadani, 2009; Politis, 2008). The more credible a feedback source is perceived to be, the stronger the effects their feedback has on the entrepreneur's satisfaction and performance (Podsakoff & Farh, 1989). The opposite is also true; a lack of credibility can reduce the effects of the feedback on performance and lower satisfaction. Thus, we assume that the perceived expertise and trustworthiness of an entrepreneurial source are strong persuasive cues for credibility that influence entrepreneurs' behavioral responses. Furthermore, we expect that entrepreneurial sources being perceived as

highly credible will lead to higher agreement with the feedback provider, and subsequently, to the withdrawal of the business opportunity.

- **Hypothesis 1A.** Nascent entrepreneurs who receive negative feedback on the business model from a highly credible entrepreneurial source are more likely to show a higher acceptance of the feedback**.**
- **Hypothesis 1B.** Nascent entrepreneurs who receive negative feedback on the business model from a highly credible entrepreneurial source are more likely to withdraw from their business opportunities.

4.3.1.2 Effects on Entrepreneurial Attribution

Being a recipient of rejection evokes the question of "why" one is being rejected. Receiving negative feedback in the form of a rejection initiates the process of sense making. Attribution theory is built on the premise that people want to identify explanations for unexpected and negative events that have occurred (Wiener & Mowen, 1986). According to the attribution theory (Weiner, 1980), which focuses on the individual's process of understanding achievement-related outcomes (i.e., success and failure), individuals tend to discover causal explanations between specific events (Rogoff et al., 2004). In particular, for unexpected or negative events, people seek to understand the source of an outcome (Gerace, 2020). The literature proposes that male and female entrepreneurs attribute the source of rejection differently (Hisrich & O'Brien, 1982; Pellegrino & Reese, 1982). However, the study of Buttner and Rosen (1992) refutes this claim. They found that men attribute rejection to factors such as insufficient collateral and inability to develop good chemistry, whereas women attribute rejection to bad timing and insufficient collateral (Buttner & Rosen, 1992). Furthermore, they also found that female entrepreneurs do not perceive there to be an existing gender bias (Buttner & Rosen, 1992). These findings suggest that both male and female entrepreneurs highly rate an external attribution (e.g., bad timing) as the source of rejection (Buttner & Rosen, 1992).

Attributions offer implications on how the entrepreneur might cope with venture failure (Zacharakis et al., 1999). Although the influencing factors on the attribution of entrepreneurial

rejection have not been explored, accounting research provides indications on this subject. Whether the cause of a rejection is attributed internally or externally depends on the credibility of the feedback provider. Cook (1969) reported evidence that counter-argumentation is a less common reaction toward highly credible sources. More specifically, when the initial opinion was negative, the persuasion effect had an impact for highly credible sources (McGinnies, 1973). Accounting research has posited that the judgment of jurors in an audit litigation setting depends on whether or not the defendant is perceived to be a specialist. Studies have proposed that the attribution of blame is reduced if the jurors perceive the defendant to be competent, in terms of displaying greater knowledge and expertise (Brandon & Mueller, 2008; Sonnier et al., 2015). However, there is a threat that the attribution of outcomes will be affected by perception errors and biases (Fiore & Lussier, 2015). For instance, Fiore and Lussier (2015, p. 171) found evidence for a fundamental attribution bias, "the naturally occurring bias of humans to over-attribute business success to celebrity-entrepreneur disposition." This indicates the tendency to overrate a person, which leads one to attribute their business success to entrepreneurial dispositions (e.g., ability, traits, attitude) and overlook situational and circumstantial explanations (Fiore & Lussier, 2015).

Based on these studies, we assume that perceived higher source credibility will increase the likelihood of feedback being assessed as valid and encourage the recipients to rethink their business ideas. On the other hand, a low credibility of the feedback source will lead recipients to disregard criticism and look for explanations for rejection outside of their ideas. Therefore, individuals who perceive a source to be highly credible are more likely to agree with the negative feedback delivered and, in turn, will seek causal explanations for the feedback that lie within themselves. Hence, the high perceived credibility of a source is more likely to increase the likelihood for an internal attribution.

- **Hypothesis 1C.** Nascent entrepreneurs who receive negative feedback on a business model from a highly credible entrepreneurial source are more likely to internally attribute the cause of the rejection.

4.3.1.3 Effects on Entrepreneurial Perception and Retention

The literature has conceptualized attention as contingently selective processing, also referring to an individual's attention (Rensink, 2013). Paying attention is the control of one or more selective processes (Rensink, 2013); it defines what information is remembered and influences the learning process. Empirical results in the domain of market research have indicated that a correlation exists between the credibility of brands and the attention given to their products (Junior Ladeira et al., 2020). The higher the credibility, the more attention is invested. Therefore, we assume that high credibility will increase attention paid to the feedback provider.

The information processing model, which is relevant due to the insight it offers into the interplay between mind and action, is the *theory of action identification*; it proposes a deep and reciprocal connection between people's thoughts and their actions, emotions, and self-concepts (Wegner & Vallacher, 1986). The theory distinguishes between lower-level and higher-level identities (Vallacher & Wegner, 2012). Lower-level identities indicate the performance of an action by including details or specifics about the action, whereas higher-level identities provide explanations for why an action is performed or for its effects and implications (Vallacher & Wegner, 2012, p. 331). Past literature has suggested that feedback is able to affect people's self-assessments (Felson, 1989). However, people strive to maintain their self-concepts (Tesser & Martin, 1996). This means that feedback that is incongruent with individuals' self-concepts existing in their high-level identities is likely to be discounted (Vallacher & Wegner, 2012). High-level identification serves as a shield against feedback that is incongruent with one's high-level perspective of his or her behavior. Thus, self-concept at high-level identification is stable and difficult to change (Vallacher & Wegner, 2012). Negative feedback heightens the recipient's focus on task processes and meta-processes that evoke the feeling of being threatened (Kim & Kim, 2020). Based on the literature, we assume that negative feedback provided by a source of high perceived credibility interferes with high-level identities, since it prompts reflection and has implications for the self. Therefore, this feedback has the potential

to intensify the locus of attention paid to the feedback source (Kim & Kim, 2020). We expect the feedback of sources that are perceived to be highly credible to be fixated upon longer than that of sources with low perceived credibility. The longer fixation will consequently lead the recipient to remember more information.

- **Hypothesis 1D.** Nascent entrepreneurs who receive feedback on their business models from a highly credible entrepreneurial source pay more attention to the information of the feedback provider.
- **Hypothesis 1E.** Nascent entrepreneurs who receive feedback on their business models from a highly credible entrepreneurial source are more likely to recall feedback information.

4.3.2 Types of Feedback

4.3.2.1 Effects on Entrepreneurial Cognition and Decisions

How the recipient processes feedback depends on the nature of the feedback (Ilgen & Davis, 2000). Feedback type can affect a person's perception of the feedback, the processing of the feedback, and the potential to trigger learning (Hattie & Timperley, 2007). For instance, negative feedback does not immediately function as a reinforcer of future action (e.g., improvement of performance; Kluger & DeNisi, 1996); rather, the effects depend on the feedback's content (Balzer et al., 1989). Feedback that not only informs learners about the correctness or incorrectness of their performance, but also provides elaborate explanations, inspires them to reflect on outcomes, results in higher acceptance, and helps learners to develop a deeper conceptual understanding (Bangert-Drowns et al., 1991; Dempsey et al., 1993). To be effective, feedback must be cognitively processed (i.e., perceived, understood, integrated, and employed) by its recipients (Ingram, 1984).

Feedback research draws a distinction between cognitive and outcome feedback both—feedback types provide performance-related information, but the content of the feedback is presented differently (Balzer et al., 1989; Brehmer, 1995). Outcome feedback provides performance-oriented information that is related to an "objective" standard that is taken as a

given (Brehmer, 1990; Sterman, 1989). This feedback type is not context-related and solely includes information on the achieved score (Haynie et al., 2012). Therefore, outcome-based feedback does not provide information about "the relationship between individual performance, the task, and subsequent adaptation" (Haynie et al., 2012, p. 243). Researchers claim outcome-based feedback is sub-optimal for dealing with "complex or dynamic tasks" (Haynie et al., 2012, p. 243) and that such a provision of feedback information without cues and relations to performance can cause detrimental effects in terms of worsening performance (Castellan, 1974; Lerch & Harter, 2001). Haynie et al. (2012) investigated the impact of feedback type on cognitive adaptability within the field of entrepreneurship. The study confirmed that cognitive feedback, compared to outcome-based feedback, is more likely to promote "normative improvements in decision accuracy" in a dynamic task.

In contrast, cognitive feedback aims at summarizing, specifying, and explaining aspects of work (Lu & Law, 2012). Cognitive feedback is constructed through performance-related information, the explication of arguments and comments, and the identification of problems, as well as the provision of solutions (Lu & Law, 2012), and is, thus, considered an effective learning tool (Shepherd & Zacharakis, 2002; Nelson & Schunn, 2009). Cognitive feedback provides three types of information: (1) it describes the prescriptive deviance between the required criteria and the decision outcome (task information); (2) it offers an explanation about the decision policy and the decision outcome (cognitive information); and (3) it gives task-related feedback and explains the decision-making process (functional validity information) (Haynie et al., 2012, p. 244). These types of information help the feedback recipient understand and accept the decision outcome (Haynie et al., 2012; Shepherd & Zacharakis, 2002). Carlson (1995) argued that people are more likely to accept information when they understand its content. Despite the superiority of cognitive feedback over outcome-based feedback, the latter is primarily used by venture capitalists to make investment decisions (Shepherd & Zacharakis, 2002). Since the ability to introspect is limited in most people (Zacharakis & Meyer, 1998),

Shepherd and Zacharakis (2002) argue that venture capitalists can derive greater benefit from cognitive feedback by knowing the process used to make a decision or series of decisions, including an explanation for how that process arrived at the specific decision.

Many studies have determined that outcome-based feedback is less effective than cognitive feedback, particularly in terms of triggering a behavioral change for improving performance (Castellan, 1974; Lerch & Harter, 2001; Haynie et al., 2012). Studies have showed greater performance improvement is triggered from cognitive feedback (Remus et al., 1996). Furthermore, Waldman and Atwater (2001) showed that managers who receive lower subordinate ratings tend to seek additional, clarifying feedback. Therefore, we presume that cognitive feedback makes it easier for recipients to understand the need for improvement and to accept that the business opportunity is currently not convincing. That is, recipients are more likely to agree with the reviewers' criticism and rejection when they receive cognitive feedback. Such feedback can lead entrepreneurs to critically reconsider the business opportunity, increasing the likelihood of a business withdrawal.

- **Hypothesis 2A.** Nascent entrepreneurs who receive cognitive feedback on their business models exhibit greater acceptance of feedback.
- **Hypothesis 2B.** Nascent entrepreneurs who receive cognitive feedback on their business models are more likely to withdraw their business opportunities.

4.3.2.2 Effects on Entrepreneurial Attribution

Trying to find reasons and explanations for negative feedback on one's performance is part of the search for closure. Askim and Feinberg (2001) argued that attributions affect entrepreneurs' future decisions and behaviors. Identifying the factors and causalities responsible for business successes or failures promotes learning. As Ford (1985) found, "attributing the cause of business failure is a mental process producing cognitive, affective, and behavioral outcomes for failed entrepreneurs." For entrepreneurship, the attribution process occurs through the interaction between an entrepreneur and his or her environment (Kelley & Michela, 1980).

Yamakawa and Cardon (2015) examined the interplay between failure ascriptions and the perception of learning. The study indicates that for entrepreneurs, unstable internal attribution enhances the perception of learning. Stable external attribution of business failure, on the other hand, is perceived as having less potential for learning and increases the tendencies of entrepreneurs abandon the entrepreneurial career path. In a related context, Walsh and Cunningham (2016) provided evidence that internal attribution of failure triggers an entrepreneur's affective response, which includes a deep, personal learning about oneself. External attribution can promote learned helplessness, since the controllability of the situation is restricted.

Feedback type can have an influence on the attribution process (Hareli & Hess, 2008). The literature has posited that cognitive feedback has the potential to stimulate learning and performance improvement (Lopes et al., 1997). Investigation of venture capitalists' decision processes proposes that "cognitive feedback helps people come to terms with their decision environment" (Shepherd & Zacharakis, 2002, p. 15). Cognitive feedback contains the decision-maker's cognitive processes. Based on this view, we assume that cognitive feedback offers implications for self-improvement and, thus, has the potential to prevent learned helplessness. Hence, we expect that cognitive feedback favors an internal attribution of rejection.

- **Hypothesis 2C.** Nascent entrepreneurs who receive cognitive feedback on their business models are more likely to internally attribute the rejection.

4.3.2.3 Effects on Entrepreneurial Perception and Retention

As mentioned, the cognitive processing of feedback is not limitless: individuals can only process a finite amount of information at a given time (Ingram, 1984). Information processing requires capacity, which is restricted. Exceeding the given capacity leads to failure in processing information. Based on this research, we assume that not all information in a piece of feedback can be processed. Through a selective process, individuals pay attention to certain information. As a cognitive system, the working memory is responsible for the temporary

maintenance and processing of information. Performing everyday activities or complex cognitive activities requires the online storage and processing of different information types (Zirk-Sadowski et al., 2013).

Cognitive psychology studies have proposed that natural categories (e.g., animals, furniture) that are prototypical, distinctive, and occur frequently can be better remembered. They are referred to as "good" categories, which are easier to recall than "poor" categories (Milikowski & Elshout, 1995). Many people find it difficult to remember (a series of) numbers because, unlike words, numbers are abstract and often lack meaning. Based on these theoretical considerations, we assume numbers represented in digits fall into a "poor" category and are difficult to remember. Depending on the nature of the feedback, we expect that the feedback type will be a factor that influences the perception, processing, and retention of cognitive information. Cognitive feedback contains written explanation, and the words can be considered a "good" category. Outcome feedback, on the other hand, uses both printed words and Arabic digits to express performance-related information. For this reason, we suggest that cognitive feedback can be better remembered.

- **Hypothesis 2D.** Nascent entrepreneurs who receive cognitive feedback on their business models are more likely to recall feedback information.

4.4 Study 1 – Effects of Source Credibility and Feedback Type on Decision-Making and Attribution

4.4.1 Sample and Randomization Check

Our experiments involved 158 undergraduate students enrolled in a bachelor's degree program in business administration at a German university. The participants were recruited from an elective entrepreneurship course, as this allows us to assume they hold a sufficient degree of interest in founding a business and ensures questions would be answered with a sufficient degree of seriousness. After removing double or incomplete data, a total of 125 responses were included in the investigation. The data were collected during 2019 and 2020. Participants were

offered the opportunity to collect bonus points for their final exam. The students' average age is 22.6, and 31% of the participants are female. To investigate the research question, the nature of the feedback provider and the form of the presentation were manipulated, resulting in four potential test groups, to which the test persons were randomly assigned.

4.4.1.1 Experimental Design and Procedure

Both studies have a simulation-based experimental research design. Simulation is usually applied as a research methodology to investigate problem-solving situations (Valentin et al., 2003), as it allows the analysis of the decision-making process. This study investigates a problematic business venturing situation, wherein entrepreneurs face rejection from a financial source, and they must make venture-related decisions and provide an explanation for their choice. Thus, we chose a simulation-based experimental design as a research methodology vehicle to test our hypotheses. The study consists of an online experiment, which has gained popularity in recent years (Dandurand et al., 2008; Birnbaum, 2004), as well as a traditional eye-tracking lab experiment. The identical experimental settings used in both experiments allows us to compare the results of both, which helps to reduce external validity (Bracht & Glass, 1968).

In the online experiment, we investigated the effects of the independent variables (source credibility and feedback type) on the participants' cognitive and behavioral responses. The participants were randomly assigned to the experimental conditions, and the experiment featured neither a time restriction nor the option to go backward. This ensured that questions were answered based on the respondent's memory. The duration of the experiments lasted around 10-15 minutes. At the beginning, we asked the participants to picture themselves as the entrepreneur of a described business opportunity and to make decisions from his or her own perspective. Afterwards, we asked the participants to rate their chances to receive financial support with the business idea (manipulation check of the business opportunity). This was done

to ensure that there were no differences in the perception of the business idea that might influence the participants' reflection upon the later rejection. The respondents then received a randomized rejection; next, they were asked to evaluate the feedback provider and rate their acceptance/approval of the rejection (manipulation check of the feedback). Then, the participants were asked to make their decision whether to continue or to withdraw the business opportunity (behavioral response). Finally, participants were able to state why they believed they received the rejection (attributional response).

4.4.1.2 Measures

Stimuli. To address the criticism of realism and artificiality—the limited generalizability of results due to the realistic employment of tasks, stimuli, and settings (Smead et al., 1981; Lynch, 1982)—in the experimental design, we included practitioners of entrepreneurship in our material development process. We sent out the developed business model and the respected feedback to a group of experts (n = 6), who are all judges of business incubator and accelerator programs. The experts were asked to evaluate the business model and to provide recommendations. After receiving the experts' feedback, we adjusted our concepts and ran a pilot test with a few students. Our fictitious business opportunity is based on the real business model concept of a regional social start-up in the nutrition industry, whose business idea is to redistribute unneeded food by creating a marketplace for restaurateurs, traders, and consumers. In our experiment, the start-up is seeking financial support from a funding program that promotes innovative business ideas. Some original characteristics (e.g., name, founding year) of the start-up have been modified to prevent participants from becoming directly familiar with the existing start-up.

Attributional response. To measure attributional responses, we developed five items capturing internal (e.g., "My application is in need of improvement") and external (e.g., "The reviewer did not understand my business model") attributions of causality.

Feedback retention. We used two open-ended questions to capture the participants memories about the feedback ("What do you recall from the feedback?") as well as the feedback provider ("What do you recall about the feedback provider?").

Manipulation check. To operationalize the source credibility level, we created a feedback source who is of sufficient integrity, in terms of the length of their professional experience in entrepreneurship, age, or formal training and qualifications. Inspired by our expert group, we created two fictitious male feedback providers with varied credibility cues in order to prevent gender bias in the responses. As a manipulation check for the perception of source credibility, we applied the four scales (e.g., trustworthy vs. untrustworthy) used by Chaiken and Maheswaran (1994). To assess the attractiveness of the hypothetical business model, we applied the single-item similarly used in Haynie et al. (2010). We asked the participants to rate their chances of receiving funding for this business model using a 7-point Likert-type measure ranging from (very low) to (very high). We assessed the acceptance of the feedback using the item "To what extent do you agree with the opinion of your feedback provider?" on a 7-point Likert-scale. This manipulation check ensures that the participants' decision does not depend on the attractiveness of the business model. On a scale from 0 = "low eligibility" to 6 = "high eligibility," the test persons rated the eligibility of the business idea as slightly increased (M = 4.248, SD = 1.4461). This assessment is valid across all groups. No significant differences (F = 0.079, p = 0.972) could be detected between the four groups, so the business idea was perceived by all groups in the same way. Therefore, we assume that the randomization was successful. Table 4 shows the correlation of variables.

Table 4: Correlation of Variables

	Variable	M	SD	(1)	(2)	(3)	(4)	(5)	(6)
(1)	Gender (1=male, 0=female)	0.69	0.462						
(2)	Age	22.62	2.066	-0.05					
(3)	Credibility of Source (1=high, 0=low)	0.536	0.500	0.029	0.07				
(4)	Feedback type (1=cognitive, 0=outcome)	0.416	0.494	0.049	0.046	-0.159			
(5)	Decision (1=continue, 0=withdraw)	0.792	0.407	-0.16	-0.057	-.200*	0.073		
(6)	Acceptance (from 0=low to 6 = high)	2.776	1.502	-0.003	0.094	0.064	.181*	-.235**	
(7)	Attribution (1=external, 0=internal)	0.4	0.491	-0.079	-0.054	0.007	-.192*	0.097	-.216*

** p<0.05, **p<0.01*

4.4.2 Results and Analyses

4.4.2.1 Behavioral Response

Manipulation Check

To test the effectiveness of the manipulation, we compared groups with low or high credibility. With 55.2%, the participants attribute a lower credibility to the reviewer in the low credibility of source groups (n = 58) than in the high credibility of source groups (n = 67) with 73.1% ($t = 2.118$, $p < 0.05$). With 27.6% agreement, the respondents in the low credibility of source groups also rated the expertise of their reviewer significantly lower than the respondents in the high credibility of source groups, which had 65.7% agreement ($t = 4.559$, $p < 0.01$). Thus, the manipulation of the credibility of source groups along the above-mentioned criteria was successful and can be included as an independent variable in the remainder of this study.

4.4.2.2 Effects of Source Credibility

To investigate the effectiveness of the manipulation with respect to the acceptance of the feedback, the attribution of the feedback, and the decision to further pursue the business model, a repeated two-factor analysis of variance (ANOVA) was performed between the groups (see Table 5). The ANOVA indicates that source credibility has an effect on the decision to continue pursuing the business opportunity ($M = 0.716$ in the high credibility of source group, $M = 0.879$ in the low credibility of source group, $F = 5.133$, $p < 0.05$) (see Table 5). This result supports hypothesis 1B. Furthermore, feedback from a highly credible source receives a higher level of agreement as well as triggers an external attribution ($M = 0.417$). However, the effects of the credibility of source manipulation are not significant; therefore, hypotheses 1A and 1C cannot be confirmed.

Table 5: ANOVA of Credibility of Source (CoS)

Variable	**Manipulation**	**N**	**M**	**SD**	**F-value, p-value**
Decision (0=withdraw, 1=continue)	CoS-Low	58	.879	.328	F=5.133, p=.025
	CoS-High	67	.716	.454	
Attribution (0=internal, 1=external)	CoS-Low	58	.413	.496	F=0.12, p=.912
	CoS-High	67	.417	.496	
Agreement with Feedback (from 0=strongly disagree to 6=strongly agree)	CoS-Low	58	2.67	1.583	F=.513, p=.475
	CoS-High	67	2.866	1.434	

4.4.2.3 Effects of Feedback Type

To investigate the effect of feedback type, we conducted a manipulation across the groups according to the methodological considerations. One group received cognitive feedback in the form of a written explanation including the source's rationale for their rejection of the business idea, while the other group received outcome feedback with their achieved scores. Here, the effects were also analyzed using a repeated measures ANOVA, in which significant differences

were identified in the acceptance of the feedback and in the feedback attribution (see Table 6). The subjects of the cognitive feedback group showed a higher feedback acceptance rate (M = 3.096) than the subjects of the outcome feedback group (M = 2.548; F = 4.148, $p < 0.05$). In addition, the cognitive feedback group also appears to have a higher internal attribution (M = 0.479) than the outcome feedback group (M = 0.288; F = 4.716, $p < 0.05$). These results support hypotheses 2A and 2C. Regarding the entrepreneurial decision to terminate or to pursue the business idea, however, no significant effect of the feedback type manipulation can be determined. Although the cognitive feedback group shows a stronger adherence to the business idea, the observed difference is not significant. Consequently, we cannot confirm hypothesis 2B.

Table 6: Effects of Feedback Type

Variable	**Manipulation**	**N**	**M**	**SD**	**F-value, p-value**
Decision (0=withdraw, 1=continue)	Outcome	73	.767	.425	F=.652, p=.421
	Cognitive	52	.827	.382	
Attribution (0=internal, 1=external)	Outcome	73	.479	.503	F=4.716, p=0.032
	Cognitive	52	.288	.457	
Agreement with Feedback (from 0=strongly disagree to 6= strongly agree)	Outcome	73	2.548	1.500	F=4.148, p=0.044
	Cognitive	52	3.096	1.458	

4.5 Study 2 – Exploring the Effects of Source Credibility and Feedback Type on Information Processing and Retention

4.5.1 Methodology and Experimental Design

4.5.1.1 Sample

In the second study, we conducted a laboratory eye-tracking experiment. The sample included German undergraduate students who were recruited from multiple mandatory and elective entrepreneurship courses. The students were enrolled in the undergraduate business administration program, and participants were offered the chance to collect bonus points for

their final exam. The data were collected at the beginning of 2020. 38 students participated in the second experiment, and 42% of the participants were female. Most respondents were undergraduates from the business college (73%), and the graduate student participants were enrolled in the teaching college, with a major in business (27%).

4.5.1.2 Measures and Procedure

The second study aims to explore the participants' information processing. Previous studies have suggested that tracking the eye-movements of participants provides insight into their cognitive processes (e.g., visual attention) (Egner et al., 2018; Armstong & Olatunji, 2012; Gidlöf et al., 2013). Thus, we employed an eye-tracking technique to identify participants' perception and strategies for scanning, reading, and processing the rejection. Using identical stimuli to the first experiment, we extended the first study by including two further questions: *1)* explain the decision to pursue or abandon the business venture, and *2)* recall information about the feedback and feedback provider. Eye-tracking methodologies are a promising approach because gaze can be used as a proxy for students' attention (Egner et al., 2018; Liu & Heynderickx, 2009). Eye tracking enables detailed moment-by-moment observations of participants' interaction with rejection. The data was recorded by a Tobii X3 120 Hz infrared eye-tracker, while the stimuli were presented on a 24" monitor.

Before starting the experiment, participants were informed about the eye-tracking measurement and received instructions on how to complete the expected task. As in the first study, respondents were negatively evaluated and rejected by a financial investor. Since this study is a simulation scenario, we asked the respondents to imagine themselves being in the described business venture situation and to make decisions from their own perspective. Furthermore, the participants were instructed to read at their normal rate, and there were no time limits or time-related effects. After the calibration procedure, participants could

autonomously navigate through the simulation. They could make decisions using the mouse key and provide written answers using the keyboard. The experiment lasted around 15 minutes.

4.5.1.3 Results Analysis

The respondents' written explanations were collected and prepared into computer files. Following the coding of Miles et al. (2014) and Gioia et al. (2013), two researchers independently conducted two cycles of coding. First, we identified reasoning patterns and coded the qualitative data into relevant categories (e.g., sustainable business idea), which represent the first-order concepts. Second, the patterns were clustered into superordinate categories (e.g., rejection is part of entrepreneurship), which are called second-order themes (Gioia et al., 2013; Corley & Gioia, 2004). After each cycle, the results coded by both researchers were compared and discussed.

4.5.2 Results and Analyses

4.5.2.1 Categories of Explanation

After the respondents chose whether to continue or withdraw their business opportunity, we asked them to provide an explanation for their decision. For the respondents in the high credibility of source group, the data analysis revealed four categories of rationales among those who decided to continue pursuing the business opportunity: *social value*, *rejection is part of the venturing process*, and *positive interpretation*. In contrast, respondents in the low credibility of source group argued that they *do not accept the feedback* and they *disagree with the negative feedback* or *the feedback provider* (see Table 7). However, respondents in the high credibility of source group who decided to withdraw the business opportunity either *directly agreed* with the feedback provider and perceived him as an expert, or they *indirectly agreed* with the feedback provider by repeating some critical aspects of the feedback. In contrast, respondents

in the low credibility of source group who decided to withdraw explained that they decided to withdraw *based on their own analysis*.

The results for outcome feedback showed that respondents who decided to continue with the business opportunity saw less learning potential in the feedback received. Furthermore, the participants who decided to withdraw the business opportunity were less likely to agree with the feedback provider, did not repeat the feedback provider's arguments, and were discouraged by the negative feedback.

Table 7: Category of Explanation for Entrepreneurial Decision

Explanation for business continuation	**Description**	**Representative quotation**
Social value	Focus of argumentation is on the value that the business opportunity creates	"*Food has a great social importance, especially in developing countries. The idea provides a good solution to the problem of throwing away food. It also involves many partners who, in turn, have great economic interest.*"
Part of the venturing process	Being rejected is considered a natural part of entrepreneurship	"*One must not be led discouraged by a rejection from strangers*."
Positive interpretation	Rejection is considered as a learning experience	"*I work through the individual points of criticism and improve the business concept.*"
Disagreement	Rejection of the negative feedback or feedback provider	"*The feedback is not comprehensible.*"
Explanation for business withdrawal	**Description**	**Representative quotation**
Agreement	Expressing direct agreement with feedback provider or directly by using argument of the feedback provider	"*I'm withdrawing because the reviewer who gave the feedback seemed to me to be very competent. The statements sounded very plausible and comprehensible.*" "*The existing competitive situation in the market is the decisive factor for the withdrawal of my business model.*"
Own analysis	Decision based on their own analysis	"*For me, the economic benefit is the main focus of a business model at the current time*."
Discouraged	The negative feedback causes discouragement by participants	*"It was quite clearly below the average*."

4.5.2.2 Credibility of Source – Information Processing

Heatmap representations are widely used to dynamically visualize the area of interest. Heatmaps are typically represented through aggregated fixations of several individuals (Drusch et al., 2014). In the current study, we intended to understand attentional processes in response

to negative feedback. The comparison of respondents' visual attention requires a low-level of stimulus' variation (see Valuch et al., 2015). Due to the high variation of the representation of feedback type stimuli, the comparability of data was difficult. Therefore, we only focused on comparing the visual attention of the source credibility stimuli. In the present study, the heatmap results indicate differences in the perception of information based on the credibility of the feedback source. Figure 10 illustrates the intensity with which the information about the feedback provider is read by the participants. The findings revealed that participants viewed information about the highly credible source much more intensely than they read information about the source with low credibility. This confirms hypothesis 1D. In particular, information about the source's entrepreneurial experience attracted the participant's attention in the high credibility of source manipulation. In the low credibility of source manipulation, participants focused on the educational attainment of the feedback source.

Figure 10: Participants' Focus on Information about Feedback Provider

Note: Conditions with high credibility of source (left) and low credibility of source (right). Reading intensity based on fixations, intensity reaches from low (green) to high (red).

In fact, the distribution of attention between the groups was examined inferentially, with mean-differences between the groups, and found to be significant ($T = 2.654$, $p = 0.011$). This underlines the support for hypothesis 1D again (see Table 8). The effect of group affiliation can be classified as weak at 0.16 (interaction effect). Furthermore, the time to first fixation for the low credibility of source manipulation was 6 seconds, whereas the same for the high credibility

of source manipulation was 12 seconds (sig. 0.036). This means that the amount of time it takes respondents to look at the specific information about the source's credibility, from stimulus onset, is faster for the high credibility of source group than for the low credibility of source group.

Table 8: Distribution of Attention of Information about Feedback Provider

	Manipulation	**N**	**M**	**SD**	**T-value, p-value**
Distribution of Attention to feedback provider information (in % from total attention on the feedback)	High	20	7	0.3	T=2.654, p=0.011
	Low	18	4.2	0.2	

4.5.2.3 Recall of Information about the Feedback and the Feedback Source

To analyze the recall of the feedback, the written response of participants was assigned to previously defined categories (business model, business industry, person-related information, and others). Results from the group with cognitive and outcome feedback stimuli show that information about the business model was easiest to retain. In particular, the competitive market situation, as a market-based obstacle, was easily remembered. In the cognitive feedback manipulation, information about the business industry was the second easiest to remember. In contrast, person-related information such as personality could be recalled in the outcome feedback stimuli. This result corresponds with the results of the heatmap. In general, outcome feedback seems to be less memorable than cognitive feedback, which supports hypothesis 2D. Respondents were able to recall the average overall performance or the best and worst scores, but they did not remember specific categories or performance scores (see Table 9).

Table 9: Retention of Feedback Type

Cognitive Feedback	**Frequency**
Business model	34
Business industry	19
Person-related information	14
Others (e.g., rejection, high competition)	4
Total	71
Outcome Feedback	**Frequency**
Business model	24
Business industry	0
Person-related information	21
Others (e.g., under average scores)	21
Total	66

Besides the retention of the feedback type, we analyzed the recall of information about the feedback provider. In general, participants could recall information about the highly credible source, in terms of frequency and precision of data (verbatim), better than information about the source with low credibility. Respondents in the low credibility of source group also showed more erroneous recall of information, or they showed an inability to recall information. These results support hypothesis 1E. Students in the high credibility of source group mostly recalled the fact that the feedback provider has already founded two start-ups. This corresponds the heatmap results, which shows that the participants focused on the start-up and business venturing experience of the feedback provider. For the low credibility of source group, respondents mostly remembered information about the educational attainment of the feedback provider, as well as his name and age (see Table 10).

Table 10: Retention of Credibility of Source

High Credibility of Source	**Frequency**
▪ name and age.	12
▪ has been a member of the jury of many renowned start-up programs for over 10 years.	4
▪ has been coaching and supporting start-ups for over 25 years.	7
▪ founded 2 successful start-ups on his own, one of which he sold for several million euros to a medium-sized company.	21
▪ is mentor, investor and business angel of more than 15 start-up projects.	10
▪ is a member of several supervisory and advisory boards of large corporations.	4
▪ runs workshops and regularly gives speeches and lectures on the topic of entrepreneurship.	7
Total	65
Low Credibility of Source	**Frequency**
▪ name and age.	12
▪ recently became a start-up consultant at a start-up institute.	1
▪ studied business with a focus on human resources & organization.	13
▪ the topic of entrepreneurship has interested him since his time as a student.	6
▪ took several entrepreneurship courses during his program of study.	10
▪ currently attends continuing education courses on the topic of entrepreneurship (including digital entrepreneurship).	2
▪ is a member of the Association of Founder Scouts.	5
Total	49

4.6 Overall Discussion

Our findings indicate that source credibility has an effect on entrepreneurial decision-making. Participants who perceive the feedback source as highly credible are more likely to withdraw their business opportunity after receiving a rejection for financial support. Hence, we can assume that feedback from highly credible sources is slightly more persuasive, while a perception of low source credibility tends to encourage entrepreneurs to continue pursuing their business venture. This finding confirms the results of prior work investigating this effect in other disciplines (Dholakia & Sternthal, 1977). In entrepreneurial mentoring, credibility and personal interest in the start-up are crucial attributes of mentors, and novice entrepreneurs consider them to be critical to the relationship's success (Audet & Couteret, 2012; McKevitt & Marshall, 2015; Ting et al., 2017). Our results reflect this by showing that high perceived credibility has a slight advantage in terms of receiving higher acceptance and follow through. This effect is also reflected in respondents' rationale for withdrawing the business opportunity. They more strongly agree with the perceived high-credibility source than do respondents

receiving feedback from a source with low perceived credibility. Additionally, these findings imply that high source credibility triggers an external attribution. Anderman and Midgley (1998) suggested that people tend to attribute positive feedback to the self (i.e., the person's ability), while negative feedback tends to be attributed to facts outside of the self. Analogous to Buttner and Rosen's study (1992), external attribution (e.g., bad timing) was also favored by entrepreneurs in this study. However, the difference between high and low source credibility is so marginal that we are cautious about attributing an interplay between credibility of source and attribution.

Regarding the feedback type manipulation, we identified a higher acceptance and a higher tendency for internal attribution among participants receiving cognitive feedback. Respondents that received cognitive feedback often argued that it provides information for learning and improvement; as a result, the rejection is perceived as something positive. This corresponds with Shepherd and Zacharakis's (2002) suggestion that cognitive feedback allows for a better understanding of a negative outcome because it is accompanied by an explanation of the decision policy, the decision outcome, and the decision-making process (Haynie et al., 2012, p. 244). We expected that this eventually leads to feedback acceptance and stimulates reflection and learning, which consequently results in the recipients locating the cause of negative outcomes within the person. The understanding and acceptance of cognitive feedback might also explain respondents' higher ability to recall cognitive feedback than outcome feedback. Our results show that cognitive feedback is more likely to be remembered. Referring to the information processing theory (Miller, 1956), we also assume that cognitive feedback presented in words is easier to remember than outcome feedback, which is rather presented as digits and numbers.

Unexpectedly, the results of neither manipulations (source credibility and feedback type) show high significant effects in terms of the entrepreneurial decision. We presume that this is because a bias is given in favor of the social business model. Individuals often use the

fulfillment of a social value as a rationale for continuing to pursue their business idea. Social innovation can be appealing for individuals and, thus, also a blind spot. Social entrepreneurship aims to have a greater societal impact (Hill et al., 2010; Short et al., 2009). Therefore, social entrepreneurs tend to pursue the business opportunity even when the economic benefit is relatively low. The respondents' explanations for their decisions confirm this assumption. The respondents frequently cited the social impact as their reason for continuing the business, even though the criticism of the feedback provider was perceived as plausible. The social value factor seems to overweight the non-scalability of the business model. We expect a mediating effect of social business opportunity explains the strong tendency toward business continuation. This potential social value creation bias in entrepreneurship needs further empirical investigation.

To our surprise, findings suggest that female respondents show a higher tendency toward business continuation compared to their male counterparts. This result is unexpected, since literature suggests an oversensitivity of women toward negative feedback, which decreases self-esteem and increases the intention to change their behavior (Johnson & Helgeson, 2002). Prior work has also reported an under-persistence in women (Fiorentine, 1987; Penner & Willer, 2019). However, other researchers also suggest that female entrepreneurs are less focused on economic value creation and more focused on social or environmental value creation (Eagly, 1987; Hechavarria et al., 2012). Statistics also show that women are more represented in the non-profit sector (Conry & McDonald, 1994; McCarthy, 2001; Themudo, 2009). Our results seem to support these findings. One explanation for this could be that women tend to lean toward social entrepreneurship, and the presented stimuli was based on a social business opportunity; this could explain their higher preference toward business continuation. Future research can explore the gender differences displayed in our experiment.

4.7 Limitations and Implications for Future Research

The present study is based on a simulated business opportunity and rejection, which was constructed with a group of experienced entrepreneurs. Although simulation-based experimental research has been applied throughout various disciplines (e.g., economics, political, and social sciences), there are certain limitations that come with this methodology. Some of these restrictions include the extendibility of validity in an experimental design and the complaint about the artificiality of experimental settings (Jiménez-Buedo & Miller, 2010). There is a standard claim that a laboratory experiment is characterized as having high internal but low external validity (Bracht & Glass, 1968). We are well aware of a tradeoff between internal and external validity, which Guala (2005, p. 144) perfectly summarizes as follows: "the more artificial the environment, the better for internal validity, the less artificial, the better for external purposes." Artificiality is given when an experimental setting does not reflect the "real world" (Schram, 2005), but the term is also subjective, and the general accusation of lab experiment artificiality ignores this point (Vissers et al., 2001). Although practitioners of entrepreneurship evaluated and validated all experimental treatments (e.g., feedback, case study of the start-up), we remain cautious about generalizing our results to different groups of subjects and settings. We acknowledge that our findings are specific to a group of German student entrepreneurs and to the set of conditions that we designed. Hence, the results of this manuscript may not show identical results for other populations of interest (population validity) and may not work under different experimental conditions (ecological validity) (Bracht & Glass, 1968). The latter means that there are limitations to replicating the results (cause-effect relationship), which were found under unique circumstances (e.g., Lynch, 1982; Cook & Campbell, 1979). However, we encourage further research to replicate our experimental design to test whether the results can be confirmed and to test to what extent the results of other studies correspond with our findings.

For instance, a field experimental design in project-based or experience-based learning settings can circumvent the limitations of a simulation-based experiment. Under such experimental conditions, participants can develop and work on their own business opportunities. Under these conditions, we expect that an entrepreneurial rejection will trigger high emotional involvement, since the business ideas not only originated from the students, but resources (i.e., time, energy) will have already been invested. This setting allows an investigation of the individual's affectional response when receiving a rejection, since the literature suggests that a rejection triggers intensely negative emotions and distress, such as aggressive tendencies and unpleasant emotional states (e.g., anger) (Buckley et al., 2004; Twenge et al., 2001; Chapman et al., 2014). Studies have also revealed an interplay between affect and the processing of new information (Bower, 1981; Wyer et al., 1999), the recall of prior knowledge (Blaney, 1986), and judgments and decisions (Schwarz & Clore, 1988; Wyer et al., 1999). This offers implications for future studies to examine the moderating effect of emotion on the relationship between entrepreneurial rejection and cognitive and behavioral responses. We also recommend investigating the effects of high/low perceived credibility on emotions. Regarding the feedback type stimuli, we recommend exploiting verbal emotional cues in cognitive feedback, but also implementing affective feedback (Nelson & Schunn, 2009), which exploits an affective language for communication (Lu & Law, 2012), in order to explore the emotional effects.

Furthermore, we are careful not to infer causal inferences, since our findings are non-significant. However, our results have the potential to offer other compelling avenues for future studies. For instance, studies (e.g., Hovland et al., 1949; Stanley, 1978) show that the effects low source credibility on behavioral response manifest with the passage of time; this is also called the *sleeper effect* (Sternthal et al., 1978a; 1978b). High source credibility has an immediate effect, but it might not last over time. This phenomenon is also called a *maturational effect*. We encourage further research to look at long-term effects through longitudinal studies.

For both studies, we decided that the gender of the feedback provider would be identical. As previously explained, we intended to avoid distorted results due to a potential gender bias. However, we also want to acknowledge that the phenomenon of gender bias is a compelling desideratum for future research. For instance, the study of Zhuang et al. (2017) proposes that receiving negative feedback from a female feedback provider results in a greater external attribution of failure, while negative feedback from a male feedback provider triggers greater negative emotional reactions. Male feedback providers with high status are also perceived as more credible (Pearson, 1982) and competent than female feedback providers (Miller & McReynolds, 1973). Thus, we highly recommend for future research to explore the effects of gender bias within the interplay between receiving an entrepreneurial rejection and the individual's acceptance, attribution, and resulting decision.

4.8 Conclusion

This study investigates the effects of an entrepreneurial rejection on student entrepreneurs' entrepreneurial decision, attribution, perception, and retention. To investigate this, we conducted two experiments with two different thematic focuses. The first experimental study aims at exploring the manipulation of perceived credibility and feedback type on the entrepreneurial attribution and decision. In contrast, the second experiment examines the effects of the above on entrepreneurial perception and retention.

The main analysis shows that perceived credibility triggers high acceptance and attracts attention. Concerning feedback type, cognitive feedback has a higher level of acceptance and is better remembered than outcome feedback. These results offer implications for both (nascent) entrepreneurs seeking financial funding as well as for investors and other stakeholders (e.g., educators) that regularly provide (negative) feedback to entrepreneurs. From the entrepreneur's point of view, cognitive feedback includes information about the decision and evaluation process. For reasons of clarification and improvement, we recommend recipients to actively

ask for additional qualitative feedback. For investors and gatekeepers of entrepreneurship who evaluate business proposals, the results recommend the provision of cognitive feedback, since it is better for information recall and is perceived as providing an opportunity for learning. Furthermore, our findings indicate that individuals best remember the entrepreneurship-related experience of the feedback provider; therefore, experience seems to be perceived as a highly relevant criteria for credibility.

Additional Note: A prior version of this paper, co-authored by Jan-Martin Geiger (TU Dortmund University) and Andreas Liening (TU Dortmund University); Dinh, A., Geiger, J-M. & Liening, A.: "Rejected, What's Next? The Impact of Entrepreneurial Rejection on Cognitive and Behavioral Responses" has been presented and discussed at the Annual Meeting of the Academy of Management (July/August 2021).

5 Manuscript IV: Errare Humanum Est: Epistemological Obstacles in Entrepreneurship Education

5.1 Abstract

The concept of "troublesome knowledge" is a generic term that encapsulates all the difficulties of comprehending or appreciating a discipline-specific learning subject. In this article, we suggest that students' errors are an indicator for troublesome knowledge. In an empirical study based on in-depth episodic interviews, we explore teachers' content, pedagogical content, and curricular knowledge on students' errors in entrepreneurship courses. We find that entrepreneurial errors have multiple characteristics (ambiguity, post-determination, etc.) that impede the diagnosis of errors. Our findings reveal two types of entrepreneurial troublesomeness: *troublesome content-related knowledge* and *troublesome methodology*. Furthermore, this article identifies the didactical strategies teachers have employed to cope with students' errors (correction by co-teacher[s], correction by peer-student[s], etc.) and didactical implications for designing error-based curricula. Finally, we conclude with a discussion on future directions for theoretical and empirical research in entrepreneurship education.

5.2 Introduction

Entrepreneurship is highly relevant both economically and socially, but it is also a multifaceted, complex phenomenon that has been discussed in a variety of ways and contexts. This is because entrepreneurship is studied by various disciplines—not only economists, but also psychologists, educators, sociologists, anthropologists, and historians—which has contributed to the subject's interdisciplinarity and heterogeneity (Filion, 1997; Gartner, 1990; Bruyat & Julien, 2001). While entrepreneurship has grown rapidly as a discipline (Morris et al., 2001; Matlay & Carey, 2007; Matlay, 2008; Kuratko, 2003), entrepreneurial learning continues to struggle with a lack of clarity regarding its learning purposes and outcomes (Matlay, 2006). In addition, the

entrepreneurial learning process is a black box, or a mystery that needs to be unraveled (Rideout & Gray, 2013; Baggen et al., 2017). Thus, scholars call for investigations into the learning processes, pedagogical instruments, outcomes, and impacts (Vanevenhoven, 2013; Matlay, 2008) that affect the quality of entrepreneurial education (Matlay, 2006). This study aims to unravel the epistemological barriers, better known as *troublesome knowledge* (Perkins, 1999), of entrepreneurship education that students face in order to provide insight into how the subject is learned and taught. Troublesome knowledge within a discipline is defined as knowledge that is conceptually difficult for learners to entirely understand at face value. Because the nature of entrepreneurship is complex, interdisciplinary, and multifaceted, the subject is perceived as conceptually challenging (Perkins, 1999; Meyer & Land, 2005).

Various disciplines have identified troublesome subjects within certain domains: *opportunity costs* in economics, *entropy* or *thermodynamics* in physics, *central limit theorem* in statistics, *precedent* in law education, and *depreciation* in accounting (Meyer & Land, 2005). Knowing students' troublesomeness with certain subjects raises the teacher's sensitivity toward the subject and calls for novel didactical strategies to approaching it. However, there is currently limited to no research on this topic within the context of entrepreneurship education, and existing research focuses on the *threshold concept* (see Hatt, 2019), which consists of five characteristics, if which troublesomeness is only one. This study, however, focuses on the concept of troublesome knowledge (Perkins, 1999). This concept has remained mostly a novelty for the field of entrepreneurship. Pioneering work was provided by Bolinger and Brown (2015), who suggest that *entrepreneurial failure* is troublesome not due to difficulties in its comprehensibility, per se, but due to students' fixation on financial costs, while the learning and new market opportunities (Minniti & Bygrave, 2001; Alvarez & Barney, 2007) that arise from failure are unappreciated. Other researchers also support this view (McGrath, 1999; Cope, 2011).

In entrepreneurship, students are confronted with a broad phenomenon that is difficult to capture entirely, and that can cause troublesomeness. Teachers' professional competencies have an influence on how students overcome their troublesomeness. For this, it is not only necessary to identify domain-specific contents that are troublesome to learners, but also to identify professional didactic strategies by experienced teachers on how to overcome students' troublesome concepts. With this study, we intend to contribute to the entrepreneurship literature by proposing a novel conceptual perspective on troublesome knowledge through the lens of students' errors. Troublesome knowledge is an abstract concept that is difficult to assess, while research on errors is established and easier to operationalize. Furthermore, we intend to contribute to the research on teachers' professional competences by exploring their professional competences regarding coping with students' errors; this examination aims to provide practical implications for entrepreneurship education.

A further objective of this research is to identify teachers' *didactical strategies* for dealing with students' epistemological difficulties. Teachers' professional competencies have a central impact on student learning, motivation, and achievement (Tulis, 2013). Mainstream research into entrepreneurship education focuses on entrepreneurial competences from the students' perspective (Kirby, 2004; Sánchez, 2011; Morris & Kaplan, 2014). However, Peltonen (2015, p. 493) argues that the focal point of future research "should be put on developing teachers' competences in relation to entrepreneurship education." Based on Shulman's (1986) *teacher competence model*, this study elaborates on teachers' knowledge about student errors (*content knowledge*), teachers' didactical strategies for dealing with learning difficulties (*pedagogical content knowledge*), and teachers' knowledge on designing curricular that provides students the opportunity to make errors and to learn from them (*curricular knowledge*), with a focus on the field of entrepreneurship education.

This paper is structured as follows: First, we identify troublesome knowledge (Perkins, 1999). We understand troublesome knowledge as a learner's engagement with a learning subject that is cognitively and emotionally challenging, which consequently results in the learner making mistakes. Thus, we used *students' error* as an indicator for identifying troublesome knowledge. Second, we identify teachers' coping mechanisms for overcoming students' troublesomeness and their curricular expertise for designing error-friendly learning settings. Due to the lack of research on this subject in the domain of entrepreneurship education, we chose an explorative approach and conducted episodic interviews (Witzel, 2000) with 17 experienced teachers of entrepreneurship.

The results revealed that student errors in entrepreneurship are perceived as learning opportunities and, therefore, have functionality. However, entrepreneurial errors are also perceived as difficult to diagnose and impossible to determine a priori. Furthermore, the interviews indicate two types of troublesome concepts in entrepreneurship: *troublesome content-related knowledge* (e.g., risk vs. uncertainty, causation vs. effectuation approach) and *troublesome methodology* (e.g., being confronted with rejection, lack of structure). The didactical response of teachers can be divided into proactive and reactive strategies. Proactive strategies include warning students of the ambivalent learning environment in advance, whereas a reactive strategy is a correction provided by the teacher or a peer student. Additionally, respondents advocate for practice-based learning, such as experiential learning or problem-based learning to promote an error-friendly learning environment.

5.3 Theoretical Context

5.3.1 Students' Learning Obstacles: A Theoretical Review

Teaching and learning involve the overcoming of barriers. The learner's perception is highly susceptible to learning barriers and failures. Learners are confronted with *counter-intuitive*, *incoherent*, or even *absurd* subjects that conflict with their *preconceptions* or *naïve theories*

(Perkins, 1999; Meyer & Land, 2005). "'Epistemological obstacles' constitute 'resistant difficulties' for students" (Meyer & Land, 2006, p. 5, original emphasis). These difficulties can be evoked through conflicting interactions between novel knowledge and "existing beliefs, past practices or inert knowledge" (Adler-Kassner et al., 2012, p. 2). These interactions are conflicting because the learner's preconcepts are challenged or because the learning subject perceives the novel knowledge as *conceptually* difficult.

In entrepreneurship education, teachers also have to deal with differences in students' learning rates, motivations, prior knowledge and experience, and resource networks (Vanevenhoven, 2013). These differences affect students' preconceptions and existing beliefs. For instance, students of entrepreneurship often link the term entrepreneurship to a person that forms a new business or a person that inherits, buys, or manages an existing business, but they are not aware that the term also includes an employee that behaves entrepreneurially (Gartner, 1985; Ripsas, 1998).

Although the concept of troublesome knowledge exists before the threshold concept and serves as a basis for its development, the latter has gained more popularity. Meyer and Land (2003; 2005) introduced the framework for *threshold concepts* and suggested the idea that learners are "stuck" in a cognitively and emotionally challenging phase while facing epistemological obstacles and experiencing a transitional change of conception. Meyer and Land (2005, p. 373) characterize this space and time when students find "the learning of certain concepts difficult or troublesome" as "liminality." The knowledge appears to be inaccessible and even troublesome to learners (Meyer & Land, 2003), but once they pass the "liminal space," learners can experience a "transformed internal view" (Meyer & Land, 2005, p. 373). In a postliminal state, learners have achieved a deeper understanding of a learning subject, which allows them to think and act like members of the "epistemic communities" "in which the concept is situated" (Adler-Kassner et al., 2012, p. 2). Threshold concepts are characteristically *transformative*, *irreversible*, and *integrative*, but they are also *bounded* and *troublesome* (Meyer

& Land, 2005). The characteristic of *troublesomeness* is based on Perkins' idea of troublesome knowledge (1999). However, Schwartzman (2010, p. 26) points out that "all defining characteristics, except for troublesome, describe the aftermath—not the experience—of student's successful acquisition of troublesome material." Threshold concepts are troublesome knowledge because they involve learning subjects that are difficult to understand (McCormick, 2008; Perkins, 2006). Therefore, the identification of threshold concepts requires the exploration of troublesome knowledge.

Social constructivist Perkins (1999) established the concept of *troublesome knowledge*. He criticizes the isolation of knowledge and understanding and argues that the integration of these two interdependent components would not only reduce tacit knowledge, but also enhance students' understanding of "explicit, discursive, and conscious" knowledge that would, in turn, promote the development of metacognitive knowledge (Adler-Kassner et al., 2012, p. 2). Meyer and Land (2003, p. 2, original emphasis) describe troublesome knowledge "as knowledge that is 'alien', or counter-intuitive or even intellectually absurd at face value." Troublesome knowledge triggers cognitive conflicts that are likely to be accompanied by emotional conflicts.

Perkins recognizes that troublesome knowledge can be difficult in different ways, so he introduced four types of troublesome knowledge: *inert, ritual, conceptually difficult, and foreign* (Perkins, 1999, p. 8). *Inert knowledge* is understood as lacking in frequency of use and transfer to "everyday application or to their science studies" (Perkins, 1999, p. 8), while *ritual knowledge* is understood as lacking in meaning due to its routine focus (Perkins, 1999). The narrowing of certain subjects can lead to the loss of meaning, thus evoking a concern over whether ritual knowledge can capture the meaning of knowledge. According to Ackoff (1999), who distinguishes between data, information, knowledge, and understanding, ritual knowledge seems to only fulfill the role of information or data; he raises concern over focusing on the transmission of information and neglecting the transmission of knowledge (analytic thinking) or understanding (synthetic thinking). *Conceptually difficult* knowledge describes the concepts

that embody a number of different elements of information; in order to grasp the entire picture of the concept, the related pieces of information need to be combined, as in a puzzle (Hill, 2010, p. 81). The last type of troublesome knowledge, *foreign knowledge* recognizes unfamiliarity with certain matter. It conflicts with one's own perspective due to cultural, ethnic, religious, or era-related differences (Perkins, 1999, p. 10).

5.3.2 Students' Errors as Indicators of Learning Obstacles

Facing knowledge that is intellectually troublesome usually results in learners making errors. However, troublesomeness is an umbrella term that captures all learning difficulties and obstacles; to operationalize this term, we use *students' error* as an indicator for troublesome knowledge.

Generally speaking, error describes a mental or physical "human action that fails to meet an implicit or explicit standard" (Senders & Moray, 1991, p. 20), which occurs if a "planned series of actions fails to achieve its desired outcome" (Reason, 1990, p. 9). Error is used as a generic term that encapsulates all situations where a "deviation from intention, expectation, or desirability" (Senders & Moray, 1991, p. 25) has taken place (Reason, 1990). Errors occur in a wide range of mental activities, manifest in "action, speech, perception, recall, recognition, judgment problem-solving, decision making, [and] concept formation," and their frequency varies from constant to variable (Reason, 1990, p. 2). In teaching-learning research, student errors neither occur randomly, nor are they a result of a lack of concentration; instead, they occur continuously and across generations (Türling et al., 2012).

The definition of "errors" varies across disciplines. Errors in mathematics or physics rely on elaborate theories and concepts that enable an accurate distinction between right and wrong. As Gruber and Mohe (2012) noticed, some disciplines struggle with determining what is "correct" and what is "erroneous" due to their complexity; that is, practitioners have difficulty forming algorithms for successful procedures. Entrepreneurship is one discipline that deals with

a higher level of abstraction: the venture creation process does not have an efficient algorithm that entrepreneurs can follow (Mitchell et al., 2007). Hence, formal education is not central to the acquisition of entrepreneurial expertise (Gruber & Mohe, 2012). In professions such as business management, "individuals develop concepts of the field mainly through real-world experience, but not through pure cumulation of a large number of knowledge units" (Gruber & Mohe, 2012, p. 73). This also applies to the domain of entrepreneurship: a successfully developed business idea cannot be easily defined through the application of algorithms. In such domains, veridical knowledge and misconceptions can exist simultaneously in the subject's nexus of knowledge without being noticed (Gruber & Mohe, 2012; Mandl & Prenzel, 1993). Knowledge in such domains have a double-edge function. This means that these domains depend on intensive knowledge, but they are also highly susceptible to errors (Gruber & Mohe, 2012). Erroneous cognition (mistake) and execution (slip or lapse) can be the product of misconceptions. This term describes knowledge and beliefs that are inaccurate to the core concepts and empirical results of a domain (Hughes et al., 2013; Hamza & Wickman, 2008; Taylor & Kowalski, 2004). Thus, misconception can be characterized as an incorrect view on a specific topic that is based on an incorrect understanding adopted during the learning process (Bransford et al., 2001).

Misconceptions also exist in entrepreneurship. There are also multiple schools of thought (e.g., the psychological characteristics school of entrepreneurship, the management school of entrepreneurship, the leadership school of entrepreneurship, and the intrapreneurship school of entrepreneurship) (Cunningham & Lischeron, 1991) that teach and discuss entrepreneurship from different and sometimes contradictory angles, due to the fact that researchers work independently of each other (Bull & Willard, 1993). Naturally, this can be confusing for learners and lead to misconceptions (e.g., entrepreneurship is a profit-seeking business, entrepreneurs are risk bearers). In learning contexts, misconceptions are not definite; they can

be overcome through the help of teachers encouraging students "to think beyond the specific problem or to think about variations on the problem" (Bransford et al., 2001, p. 78).

Researchers argue that learning from errors allows students to develop their repertoire of *negative knowledge* (Minsky, 1994; Parviainen & Eriksson, 2006). Gartmeier et al. (2008, p. 89) describe negative knowledge as "non-viable knowledge that is heuristically valuable." The concept of negative knowledge is highly relevant to entrepreneurship because the recipe for a successful new business venture cannot be determined ex ante. Therefore, negative knowledge can serve as a valuable heuristic in the venturing process.

5.3.3 Pedagogical Techniques for Dealing with Troublesome Concepts

Scholars consider teachers' diagnosis of typical student errors and their handling of these errors in a way that allows students to learn from them as teachers' professional competence (Baumert et al., 2010; Seifried & Wuttke, 2010; Seifried, 2012; Türling et al., 2012). Tulis (2013) distinguishes between *adaptive error management* (e.g., reflecting and sharing errors and [near-] mistakes) and *maladaptive error management* (e.g., assessing students' errors as a lack of skills). An adaptive error management response initiates and supports learning processes, while a maladaptive response is driven by a desire to eliminate errors (Tulis, 2013). Studies have shown that a teacher's error management behavior affects his or her students' attitudes toward learning from their errors and mistakes (Tulis, 2013; Steuer & Dresel, 2011) and even affects students' performance (Lee, 2008; Griffiths, 2007). According to Tulis (2013), students' attitudes toward learning from errors and mistakes are affected by their teacher's error competences. In entrepreneurship education, teachers' strategies for handling student mistakes might affect students' entrepreneurial intention to pursue a new venture formation, their entrepreneurial competences and mindsets, as well as their positive attitudes toward entrepreneurship (Garavan & O'Cinneide, 1994; Baggen et al., 2017; Kuckertz, 2013). Scholars claim that unlike other disciplines, the number of students who have graduated does not reflect

teaching quality; instead, the success of entrepreneurship education is measured by the socioeconomic impact generated by the graduates (McMullan & Long, 1987). Thus, the way teachers deal with students' errors also influences learners' creation of societal values.

A teacher's ability to identify students' errors is a teacher's professional competence. The modeling of teachers' professional competence, including teachers' understanding and the transmission of knowledge, is a complex process that requires a coherent theoretical framework. Shulman (1986) distinguishes between teachers' *content knowledge*, *pedagogical content knowledge*, and *curricular knowledge*. He defines *content knowledge* as "the amount and organization of knowledge per se in the mind of the teacher" (Shulman, 1986, p. 9). This means that teacher knowledge comprises not only knowledge about the learning subject, but also its genesis and entrenchment inside and outside of a domain. *Pedagogical content knowledge* describes teachers' didactical knowledge about a subject area (e.g., examples, analogies, illustrations, and visualizations) and their understanding of learners (e.g., preconceptions, misconceptions), but it also describes "what makes the learning of specific topics easy or difficult" (Shulman, 1986, p. 9). Lastly, *curricular knowledge* includes teachers' expertise about designing learning settings or curricula for teaching particular subjects (Shulman, 1986). A second professional teacher competence model within the domain of students' error was provided by Seifried and Wuttke (2010), who distinguish between three error categories: *knowledge level*, *procedural-performance level*, and *belief-system level*. The first level describes teachers' knowledge of student errors, the procedural-performance level describes teachers' coping mechanisms, and the third level contains teachers' beliefs regarding the error's benefits (Seifried & Wuttke, 2010).

In this study, we applied Shulman's categorization and Seifried and Wuttke's (2010) professional teacher competence model to entrepreneurship education (see Table 11). At the content knowledge level, teachers are in the position to define the "accepted truths" of entrepreneurship, to explain and clarify its legitimation (e.g., socioeconomic impact), and to

draw its relationship to the managerial domain, as well as to distinguish between entrepreneurship theory and practice (Shulman, 1986, p. 9). Both the recognition of students' errors as well as the types and causes of entrepreneurial errors are considered to be content knowledge. This also includes knowledge about typical venture mistakes (e.g., lack of scaling, co-founder misalignment) (Cantamessa et al., 2018). The identification of erroneous behavior alone is not sufficient; to be effective, learning from errors requires corrective feedback. Teachers of entrepreneurship must provide feedback that includes information for further exploration and deeper analysis of the underlying problems and directs the learner toward the correct answers (Metcalfe, 2017). Studies show that elaborative and layered feedback are effective for learning (Finn & Metcalfe, 2010). Regarding pedagogical content knowledge, this category includes teacher's knowledge about the strategies for dealing with student errors in entrepreneurship, as well as their knowledge about providing qualitative feedback that helps students with their business ideas. Entrepreneurship education can have stimulating as well as discouraging effects on students' intention to become entrepreneurs (Slavtchev et al., 2012). Maladaptive responses toward student errors might have a dispiriting effect on students' entrepreneurial intention. However, the application of didactical strategies to deal with students' errors depends on the teacher's understanding of these errors (e.g., teacher's concepts and beliefs) (Tulis, 2013; Lee, 2008; Borg, 2001; Burns, 1992), which refers to his or her content knowledge and pedagogical content knowledge (Wuttke & Seifried, 2017). Teachers that consider entrepreneurial failure as learning opportunities are more likely to encourage learning from failures, and thus contribute to the positive interpretation of the venture's mistakes, crises, and failures.

Finally, knowledge about designing entrepreneurship curricula that enhances error-based learning refers to curricular knowledge. "Design" describes engagement in self-organizing and goal-directed activities with the purpose to create something new (Rowland, 1993). "Design expertise is thought to lie not only in knowledge and skill, but in the designer's ability to reflect

on his or her own actions" (Rowland, 1993, p. 86). Instructional design theories and models (Reigeluth, 1983; Dick & Carey, 1996; Richey, 1995) are concerned with understanding the learning process (Khalil & Elkhider, 2016). The goal of focusing on developing instructional design strategies is to elicit "appropriate cognitive processes in the learner" and mediate "more successful learning outcomes" (Khalil & Elkhider, 2016, p. 149). The way learning settings are designed and instructions are conducted influences the error culture inside the classroom. The venturing process is characterized through a trial-and-error approach (Sosna et al., 2010). This also applies to entrepreneurial learning; thus, teachers of entrepreneurship should embrace and implement trial-and-error-learning and simultaneously promote experience-based learning (Henry et al., 2005).

Table 11: Professional Error Competences

Professional error competences	**Description**	**Competence level**
Knowledge about entrepreneurial error (types)	This competence level addresses teachers' knowledge about common logical flaws and false assumptions (e.g., entrepreneurial misconceptions) made by students. Having this knowledge enables them to recognize and categorize students' errors (planning vs. performance error).	*Content knowledge*
Strategies of (re)action towards entrepreneurial errors	This competence level comprises teachers' available pedagogical and didactical strategies of (re)action to treat entrepreneurial errors "adequately," which require both cognitive competence and physical skills.	*Pedagogical content knowledge*
Constructive view on entrepreneurial errors	This stage addresses the "overarching" ability or meta-competence to reflect on the learning and teaching process from and with entrepreneurial errors with the purpose to adapt and create change.	*Content knowledge, pedagogical content knowledge*
Designing error-encouraging entrepreneurship learning settings	This competence describes the ability to design a constructive error-friendly environment instead of an error-prevention-didactic. It also includes knowledge about a variety of programs designed for teaching entrepreneurship, relating disciplines, and creating curriculum materials.	*Curricular knowledge*

Source: Türling et al., 2012; Seifried & Wuttke, 2010; Wuttke & Seifried, 2017; Shulmann, 1986

5.4 Methodology – Research Design

This study was conducted using in-depth *episodic interviews* with teachers of entrepreneurship education. The episodic interview focuses on the balance between narrative elements and structured questions (Witzel, 2000). A key characteristic of this type of interview is its access to semantic and episodic memories (Tulving, 1972; Flick, 2007). Episodic memory captures recalled situation-specific information from the interview partner (Flick, 2007; 2018). To explore teachers' knowledge of student errors as well as their strategies for coping with them, we exploited the recall of situation-based memories. As indicators for student errors, we asked respondents to recall entrepreneurship subjects that usually require more time for explanation, in which students asked more questions in terms of understanding difficulties, and in which students commit visible errors, such as in assignments or tests. To identify teachers' understanding of errors, including their definitions and normative subjective beliefs, which are "more abstract, generalized, and decontextualized from specific situations and events" (Flick, 2007, p. 55), we used semantically oriented questions to trigger semantic memories. Table 12 shows a shortcut of the interview guide.

Table 12: Types of Questions from the Interview Guide

Questions regarding recall of episodic memories
You have taught entrepreneurship for so many years. While reflecting on all of your teaching experiences, which particular subject of entrepreneurship turned out to be difficult for your students? 1. Could you describe a situation in which your students asked more questions, in terms of understanding difficulties, than usual? 2. Could you describe a situation in which you had to provide more support or instruction than usual?
Questions regarding the recall of semantic memories
Mistakes and errors are some common phenomena in our private and professional lives. What is your definition of student errors, first in general, and second in the context of entrepreneurship?
According to empirical studies, there are useful and less useful reactions toward student mistakes. From your point of view, which teacher reactions would you consider to be useful and appropriate and which are less?

5.4.1 Sample Selection and Recruitment

For the sample selection of the interview partners, we used an open and undetermined *theoretical sampling* (Glaser & Strauss, 1965; 1998), which recommends that sampling and data analysis processes proceed simultaneously. This allows the alternation of the testing group based on prior processed data, generates maximal theoretical insights, and allows for the comparison of collected data. We also followed the process of purposeful sampling (Lincoln & Guba, 1985) to identify the interview partners. Our goal was to recruit a diverse representation of educators, varying in gender, age, and teaching experience, to capture a holistic understanding of student errors in entrepreneurship education. Furthermore, we wanted to integrate the academic, pedagogical, and practitioner perspectives in our study. Thus, we not only included professors and research fellows, but also lecturers at higher education institutions that are specialized in designing curricula/teaching, as well as start-up consultants at higher education institution who provide workshops and seminars to potential entrepreneurs. Table 13 shows the distribution of the interviewees. We selected interviewees using personal relationships, convenience, and snowballing techniques (Miles et al., 2014). In total, we obtained this study's qualitative data from 17 semi-structured interviews with experts of entrepreneurship at higher education institutions and entrepreneurship centers. The interviews were conducted during 2019 and 2020, and they ranged from 35 to 70 minutes in length. The majority of the participants have obtained a doctoral degree (n = 9), and most have a significant amount of teaching experience, in general, and teaching experience in entrepreneurship education, in particular.

Table 13: Distribution of Interviewees (n = 17)

Job Position	Age	Women	Men	TE*	TEE*
Professor	40-49 50-59	1	2	≥ 10 years	5-10 years ≥ 10 years
Lecturer (focus on curricula design)	30-39	4	0	5-10 years ≥ 10 years	2-5 years 5-10 years
Lecturer (focus on teaching)	30-39 40-49	4	2	5-10 years	2-5 years 5-10 years
Research fellow	21-29 30-39	1	1	≤ 2 years 5-10 years	≤ 2 years 5-10 years
Startup consultant	30-39	1	1	2-5 years	2-5 years

*Teaching experience in general, **teaching experience in entrepreneurship education

5.4.2 Data Analysis and Interpretation

According to Leitch et al. (2010), the quality of interpretivist research in entrepreneurship is based on the process of validation, a value-laden approach, which follows a recursive process of data analysis. This study is less interested in the frequency of entrepreneurial phenomena than it is in the meaning behind them (Van Maanen, 1979). For a thematic interpretation and analysis of the qualitative data set, we used codes and salient themes (e.g., descriptive, in vivo code) (Strauss & Corbin, 1990). A coding system based on the professional error competences (Seifried & Wuttke, 2010; Wuttke & Seifried, 2017; Shulman, 1986) was established beforehand. The interviews were transcribed verbatim into computer files, and the coding and the interpretation of coded data were handled in MAXQDA Analytic Pro 2020. We employed two cycles of coding (Gioia et al., 2013; Miles et al., 2014). In the first coding cycle, we coded the transcripts into segments of potentially relevant categories (i.e., teacher's knowledge, strategies, constructive view, and design implications). In the second coding cycle, we generated pattern codes and clustered them into distinctive types (Miles et al., 2014). This approach is related to axial coding (Strauss & Corbin, 1990), which is used to examine the relationships between established categories. Two cycles of coding help with the assigning of codes into *first-order concepts* and *second-order themes* (Gioia et al., 2013; Corley & Gioia,

2004; Malshe & Sohi, 2009). The first-order concepts represent the in vivo codes, for instance, the described student errors, while the second-order themes demonstrate the suggested troublesome knowledge. Finally, the second-order themes were clustered into anchoring concepts (aggregate dimensions). To increase the validity, the cycles of coding and the determination of first-order concepts, second-order themes, and anchoring concepts were separately performed by two investigators. After each coding cycle and the analysis, we discussed the results to obtain consensus (Burnard, 1991; Graneheim & Lundman, 2004).

5.5 Findings and Discussion: Teaching Obstacles in Entrepreneurship

In this section, we discuss the study's findings based on the analysis of the interviews. In addition, we also include representative in-line quotes of the results and provide immediate reflections and discussions to offer a coherent understanding of the link between results and their meaning. This approach is also referred to the "claim, data, elaboration" sequence: which starts with the theoretical assumption, followed by data (in-line quotes) to support this assumption and, finishes with a discussion of how both the data and their interpretations legitimate the initial claim (Gopaldas, 2016). Our results and discussions include the teachers' knowledge on troublesome concepts, as well as the characteristics of student errors in entrepreneurship that cause the troublesomeness. Furthermore, the findings and discussions include teachers' reactions toward student errors and teachers' curricular knowledge on how to design learning settings that encourage students to learn from their errors.

5.5.1 Defining Entrepreneurial Errors – Ontological Challenges

Our analysis revealed some distinctive characteristics of errors in entrepreneurship (see Appendix 3). The interviewees explain that to a certain level, *ambiguity* is involved that complicates the immediate diagnosis of errors. Compared to formalized and structured domains (e.g., economics or accounting), entrepreneurship is reported as *fuzzy* and *ambivalent*. This

description corresponds with existing conceptions that the entrepreneurial conditions under which entrepreneurs operate are complex, problematic, and uncertain (Holm et al., 2013; Gaglio & Katz, 2001; Townsend et al., 2018). However, errors require a fundament of accepted truths in order to be identified as a "failure of meeting implicit and explicit standard[s]" (Senders & Moray, 1991, p. 20). Entrepreneurship lacks clarity, and this impedes teachers' ability to diagnose and respond ad hoc in (on-line) situations.

> In economics it's always the case that you work a lot with mathematical models and it's rather easy to say: "That's wrong. That's right." (...) It's all very formalized to some extent. That is simply not the case with entrepreneurship and what is right or wrong in entrepreneurship is often in the eye of the beholder.
>
> *(Male research fellow)*

This means that entrepreneurial errors are influenced by the context of the situation and on the biography of the involved actor. Existing literature also states that the locus of uncertainty can lie in the entrepreneurial actor, action, and environment (Townsend et al., 2018). Furthermore, educators also report a lack of *ex ante determination*. This reflects the problem of a priori uncertainty in entrepreneurship (Townsend et al., 2018). For entrepreneurship education, the more entrepreneurial learning moves toward experience-based didactical methodologies, the more difficult it is for teachers to diagnose errors. Most of the time, the correct answer remains unidentifiable until the venturing process has ended. Entrepreneurship is a venture into the unknown, for teachers as well as students; therefore, the rationale of entrepreneurial action can only be *determined ex post*. However, literature also argues that knowledge about new information does not necessarily reduce uncertainty ex post (Townsend et al., 2018).

> The thing is, you never know what's going to happen. And you can always rationalize so well backwards and say, if I had not, I would not have, but at the end of the day it could have turned out differently.
>
> (Female lecturer)

While error is, in general, negatively connotated (Harteis et al., 2008), error in entrepreneurship predominantly triggers positive associations. The informants describe positive associations with the term. In our interviews, error is described as part of a learning and innovation process. Error holds a relevant *functionality*: it is an indicator for a market chance, a room for improvement, or a warning signal.

> I actually see it more as something positive, something we need, and (…) it is a step in the innovation process to discover many things and then to quickly change direction, that is what I find exciting.
>
> *(Male university professor)*

This positive interpretation is consistent with the claim that entrepreneurial failure should be considered a learning opportunity and that failure is also accompanied by knowledge and the ability to re-emerge stronger as an entrepreneur (Cope, 2011; Shepherd et al., 2016; Lattacher & Wdowiak, 2020). An interesting description of entrepreneurial error identified by the interviewees is also the distinction between *good* and *bad errors*. Educators of entrepreneurship draw a clear distinction between acceptable errors, in terms of inevitability, and unacceptable errors, in terms of uncalculated errors and careless mistakes. Prior work also indicates that entrepreneurial mistakes are more accepted by society if their occurrence was unavoidable, that is, they were beyond the entrepreneur's control (Mandl et al., 2015). Entrepreneurship literature also distinguishes between business failures that are related to misfortune, in terms of an external locus of causality, and failures that are related to mistakes,

which are due to inadequate ability and or lack of effort (Cardon et al., 2011). Although mistakes are inevitable in the venturing process, careless mistakes should be avoidable.

> I think there's a difference between necessary mistakes and careless mistakes. I think we as entrepreneurs, educators, try to teach students to avoid the careless mistakes; ones that we can kind of foresee coming that result from a lack of training or experience. I think there is always going to be a set of necessary mistakes lining.
>
> *(Male university professor)*

The differentiation between good and bad errors relates to the severity of consequences that entrepreneurial mistakes can create (Shepherd, 2003). Due to the liability of smallness and newness (Wiklund et al., 2010), entrepreneurial errors in small-scale business ventures are highly susceptible to *negative impacts* (insolvency, legal consequences, etc.) with both internal and external locus of causalities.

> And there, of course, mistakes can have [more] serious consequences than in other areas, namely when I am somehow financially ruined, or I lose my family or whatever.
>
> *(Male research fellow)*

5.5.2 Troublesomeness in Entrepreneurship Education

The data analysis included the identification of troublesome knowledge. Then, the identified troublesome knowledge was categorized into action-related and/or cognition-related errors, according to teachers' opinions, to explore the cause of such errors. In this context, teachers report that students' error is related to meta-competences. Boak and Coolican (2001, p. 214) describe meta-competences as abilities that "underpin or allow the development of competencies" and "characteristics that individuals will need in addition to competency" (e.g.,

motivation or cognitive abilities). Student errors that are meta-competence-related are found in troublesome methodology.

Our main findings revealed two types of troublesome knowledge in the field of entrepreneurship education: *troublesome content-related knowledge* and *troublesome methodology* (see Appendix 4). Troublesome knowledge describes students' difficulties and errors with contents of entrepreneurship education (e.g., models, theories, concepts, terminologies). These types of errors are usually rooted in a lack of procedural knowledge (action-related errors) and/or declarative knowledge (cognitive-related errors). A remaining challenging knowledge seems to be the concept of business modeling; for instance, the *business model canvas*—an instrument for business idea generation that includes nine interdependent segments, such as customer relationships, key partners, or key activities (Osterwalder & Pigneur, 2010)—causes students to struggle. The interviewees report difficulties differentiating the segments and the terms, and they even report that the method sometimes negatively affects the innovation process, since students are too focused on the theory behind the concept, and they struggle with transferring the theory to their own business ideas.

> I think the difficulty here was that this business model canvas model was used to separate the different segments to some extent. That was a certain problem. I remember that we pushed back and forth a lot. We did the whole thing with post-its. And then a lot of "doesn't that belong more to the area or to the area?" and that was one of the difficulties that came up at that point.
>
> *(Female research fellow)*

A further example of troublesomeness in the area of business modeling is the application of *the lean start-up concept*, *design thinking*, and *prototyping*. The lean start-up concept emphasizes the idea of short feedback-loops, including techniques such as *minimal viable product*, created for small firms (Ries, 2014), and the *design thinking* concept, which

emphasizes using creativity as a method to generate business ideas (Kelley, 2001). Educators argue that students have trouble measuring their business ideas and drawing learning implications from them.

> They struggle with the lean start-up—they can say build-measure-learn and they can for sure build, but they can't measure (…) So, if they don't measure correctly, then they will learn something wrong. (…) and then again, I see as they don't want to go into the hard work of the build-measure-learn loop.
>
> *(Male lecturer)*

According to the interviewees, students' misconceptions and prejudices are also common phenomena in entrepreneurship education. As discussed in the theoretical section, in entrepreneurship education, veridical knowledge and misconceptions co-exist in the subject's nexus of knowledge, and they are difficult to separate (Gruber & Mohe, 2012; Mandl & Prenzel, 1993). Hughes et al. (2013) divide misconceptions into factual and ontological misconceptions, depending on the origin of their sources. Factual misconceptions represent beliefs "that arise from incorrect or incomplete information encountered in the popular media, classroom or the every-day environment" (Hughes et al., 2013, p. 21). This type of misconception derives from external sources (Hughes et al., 2013). "Ontological misconceptions are those that reflect naïve or commonsense theories about thought, feelings and behavior" (Hughes et al., 2013, p. 21). This type of misconception originates from "underlying naïve […] ontological assumptions, explanatory concepts and causal mechanisms" that do not reflect "contemporary theory and research" (Hughes et al., 2013, p. 21). Misconceptions in the entrepreneurial context seem to originate from both sources. Business students who take entrepreneurship courses for the first time usually assume that entrepreneurship only addresses students with venture creation intentions. However, explaining the relevance of an entrepreneurial mindset easily dissolves this believe. This misconception seems to result from of lack of information and seems to be

recognized as a factual misconception. The cross-disciplinary character of entrepreneurship causes students outside of business-related faculties to struggle with recognizing the societal value of entrepreneurship, due to their prior perceptions of business and economics. This misconception originates from naïve conceptions and relates to ontological misconceptions.

> They fight with prejudices, so when I ask what I associate with the term entrepreneur, then I get something like capitalist focus or something.
>
> *(Female research fellow)*

In addition to troublesome knowledge, we also identified some troublesomeness relating to methodology, which we call *troublesome methodology*. This type of troublesomeness describes the struggle with the methodological design of the learning setting, which is less related to declarative or procedural knowledge and more related to "soft qualities," such as self-organization competences or sense of responsibility, and which are rather related to meta-competences. Entrepreneurship pursues a rather constructivist learning theory that includes exposure to making one's own decisions, self-determination, and proactive and innovative behavior (Kickul & Fayolle, 2007). Learning is regarded as an autopoietic procedure, which can be stimulated through errors (Reinmann, 2013). Therefore, constructivist education theorists agree on the requirement of complex learning settings with authentic content and tasks, which stimulate self-organization and social exchange (Reusser, 2001). Thus, participation and connections drawn between real or virtual networks enable the learning process. For constructivism, knowledge is an individual and/or socially constructed performance (Reinmann, 2013). Students' confrontation with the self-organized learning process is challenging because it is unfamiliar compared to their structured learning settings. In addition, students are not only confronted with ambivalent content but also uncertain and ambivalent learning contexts. The educators interviewed characterized entrepreneurship education as

result-open and unformalized. The outcome or the process of entrepreneurship education cannot be determined in advance, and both teachers and students have to stay flexible. This enforces the ambiguous environment, which is not always satisfying for students.

> The more rational the concepts are, or the simpler, or let's say more schematic they are (…) the easier it is for the students. The greater the uncertainty factors, in the sense of when is an idea a business idea? How do I define a target group? How do I hierarchize different target groups? What does my product portfolio look like? So, the uncertainties are actually the point where the students have the most difficulties.
>
> *(Male start-up consultant)*

Furthermore, entrepreneurship education also involves the didactical elements of playfulness (simulation, games, etc.), which actively encourages students to experiment and to discover novel ideas. However, the higher education context also requires adherence to academic standards (Trow, 1987; James, 2003). This playful didactic is embedded in an academic environment that involves grading. This leads to cognitive dissonance, since students are asked to balance the playful procedures and the academic standards.

> And I also think it's important, which is perhaps another challenge, because you want to provide the students with a playground somewhere in quotation marks. That they can try themselves out, learn, okay, what's it like when I actively get involved. And of course, it's a bit difficult to sometimes agree that they should be graded for it.
>
> *(Female lecturer)*

One further troublesome methodology is students' exposure to the downside of entrepreneurship, such as being confronted with entrepreneurial failure or receiving criticism and negative feedback. The venturing process is paved with obstacles (Van Gelderen et al.,

2011), and experiencing setbacks and facing rejections contribute to this challenging path. Compared to other disciplines, entrepreneurship is about generating and testing business ideas, which usually takes place outside of the classroom with real customers and investors. Receiving criticism and rejection after investing enormous time and energy into a business model is emotionally and cognitive challenging for students.

> A group of students (…) were very, very committed to the course. They also invested a lot of time in project work (…) were super frustrated that the client was not overjoyed with their work (…). And, that didn't come out so well for them, because they invested a lot of time in it and that was very difficult for the students (…) even tears flowed over this result. But that was difficult to convey, because the expectation was that a lot of time spent is equal to a lot of recognition.
>
> *(Female research fellow)*

This result corresponds with the study of Bolinger and Brown (2015), who propose entrepreneurial failure as a threshold concept, which includes troublesome knowledge. "Teaching students about entrepreneurial failure offers a particular challenge for management educators, who sit on the horns of a dilemma" (Bolinger & Brown, 2015, p. 453). Demonstrating failure as a realistic scenario for founders (McGrath, 1999) can decrease students' entrepreneurial intention.

5.5.3 Teacher's Didactic Responses to Students' Errors

The interviewees also discussed their behavioral responses toward student errors. Our analysis shows that two time-related types of strategies exist: *proactive* and *reactive* responses. Appendix 5 displays both teachers' *reactive* instructional strategies for responding to students' errors and their *proactive* responses, in which teachers use early and open communication to sensitize students toward an uncertain and ambiguous entrepreneurial context. As previously

discussed, in certain domains it is sometimes difficult to evaluate "whether an undertaken activity is correct or erroneous" (Gruber & Mohe, 2012, p. 73). Therefore, teachers respond through sensitizing students toward a poorly structured domain or through honest confession that there are no right answers.

> I say that I only make statements in an open and honest manner. The first one is, and we try to do this consistently, we cannot make a statement about whether an idea will be successful. But what we can do is try to show them how such a process could look in the context of their academic time.
>
> *(Male research fellow/start-up consultant)*

Furthermore, educators reported using constant feedback and monitoring students' learning process as strategies for reducing unnecessary errors. This also helps them to develop a trustful relationship with their students that facilitates the open communication of errors.

More challenging are situations, in which teachers have to respond immediately to students' errors. Reactive responses toward students' errors take place in (on-line) situations and require immediate responses from teachers. The quality and abundance of responses in an on-line situation depend on the teacher's knowledge (i.e., implicit knowledge), also often referred to as expertise (Neuweg, 2004). This knowledge is not entirely, partially, or appropriately able to be verbally explicated, but it can be observed through performance (Neuweg, 2004). Schön uses the term "knowing-in-action" to describe the way of acting spontaneously, automatically, and intuitively; this way of acting implies knowledge, since "knowledge is tacit" and is included in pattern of actions (Schön, 1983, p.43). "Knowing-in-action" is often used to refer to an expert who is able to follow an algorithm in an intuitive way but is also able to extend his or her "knowing-in-action" (Bromme, 1992, p. 150). Dreyfus and Dreyfus (1986) refer to this knowledge as an expert who acts intuitively. This explains the application of heuristics to responses to students' errors in (on-line) situations.

> Then I don't really have a right or wrong situation anymore, but I basically have, I only have heuristics, I only have contingent solutions that are right or wrong in the eye of the observer.
>
> (*Male research fellow/start-up consultant*)

As a common reactive strategy, we identified a direct and immediate correction of students' errors by the teacher (e.g., correction within the class, solving errors in personal, eye-to-eye conversations). The ability to spark a discussion with the whole class when an error appears is classified as an adaptive response (Tulis, 2013).

> Let's talk about what went wrong. It's almost one of those autopsies without blame scenarios where we're not looking to say, you screwed up, you are an idiot, you're a bad person. You made a bad decision. We're looking at [it] today, the outcome from this decision wasn't what we wanted. Let's dissect when it happens. Not because we need to blame someone, but because we want to make sure that it doesn't happen again.
>
> *(Male university professor)*

A further type of correction is made through the student who made the mistake. Interviewees report that they will lead the student toward the right answer by using examples or visualizations or by asking challenging questions. Research on instructional learning considers nudging students to find the right answer themselves, including giving time to respond and pointing out errors, as the most challenging but also a highly adaptive method of correction for learning success (Tulis, 2013).

> I'm a big fan of the Socratic questioning method. That is, you try to get the people there to see that they can see that, well, I might have to take a different approach. I simply try, if someone has not understood the basic concepts or has misinterpreted an important theory, if it's really wrong. I try to describe it in such a way or to lead people to look at it themselves and then recognize it themselves.
>
> *(Female research fellow)*

Teachers also often respond to students' errors by redirecting the question to fellow students. This is also called the *triangle principle*, and it is a common approach for responding to students' errors (Tulis, 2013). Oser and Spychiger (2005) describe this response as the *Bermuda triangle of error correction*. Videotaped studies have shown that math teachers apply this response the most often; however, this response is also considered maladaptive (Tulis, 2013) because it has the shortest distance from a wrong answer to the right answer (Santagata, 2005). This approach discourages error reflection and reduces students' motivation for self-correction (Bray, 2011).

> I have always had the feeling that by asking again in the round and someone else says it, then several more students come forward, then I also call several students and then they realize, "ok, everybody else sees it differently than I do." Then I believe, so I have the feeling that it is always quite well accepted.
>
> *(Female lecturer)*

One distinctive type of teachers' response is the *correction by co-teachers*. This type of response can be explained through the specific characteristic of the discipline. Entrepreneurship can be considered an applied science, which is interested in real conditions and follows logical laws. Applied domains such as medicine, engineering, law, and also entrepreneurship, are related to specific professions (Ben-David, 1972, p. 362). A particular feature of applied, "profession-based" domains is that their educators also practice these professions. For instance,

in addition to professional knowledge or teaching enthusiasm, medical educators require clinical competences (Irby et al., 1991). In entrepreneurship education, most teachers only have theoretical knowledge of the field. Thus far, entrepreneurship education has depended on external experts (investors, start-up consultants, etc.) to balance the practitioner side. This also allows teachers to redirect students' errors to co-teachers, who take over the task of correcting students as well as navigating learners to the correct answer. In this context, Filion (1997) called for a distinction between entrepreneurship education, which focuses on practical and application-orientated perspective, and *entreprenology*, which addresses the academic perspective.

5.5.4 Implications for Error-Based Learning

Kilby (2003, p. 15) once said that "the problem is not with the capacity to act, but the opportunity to act." While policies are demanded to support entrepreneurship by developing entrepreneurship-beneficial infrastructure, teachers are in the position to create opportunity to act entrepreneurially. Particularly, the risks for real entrepreneurial consequences are low in the learning environment. Thus, enabling learning conditions that allow students to commit entrepreneurial errors and gain experience is highly relevant. Focusing on errors as an opportunity for learning, we asked the interviewees how to create a learning setting that encourages error-making and error reflection toward an *error-based learning* environment. The results provide methodological implications for both educators as well as managers on how to design error-based learning settings to promote an entrepreneurial and intrapreneurial mindset (see Table 14). The analysis shows a unanimous consensus regarding the social form and the learning group. Therefore, the interviewees highly emphasize the conduction of effective social and collaborative learning.

> Perhaps make it clearer that they also see themselves as a resource and learn from each other. That is, they see themselves as a community in the course or wherever they work and see this as a resource to learn from each other.
>
> *(Female research fellow)*

This finding resonates with the results of prior entrepreneurship literature. Researchers consider entrepreneurship as an interdisciplinary domain that should not, therefore, be limited to business students (Goethner & Wyrwich, 2020; Janssen & Bacq, 2010; Janssen et al., 2007; 2009). The entrepreneurial venture is a collective effort, and most successful ventures are founded in teams (Vyakarnam et al., 1999; Zolin et al., 2011). An interdisciplinary founding team can be beneficial for the venturing process. Collaborative learning helps students realize that peer-students can be valuable resources and serve as a sort of personal "advisory board." Such a learning approach relates to the communal learning concept of "communities of practice" (Marsick & O'Neil, 1999) that helps learners to build self-confidence by sharing mistakes with co-learners, which helps dispel insecurities (Peltonen, 2015).

An error-based learning approach requires active and "hands-on" learning, the stimulation of self-organization, and the opportunity for learners "to create or recreate knowledge for themselves" (Perkins, 1999, p. 8), as well as to make mistakes and reflect on them. Individuals' construction and reconstruction of knowledge is key to knowledge retention, understanding, application, and transfer (Perkins, 1999, p. 8). Therefore, the interviewees addressed the implementation of project-based learning and simulation-based learning settings that enable the solving of real venture problems. This corresponds with existing literature that has called for learning settings that go "beyond problem solving" (Hynes et al., 2011, p. 19) and demands for students to work on real entrepreneurial assignments, cases, or projects so they can engage in deeper cognitive learning (Tenenbaum et al., 2001; Hytti & O'Gorman, 2004). Such a learning environment stimulates the transfer of declarative knowledge into procedural knowledge, which is highly challenging for novices, but highly automated for experts "in most professional

fields" (Gruber & Mohe, 2012, p. 71). Furthermore, our interviewees emphasize that exposure to venture discontinuities and obstacles, in combination with constant iterative feedback cycles, helps reflective and reflexive learning processes. This perspective aligns with prior studies in entrepreneurship education (see Cope, 2003; Cope & Watts, 2000), which recommend learning settings that force students to step outside of the traditional teaching environment and linking students' "academic performance to their 'real' project performance" (Pittaway & Cope, 2007a, p. 214, original emphasis).

Furthermore, Pittaway and Cope (2007a, p. 215) outline that the "*practice in*" form for entrepreneurship education is one that "seeks to simulate entrepreneurial learning by creating an environment where such learning can take place." For this purpose, Pittaway and Cope (2007a, p. 214) propose the use of "self-selecting venture teams, learning coaches and a venture panel" that consist of practitioners. The suggestions of the interviewees reflect the conclusions of external experts and practitioners of entrepreneurship. As previously mentioned, entrepreneurship is a profession-dependent domain and requires a practice-centered approach. In the entrepreneurship context, this not only means involving practitioners such as investors, business angels, start-up consultants, as well as co-teachers, but also entrepreneurs who serve as role models and can provide reflection on entrepreneurial mistakes and crisis.

Table 14: Methods for Error-Based Learning

1st Order Concepts	2nd Order Themes	Didactical Dimensions/ Anchoring Concept
▪ Problem-based learning ▪ Real projects and problems ▪ Situated learning ▪ Collaborative learning ▪ Interactive learning ▪ Trial-and-error-learning ▪ Self-organized learning ▪ Experiential learning	Practice-based learning	Methods
▪ Founder talks ▪ Field trips ▪ Blended Learning ▪ Inviting alumni ▪ Storytelling ▪ Experts speech	Practitioner-based learning	

5.6 Conclusions and Implications for Future Research

This study identified students' troublesomeness with learning the subjects of entrepreneurship education through the lens of students' errors, teacher's didactical methods for dealing with troublesome knowledge, and teacher's curricular knowledge on creating an error-friendly learning environment. As remarked, troublesome knowledge is only one characteristic of the threshold concept. Therefore, future research into the remaining four characteristics of the threshold concept is required. Based on the troublesome knowledge and troublesome methodologies identified herein, future research should also focus on testing the results. Thus, this study also provides implications for the design of a learning setting that embraces errors in order to develop a positive error culture in class. For instance, the didactical methods suggested by educators and illustrated in Table 14 offer implications for experimental designs that test the effects of these methods or for intervention studies that assess the intervention's impact on the development of students' error orientation. Learning forms, such as the trial-and-error-approach, have been recognized, but the profound theory of errors has yet to be used for entrepreneurship. For instance, studies argue that learning from critical events is a form of "higher-level" learning, which stimulates transformative personal learning and serves as a basis for deep reflection and critical analysis (Cope, 2003; Pittaway & Thorpe, 2012). Thus, we conclude that error-based learning can help students develop critical analytical thinking, problem-solving, and reflection/meta-competences.

The entrepreneur operates in an error-prone environment characterized by a non-linear and complex process that is subject to risks, uncertainties, embroilments, coincidences, and turbulences (Morris et al., 2013a; 2013b). Entrepreneurial errors signal that something went wrong, but they also represent learning opportunities that enable the development of negative knowledge (Minsky, 1994; Parviainen & Eriksson, 2006). An extensive repertoire of negative knowledge also represents a certain level of expertise. As previously mentioned, teachers' responses toward student errors can influence how the students learn from their errors (Tulis,

2013; Steuer & Dresel, 2011). This includes affecting the development of a negative knowledge. Investigating learners' potential to build their repertoire of negative knowledge in entrepreneurship courses in relation to their teachers' reactions toward student errors offers a research desideratum for future studies (e.g., assessing through learning diaries).

This study used interviews to identify teachers' understanding of entrepreneurial errors, their responses toward students' errors, and their curricular knowledge on designing error-based learning settings. This approach recalls the complex cognitive structures through consensus of communicative dialogue. However, further research is required to test these complex cognitive structures. We recommend employing the *Research Program Subjective Theories*, which is a methodological instrument for achieving an explanative validation (i.e., explaining and predicting human behavior; Grotjahn, 1991). We encourage future studies to use observational methods (e.g., videography study; Christmann et al., 1999; Groeben, 1988) to assess teachers' responses toward the student errors described in this study. Furthermore, studies have shown that a teacher's error management behavior affects his or her students' attitudes toward learning from errors and mistakes (Tulis, 2013; Steuer & Dresel, 2011). Future research can also investigate the impact of teachers' error management on the error culture in classrooms and their students' error orientation (e.g., Rybowiak et al., 1999; Spychiger et al., 2006).

Additional Note: A prior version of this paper, co-authored by Andreas Liening (TU Dortmund University); Dinh A. & Liening, A.: "Epistemological obstacles and epiphany of Entrepreneurship Education – Identifying Troublesome Concepts through Student Errors" has been presented and discussed at the United States Association for Small Business and Entrepreneurship (USASBE) in St. Pete Beach (2019).

6 Overall Discussion

Entrepreneurial cognition and behavior, particularly opportunity decisions, have become central concepts in entrepreneurship research (Mitchell et al., 2007; Shane & Venkataraman, 2000; Randolph-Seng et al., 2014). However, this domain of entrepreneurial cognition has been described as a "multidisciplinary jigsaw" (Harrison & Leitch, 1996, p. 69), and more research is required to complete the fragmented picture of entrepreneurial cognition and opportunity decisions (Mitchell et al., 2004). Therefore, this dissertation aims to advance the research in the field of entrepreneurial cognition and decisions through four studies that investigate both the contextual and individual factors that affect opportunity recognition. In addition, this paper explores the interplay between feedback and opportunity decisions and includes entrepreneurial learning into the discussion of entrepreneurial cognition and decisions through troublesome knowledge. This section discusses some key findings from the four studies, compares them to each other, and juxtaposes them to previous research.

This dissertation begins with *MANUSCRIPT I*, which analyzes the entrepreneurial context in which entrepreneurs make their decisions and discusses the limitations of rationality in entrepreneurship and the consequences for entrepreneurship education. The findings of the conceptual paper reveal that entrepreneurship is best characterized through interdependency, emotional attachment, or multiple-dynamic problems. The literature often highlights the emotional involvement of entrepreneurs (Fodor & Pintea, 2017; Zhao & Xie, 2020). However, most past studies have reported that men display a higher level of affection towards entrepreneurship than do women (Dempsey & Jennings, 2014; Minniti & Nardone, 2007). Interestingly, the women's lower level of affection is also considered to be a cause for their lower tendency toward entrepreneurial intention and self-efficacy (Dempsey & Jennings, 2014). This finding is further supported by *MANUSCRIPT II*, which also found that women display a lower level of entrepreneurial self-efficacy. In sum, the characteristics of

entrepreneurial complexity discussed in *MANUSCRIPT I* challenge the entrepreneur's cognition and decisions, including opportunity recognition and exploitation.

Prior research suggests that cognitive abilities, which are manifested in human behavior (Kim et al., 2018), influence opportunity recognition and exploitation (Lumpkin & Dess, 2004). The findings of this dissertation support this suggestion. The overall results indicate that cognitive abilities are central to entrepreneurial behaviors, including the identification of business opportunities. The results of *MANUSCRIPT II* show a positive interplay between entrepreneurial self-efficacy and opportunity recognition, as well as between entrepreneurial imaginativeness and opportunity recognition. Furthermore, a high correlation among the antecedents was identified, and our findings reveal existing differences in terms of country affiliation, gender, and exposure to entrepreneurial learnings. For instance, US sample, male students, and prior experience with entrepreneurship education show a higher level of opportunity recognition.

These results correspond with the findings of several previous studies (e.g., Dempsey & Jennings, 2014; Shinnar et al., 2014; Wilson et al., 2007; Karlsson & Moberg, 2013), which provide evidence that male respondents display significantly higher entrepreneurial self-efficacy. In particular, Dempsey and Jennings (2014) indicate that the reason for the lower entrepreneurial self-efficacy exhibited by women might be rooted in their lower experience with entrepreneurship, but women are also more likely to receive negative opportunity evaluation feedback. Other studies have also provided evidence that women exhibit a lower level of affection towards entrepreneurship (Dempsey & Jennings, 2014; Minniti & Nardone, 2007), confirming the reports of lower entrepreneurial activity and entrepreneurial intention among female entrepreneurs (Minniti, et al., 2005; Minniti & Nardone, 2007). However, Wilson et al. (2007) also showed that the effects of entrepreneurship education on entrepreneurial self-efficacy were higher for women than for men. Therefore, due to their higher likelihood to receive a failure feedback on entrepreneurial performance and their lower

emotional involvement (Dempsey & Jennings, 2014), for *MANUSCRIPT III*, we assumed that female students would react more sensitively towards entrepreneurial rejection, resulting in the termination of their business opportunity. Surprisingly, however, female respondents showed a stronger tendency toward continuing the venture opportunity after receiving negative feedback. This finding offers an interesting direction for future studies to explore the link between negative feedback and entrepreneurial self-efficacy among female students.

Negative or failure feedback can also be a source of potential learning that could lead to the venture's success. When confronted with an abundance of information, people reply on feedback. Since *MANUSCRIPT II* only offers correlation between three antecedents and opportunity recognition and does not enable us to determine causation, the third study continues the opportunity research and includes opportunity exploitation. Key findings from *MANUSCRIPT III* reveal that negative feedback is more accepted when it comes from a source that is perceived to be highly credible, it is more likely to result in the withdrawal of a business opportunity, and it attracts stronger attention and remains in the entrepreneur's memory longer. These results align with existing research (e.g., Dholakia & Sternthal, 1977; Maloney, 1994; Wathen & Burkell, 2002; Reich, 2011) examines the influencing effects of source credibility: they find that people tend to trust sources they perceive as credible and which makes them more likely to accept their feedback. The influence of credibility and cognitive feedback on individual's cognition and behavior provides central implications not only for business angels but also for teachers of entrepreneurship. Feedback is a central element of learning (Goodman & Wood, 2004). The perceived credibility of entrepreneurship teachers as well as the type of feedback they provide is an intriguing desideratum that requires further investigation.

The discussion of entrepreneurial complexity in conceptual *MANUSCRIPT I* reflects the findings of *MANUSCRIPT IV*, which focuses on transformative learning and troublesome knowledge. The results of *MANUSCRIPT IV* reveal two types of troublesome concepts in entrepreneurship: troublesome content-related knowledge and troublesome methodology.

Educators reported that a high level of ambiguity exists in entrepreneurial learning, and their students struggle with an entrepreneurial environment that they characterize as open-ended, uncertain, and highly dependent on external and internal factors (i.e., students must depend on their team members, and they require a certain level of self-organized learning that they are not used to). This challenging perception of high dependency and ambiguity is reflected in the results of *MANUSCRIPT IV*, which found a high level of interdependency and uncertainty. This means that both the practical context of entrepreneurship and the entrepreneurial learning context are considered complex. However, education studies suggest that dealing with troubling situations can have a transformative effect due to their potential for "higher-level" learning (Cope, 2001; 2003; Meyer & Land, 2005).

Finally, teachers of entrepreneurship argued that the concept of opportunity recognition is unclear, making it difficult for students to entirely comprehend. In particular, the term opportunity is perceived as rather abstract and impractical for students to fully appreciate. Opportunity recognition is the subject of *MANUSCRIPT II*, and the outcomes of *MANUSCRIPT IV* highlight the relevance of investigating the influencing factors of opportunity recognition.

Table 15: Key Findings of the Dissertation

Research Questions	Findings
Manuscript 1: What situational factors constitute the conditions under which entrepreneurial decisions take place?	• The entrepreneurial environment is imperfect, which is characterized by interdependency, emotional attachment, or multiple-dynamic problems, etc. • Entrepreneurial learning can have a transformational character
Manuscript 2: What cognitive psychological factors serve as predictors of individuals' opportunity recognition?	• Entrepreneurial self-efficacy and entrepreneurial imaginativeness correlate with opportunity recognition • Problem-solving does not correlate with opportunity recognition • Entrepreneurial self-efficacy, entrepreneurial imaginativeness, and problem-solving show high correlation among one another • US-sample and male respondents show a higher entrepreneurial self-efficacy and opportunity recognition
Manuscript 3: Which feedback-related information has an effect on the individual's decisions whether to continue or to withdraw the business opportunity?	• High credibility of source tends to lead to a higher agreement, external attribution, and has the potential to attract attention • Cognitive feedback correlates with internal attribution, higher acceptance, and retention of information
Manuscript 4: Which entrepreneurial subjects cause learning difficulties for students?	• The entrepreneurial learning environment is characterized through ambiguity, post-determination, negative impact, etc. • There are two identified types of troublesome concepts: troublesome content-related knowledge and troublesome methodology • Didactic strategies to deal with troublesome concepts: proactive and reactive strategies • Error-based learning: practice-based and practitioner-based learning

6.1 Limitations and Implications for Future Research

The dissertation strives to understand entrepreneurs and their behavior during the venturing process. Although this dissertation offers numerous novel insights, it has limitations that also provide intriguing avenues for future research. This section addresses some overall and cross-study limitations of this dissertation and discusses a few compelling topics for future entrepreneurship research.

MANUSCRIPT II focuses on the elaboration of cognitive abilities and their relevance in identifying entrepreneurial opportunities. Based on entrepreneurship literature, the first study conceptualizes entrepreneurial self-efficacy, problem-solving, and entrepreneurial imaginativeness as cognitive abilities and as antecedents of opportunity recognition. *MANUSCRIPT II* identifies the correlation between opportunity recognition the proposed antecedents. However, it is impossible to determine causation between these components; therefore, this should be approached by future studies. Although the experimental research conducted in *MANUSCRIPT III* investigates effects on the pursuit of opportunities, the three aforementioned antecedents were not considered. Future research should combine both studies using an identical sample in order to investigate both entrepreneurial behaviors, that is, opportunity recognition and exploitation. For instance, the literature proposes that an empirical closeness exists between perceived self-efficacy and resilience (Cassidy, 2015; Schwarzer & Warner, 2013; Benight & Cieslak, 2011). Self-efficacy has a positive effect on coping with adversity by maintaining motivation and setting challenging goals (Schwarzer & Warner, 2013). Thus, it can be assumed that individuals with a higher level of entrepreneurial self-efficacy are more resilient and not as easily discouraged by rejection. Therefore, despite experiencing an entrepreneurial rejection, they might be more likely to continue pursuing their entrepreneurial endeavors. Future studies can explore the mediating effect of entrepreneurial self-efficacy between entrepreneurial rejection and entrepreneurial persistence in terms of the decision to continue pursuing the business opportunity.

MANUSCRIPT I discusses the different elements that characterize the context in which the entrepreneurial decision takes place. The findings of this research provide suggestions for further research. For instance, the indication of an emotional attachment inspired *MANUSCRIPT III's* focus on entrepreneurial rejection, which triggers negative emotions and challenges the emotional attachment towards the business opportunity. Furthermore, the outcome-based feedback used here was based on the aspect of intransparency discussed in

MANUSCRIPT I. The quantitative-oriented character of the outcome-oriented feedback does not offer an explanation and can be perceived as inconclusive (Haynie et al., 2012). However, there are further characteristics of entrepreneurial complexity that can be addressed in future research. For instance, the entrepreneur's pursuit of multiple goals during the venturing process (*polytely*) can be subject to future research. Literature postulates that entrepreneurs often pursue multiple goals during the venturing process. This particularly applies to social enterprises, which intend to achieve profitable, sustainable, and societal impact goals (Markman et al., 2016; Stevens et al., 2015). While *MANUSCRIPT III* is based on social business innovation and intends to trigger the complexity of entrepreneurial decision-making by weighting social and economic values, it does not explicitly address the collision of venture goals. Hence, entrepreneurial decisions, including prioritizing goals after receiving negative feedback, can be a desideratum for future studies.

A final suggestion relates to *MANUSCRIPT IV*, which investigates troublesome knowledge in entrepreneurship. Troublesome knowledge is identified through the teachers' perspective. Entrepreneurial learning that integrates troublesome concepts and critical reflection has the potential to trigger transformative learning (Mezirow, 1996; Cope, 2003). Teachers of entrepreneurship are asked to reflect on their students' errors and struggles with entrepreneurial subjects. Therefore, *MANUSCRIPT IV* focuses on the teachers' perspective, whereas *MANUSCRIPTS I* and *III* focus on the learners' perspective. Future research can examine the troublesomeness of learning subjects by focusing on opportunity recognition or entrepreneurial rejection from the students' perspective. The characteristics of entrepreneurial complexity examined in *MANUSCRIPT I* can be used to model the entrepreneurial environment. For instance, an invention-based research can be conducted to investigate the transformative learning (e.g., the entrepreneurial mindset) that has been suggested by literature (Mezirow, 1996; Cranton, 1996; Konovalenko Slettli, 2019).

6.2 Practical Implications for Entrepreneurship

In addition to the implications for entrepreneurship research, the findings of this dissertation also have practical implications for practitioners of entrepreneurship (entrepreneurs, educators, start-up consultants, investors, etc.), who deal with entrepreneurship-related tasks in their daily work. This section outlines key implications from the four studies.

MANUSCRIPT I focuses on establishing an understanding of entrepreneurial complexity and a distinction between certain, risky, uncertain, and complex entrepreneurial situations. This differentiation can help future entrepreneurs distinguish between situation types and to analyze their scope of actions. Furthermore, this situational distinction can be incorporated into entrepreneurship training programs that raise awareness about different situation types; it may be used to help entrepreneurs distinguish between situations that allow a deliberate and thoughtful decision-making process and situations that require a heuristic and intuition-based decision-making approach. Prior work has already examined the process of dealing with complexity through simulation-based learning (Dörner, 1983; Brehmer, 1989) and crisis-based learning (Pittaway & Thorpe, 2012). Such learning approaches can increase analytical, problem-solving, and reflection competencies (Boyles, 2012).

MANUSCRIPT II understands opportunity recognition as a cognitive ability that involves working memory, speed processing, and executive control (Jin et al., 2019). The cognitive ability to recognize patterns, which eventually leads to innovative business ideas, can be acquired and trained through entrepreneurship education (Costa et al., 2017). Creativity and imaginativeness are vital to the generation of novel ideas that lead to new venture formation (Amabile & Kramer, 2011), and many scholars have proposed a link exists between creativity and education (Shaheen, 2010; Craft, 2001). The findings of this dissertation also support this relationship. Hence, educators are strongly recommended to actively enforce imaginativeness in entrepreneurial learning. Research into entrepreneurship education also recommends the

integration of art and creative techniques (e.g., design thinking) in entrepreneurship education (Ko & Butler, 2007; Baldacchino, 2009).

The results of *MANUSCRIPT II* also confirm the positive correlation between entrepreneurial self-efficacy and opportunity recognition. This makes the question of how to promote entrepreneurial self-efficacy highly relevant, particularly for teachers of entrepreneurship. Previous work has suggested that perceived self-efficacy can be boosted through self-regulated learning (Zimmerman et al., 1996), coaching, increased participation, mentoring, as well as incentives and rewards (Heslin, 1999). Such didactical recommendations can be implemented by teachers in entrepreneurship classrooms to help students with the development of their entrepreneurial self-efficacy. Furthermore, combining the implications of *MANUSCRIPTS I* and *II*, educators are also encouraged to create a complexity-based venture environment in order to strengthen entrepreneurial self-efficacy and entrepreneurial imaginativeness. This also works for *MANUSCRIPT III*, which deals with entrepreneurial rejection. The experience of coping with entrepreneurial rejection can be trained within entrepreneurship education.

This highlights the implications of *MANUSCRIPT IV*, which focuses on troublesome concepts. Identifying epistemological and ontological transformations has an impact on the teaching of any discipline (Kallia & Sentance, 2020). Critical and troublesome subjects help teachers structure their lessons, prepare didactical strategies, and create teaching materials that help students master their learning obstacles and help enhance learning effectiveness (Kallia & Sentance, 2020). Entrepreneurial rejection, as a potential troublesome concept, can be implemented in entrepreneurial learning to generate transformative learning experiences. Without transforming learners understanding, interpretation, and perspective, epistemic progress rarely happens (Meyer et al., 2008).

Entrepreneurship education not only struggles with developing curricula that include central theories and models, but also with providing students with practical methods and tools for dealing with the precarious venturing process; therefore, there is an urgent need for the examination of learning theory and didactic considerations (Fayolle, 2013; Neck & Greene, 2011; Rigg & O'Dwyer, 2012). Cousin (2008) argues that identifying transformative concepts has the potential to create new forms of transactional curriculum inquiry, which integrates different stakeholder perspectives. Thus, this dissertation also offers a framework for designing entrepreneurship curricula that have a transformative effect on learners. Table 16 illustrates the implications for entrepreneurship research and practical entrepreneurship.

Table 16: Implications for Entrepreneurship Research and Practical Entrepreneurship

Manuscript I	Manuscript II	Manuscript III	Manuscript IV
Implications for entrepreneurship research			
▪ Consideration of entrepreneurial errors as a step before entrepreneurial crisis and failure ▪ Further investigation of reflection of entrepreneurial errors as a cognitive ability ▪ Including generic error and complexity research in continuing discussion on entrepreneurial complexity	▪ Cognitive abilities such as entrepreneurial self-efficacy and entrepreneurial imaginativeness are relevant in recognizing business opportunities ▪ Offer implication for investigation on the interplay between entrepreneurship education and entrepreneurial self-efficacy through pre-post-test	▪ Credibility of source as a potential cognitive bias on individual's perception, information processing, and entrepreneurial decision ▪ Implications for investigating social business model as a cognitive bias	▪ Suggestions of entrepreneurial subjects that are troublesome and can empirically be tested ▪ Insights into professional error competencies that can be analyzed by future research
Implications for practical entrepreneurship			
▪ Provision of differentiation and reflection on types of situations and the level of complexity for (nascent) entrepreneurs while making entrepreneurial decisions ▪ Educators can address the characteristics of entrepreneurial environment in learning settings	▪ Promoting entrepreneurial imaginativeness in entrepreneurship education ▪ Implication to using the reflection process to enhance entrepreneurial self-efficacy ▪ Indicate a cross-disciplinary strategy on implementing entrepreneurial learning	▪ Implications on the design of negative feedback for educators of entrepreneurship training programs and investors or venture capitalists ▪ Implications on providing information about the feedback provider (anonymous or transparent provision of the person-related information)	▪ Results offer implications for designing entrepreneurship curricula that is based on troublesome concepts ▪ Offer insights into troublesome topics in entrepreneurship and suggest didactical strategies to deal with troublesomeness

6.3 Conclusion

The entrepreneurial journey is an emotional rollercoaster with many highs and lows (Shepherd & Patzelt, 2018; Cock et al., 2020), and entrepreneurial actions are performed in an ill-defined environment. Not only does this make entrepreneurship susceptible to mistakes and bounded rationality, it is also the root of entrepreneurial crises and failures. Therefore, an investigation into the cognitive process of entrepreneurs is necessary to understand what motivates them to enter the venturing process, to understand the factors affecting the identification and pursuit of entrepreneurial opportunities, and to understand why some entrepreneurs are more successful than others (Baron, 2000).

Central to this cognitive process is the nature of the learning process (Harrison & Leitch, 2005; Ravasi & Turati, 2005) that leads to entrepreneurial activities (Krueger, 2003). Minniti and Bygrave (2001, p. 1) pointed out that "entrepreneurship is a process of learning, and a theory of entrepreneurship requires a theory of learning." Thus, researchers must understand "how individuals learn and how different modes of learning influence opportunity identification and exploitation" (Corbett, 2005, p. 473). This means that the ability to learn determines the ability to recognize business opportunities, and vice versa (Corbett, 2005). Although the literature proposes an existing interdependency between entrepreneurial learning and entrepreneurial cognition (Smilor, 1997), these subjects have been largely explored in isolation from one another; few studies have combined these two thematic areas (e.g., Corbett, 2005). However, the combination of the two enables an understanding of the nature of entrepreneurial cognition and allows for the incorporation of this insight into entrepreneurial learning. Smilor (1997, p. 344) argues that "effective entrepreneurs are exceptional learners. They learn from everything. They learn from customers, suppliers, and especially competitors. They learn from employees and associates. They learn from other entrepreneurs. They learn from experience. They learn by doing. They learn from what works and, more importantly, from what doesn't work." Not only can entrepreneurial learning prepare students to face the adversarial

entrepreneurial environment, it can also help students develop the cognitive ability of opportunity recognition.

Based on these insights, the dissertation considers opportunity recognition as the major driver of new venture formation and acknowledges that the entrepreneurial journey is discontinuous, disruptive, and paved with difficulties. The main purpose of this dissertation is to substantiate the entrepreneurial cognition and education research by exploring the ill-structured environment of entrepreneurship, the factors that influence the recognition and exploitation of business opportunities, and the epistemological obstacles in entrepreneurial learning. Key results of the studies reveal that the entrepreneurial context is best characterized through its plurality of goals and internal dynamic; the former means that entrepreneurs confront problems for which multiple solutions exist, while the latter means that each situation is active, and the market will not wait for the entrepreneur to make a decision (Dörner, 1997; Dörner et al., 2006). Furthermore, entrepreneurial self-efficacy seems to be a driving force of opportunity recognition, and it should receive more attention in entrepreneurial learning. The results also show that external feedback has an effect on entrepreneurial cognition and behavior. Notably, the perceived credibility of the feedback source seems to have a strong effect on the individual's response toward entrepreneurial opportunities. Finally, the results indicate the existence of both troublesome content-related knowledge (e.g., effectuation) and troublesome methodology (e.g., entrepreneurial rejection), both of which challenge students of entrepreneurship; however, overcoming these epistemological challenges can have a transformative character.

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9 Appendix

List of Appendices

Manuscript II

Appendix 1: Item Reliability

	Alpha	Item-total corre-lation	Mean	SD
Opportunity recognition				
I am always alert to business opportunities	0.926	0.827	3.8	1.801
I research potential markets to identify business opportunities	0.912	0.907	3.033	1.867
I search systematically for business opportunities	0.91	0.918	2.824	1.84
I look for information about new ideas on products or services	0.939	0.753	3.804	1.973
I regularly scan the environment for business opportunities	0.915	0.889	2.95	1.88
Entrepreneurial self-efficacy				
I regularly scan the environment for business opportunities	0.938	0.702	4.874	1.529
Identify the need for a new product or service	0.937	0.768	4.777	1.458
Design a product or service that will satisfy customer needs and wants	0.938	0.734	4.89	1.416
Estimate customer demand for a new product or service	0.938	0.744	4.801	1.378
Determine a competitive price for a new product or service	0.938	0.728	4.53	1.491
Estimate the amount of start-up funds and working capital necessary to start my business	0.938	0.698	4.073	1.56
Design an effective marketing/advertising campaign for a new product or service	0.94	0.597	4.547	1.582
Get others to identify with and believe in my vision and plans for a new business	0.937	0.775	4.95	1.41
Network—i.e., make contact with and exchange information with others	0.94	0.621	5.12	1.411
Clearly and concisely explain verbally/in writing my business idea in everyday terms	0.938	0.693	5.385	1.399
Supervise employees	0.938	0.703	5.226	1.342
Recruit and hire employees	0.938	0.693	5.007	1.356
Delegate tasks and responsibilities to employees in my business	0.939	0.692	5.213	1.263
Deal effectively with day-to-day problems and crises	0.939	0.655	5.318	1.203
Inspire, encourage, and motivate my employees	0.939	0.674	5.362	1.28
Train employees	0.941	0.566	5.047	1.399
Organize and maintain the financial records of my business	0.939	0.678	4.385	1.546
Manage the financial assets of my business	0.939	0.681	4.309	1.569
Read and interpret financial statements	0.939	0.641	4.218	1.579
Problem-solving				
Being confronted with a maze of ideas which may, or may not, lead me somewhere	0.904	0.679	4.709	1.335
Pursuing a problem, particularly if it takes me into areas I don't know much about	0.902	0.724	4.593	1.368
Linking ideas which stem from more than one area of investigation	0.9	0.747	4.944	1.337
Being fully occupied with what appear to be novel methods of solution	0.897	0.791	4.831	1.307
Making unusual connections about ideas even if they are trivial	0.896	0.794	4.795	1.368
Searching for novel approaches not required at the time	0.899	0.759	4.394	1.381

Struggling to make connections between apparently unrelated ideas	0.909	0.598	4.132	1.335
Spending time tracing relationships between disparate areas of work	0.899	0.752	4.631	1.366
Being 'caught up' by more than one concept, method or solution	0.901	0.724	4.202	1.422
Entrepreneurial imaginativeness				
I consider myself to be inventive.	0.863	0.709	4.578	1.471
I consider myself to be innovative.	0.862	0.732	4.678	1.421
I demonstrate originality in my work.	0.858	0.796	4.983	1.37
I like to create original work.	0.861	0.727	4.904	1.436
People say that I am artistic.	0.876	0.56	4.15	1.92
Being creative is a large part of who I am.	0.862	0.709	4.465	1.739
I tend to be good at project management.	0.876	0.527	4.881	1.439
I can picture what the bottleneck of a system will be.	0.872	0.597	4.664	1.353
Before I face a new situation, I picture the issues I may encounter and plan accordingly.	0.876	0.533	5.05	1.276
I see connections between seemingly unrelated pieces of information.	0.867	0.69	4.801	1.244
Forming mental images helps me solve problems.	0.874	0.531	5.233	1.303

Note: This table shows reliability measures including Cronbach's alpha and item-total correlations as well as means and standard deviations for all single items.

Appendix 2: Items and Factor Loadings

	(1)	(2)	(3)	(4)
Opportunity recognition				
I am always alert to business opportunities	0.84			
I research potential markets to identify business opportunities	0.93			
I search systematically for business opportunities	0.93			
I look for information about new ideas on products or services	0.75			
I regularly scan the environment for business opportunities	0.89			
Entrepreneurial self-efficacy				
I regularly scan the environment for business opportunities		0.73		
Identify the need for a new product or service		0.79		
Design a product or service that will satisfy customer needs and wants		0.76		
Estimate customer demand for a new product or service		0.78		
Determine a competitive price for a new product or service		0.73		
Estimate the amount of start-up funds and working capital necessary to start my business		0.68		
Design an effective marketing/advertising campaign for a new product or service		0.61		
Get others to identify with and believe in my vision and plans for a new business		0.78		
Network—i.e., make contact with and exchange information with others		0.61		
Clearly and concisely explain verbally/in writing my business idea in everyday terms		0.7		
Supervise employees		0.68		
Recruit and hire employees		0.67		
Delegate tasks and responsibilities to employees in my business		0.67		
Deal effectively with day-to-day problems and crises		0.64		
Inspire, encourage, and motivate my employees		0.66		
Train employees		0.55		
Organize and maintain the financial records of my business		0.63		
Manage the financial assets of my business		0.62		
Read and interpret financial statements		0.61		
Problem-solving				
Being confronted with a maze of ideas which may, or may not, lead me somewhere			0.69	
Pursuing a problem, particularly if it takes me into areas I don't know much about			0.71	
Linking ideas which stem from more than one area of investigation			0.74	
Being fully occupied with what appear to be novel methods of solution			0.78	
Making unusual connections about ideas even if they are trivial			0.8	
Searching for novel approaches not required at the time			0.76	
Struggling to make connections between apparently unrelated ideas			0.63	
Spending time tracing relationships between disparate areas of work			0.75	
Being 'caught up' by more than one concept, method or solution			0.73	
Entrepreneurial imaginativeness				
I consider myself to be inventive.				0.76

I consider myself to be innovative.	0.77
I demonstrate originality in my work.	0.85
I like to create original work.	0.78
People say that I am artistic.	0.57
Being creative is a large part of who I am.	0.70
I tend to be good at project management.	0.44
I can picture what the bottleneck of a system will be.	0.52
Before I face a new situation, I picture the issues I may encounter and plan accordingly.	0.41
I see connections between seemingly unrelated pieces of information.	0.58
Forming mental images helps me solve problems.	0.48

Note: Items and factor loadings from Confirmatory Factor Analysis as part of the structural model displayed in chapter 3.5.3

Manuscript IV

Appendix 3: Teachers' Definition of Entrepreneurial Error

1st Order Concepts	2nd Order Themes	Aggregate Dimensions/ Anchoring Concept
▪ Errors are fuzzy and are not clearly identifiable ▪ Determining the error is difficult ▪ No black and white thinking	Diagnostic difficulties	Ambiguity
▪ Error is context-dependent ▪ Error depends on personal biography	Interdependency	
▪ As long as you learn from mistakes, there is no mistake ▪ Error is a learning process and opportunity ▪ Errors are part of the learning process (testing, trial, error) ▪ Error is part of the innovation process	Opportunity	Functionality of errors
▪ Ex ante rationalization not possible ▪ Error not determinable, because we must know beforehand what is right and wrong. ▪ Error of something where there was nothing before cannot be an error	Unpredictability	Post-determination
▪ Error and Failure is not the end result ▪ Process-oriented not outcome-oriented ▪ Error and failure are part of the venturing process	Process-orientation	
▪ Careless vs. negligent errors ▪ Ill-considered vs. calculated errors ▪ Smart mistake vs. avoidable mistake ▪ Acceptable vs. unethical mistakes	Good vs. bad error	Differentiation of errors
▪ Investments made and costs incurred ▪ Severe consequences (e.g., insolvency)	Direct or indirect effects	Negative Impact

Appendix 4: Data Structure of Troublesomeness in Entrepreneurship Education

Anchoring Concept	Suggested troublesome knowledge	Described error	Type of error	No. of informants
Business modelling	Business model canvas	▪ Differentiating the segments and terms ▪ Innovation reduction ▪ Transfer of theory to practice ▪ Understanding of the interconnections	Action-related / Cognitive-related	11
	Opportunity recognition	▪ Creativity problem ▪ Dependency between opportunity and its creator		
	Scalability of a business model	▪ Understanding of a functioning business model		
	Lean start-up, design thinking and prototyping	▪ Ability to measure and visualize ▪ Understanding the principle of minimal viable product ▪ Identify valuable insights from testing and measuring		
	Value creation	▪ Concept of social entrepreneurship ▪ Integrating aspects of sustainability or ethical perspective (CSR) in business models ▪ Relation between innovation and value creation		
Business value chain	Corporate law	▪ Distinction between legal forms of businesses ▪ Labelling obligations	Cognitive-related	7
	Finance and pricing	▪ Form of financing ▪ Company valuation ▪ Estimating turnover, costs, sales vs. profit limits ▪ Calculating profit margin		
	Market and customer analysis	▪ Customer survey ▪ Product-orientation instead of customer-orientation ▪ Lack of focus on the market, customers, problem ▪ Calculating the market volume		
Reference to a domain	Entrepreneurship vs. Management	▪ Separate entrepreneurship and management theories ▪ Apply entrepreneurship and management theories	Cognitive-related	3
	Leadership	▪ Entrepreneurial vs. managerial leadership		
Semantic boundaries	Entrepreneurship vs. Intrapreneurship	▪ Separate entrepreneur from intrapreneur	Cognitive-related	6
	Causation / Effectuation / Bricolage	▪ Accepting novel decision modes ▪ Grasp the meaning of the principles (e.g., *Crazy Quilt*) ▪ Acting under scarcity of resources		
	Heuristics vs. Bias	▪ Using heuristics in an entrepreneurial situation ▪ Finding examples for different biases		
	Uncertainty vs. Risk	▪ Terminology		

Misconceptions	Perception	▪ Capitalism ▪ Negative image	Action-related	6
	Personality of entrepreneurs	▪ Risk-orientation		
	Learning goals of entrepreneurship education	▪ Entrepreneurship education is aimed at people with venturing intentions ▪ Neglecting the entrepreneurial mindset ▪ Neglecting the social added value ▪ Difficulties to recognize entrepreneurship as an interdisciplinary competence		
Anchoring Concept	**Suggested troublesome methodology**	**Described error**	**Type of error**	**No.**
Didactical concept	Uncertainty and ambiguity	▪ Confrontation with openness of results ▪ Complexity (secondary effects) ▪ Academic standard vs. playful didactic ▪ Lack of structure	Action-related / Meta-competencies	8
	Self-organized learning formats	▪ Work intensity, time management, freedom of decision ▪ Planning and organizational skills ▪ Action orientation, pressure to perform		
	Entrepreneurial Identity	▪ Know your own competences, strengths and weaknesses ▪ Self-concept		
Downside of entrepreneurship	Rejection and criticism	▪ Acceptance of rejection, criticism and negative feedback ▪ Hesitation towards negative topics (e.g., failure, crisis, resilience)	Meta-competencies	5
Practice-dependency	Academic vs. practical experience	▪ Scientific depth ▪ Transfer of theories into entrepreneurship ▪ Practical problem and scientific question	Cognitive-related / Action-related	2
Social form	Team-dependency	▪ Dependency on team members ▪ Free rider problem ▪ Communication and coordination within the team ▪ Task assignment within a group ▪ Interdisciplinary group	Cognitive-related / Meta-competence-related / Action-related	5

Appendix 5: Teachers' Response Towards Students' Errors

1st Order Concepts	2nd Order Themes	Aggregate Dimensions/ Anchoring Concept	
▪ Instruction ▪ Establishing rules ▪ Clarifying learning goals ▪ Linking with previous knowledge	Structuring	Advance Organizer	Proactive
▪ Show handling of heuristics ▪ No right and wrong communication ▪ No immediate answer at hand	Sensitization		
▪ Regular exchange ▪ Supervision & guiding ▪ Coaching & mentoring	Constant feedback & monitoring	Formative Evaluation	
▪ Openness & honesty ▪ Fairness & trust ▪ Admit own mistakes	Relationship building	Create a positive error culture	
▪ Two-eye conversation	Tutoring	Correction by teacher	Reactive
▪ Call it out ▪ Lean learning	Immediate correction		
▪ Application of theory & testing ▪ Using examples & concepts ▪ Case studies ▪ Visualization	Explorative learning	Correction by student	
▪ Asking critical questions ▪ Evidence-based argumentation ▪ Socratic question	Challenging / nudging		
▪ Autopsy without blame	Deep analysis	Correction by whole class	
▪ Discussion ▪ Plenum discourse	Integrating diverse opinion		
▪ Role playing	The devil's advocate	Correction by Bermuda triangle	
▪ Peer/Group-Feedback	Redirecting question		
▪ Directing to practitioners & experts ▪ Team-teaching	Redirecting to co-teachers	Correction by co-teachers	