

**UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL
ESCOLA DE ADMINISTRAÇÃO
PROGRAMA DE PÓS-GRADUAÇÃO EM ADMINISTRAÇÃO
DOUTORADO EM ADMINISTRAÇÃO**

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**The effect of entrepreneurial impulsivity and resilience in
firm innovativeness: the case of Agtech startups in
southern Brazil**

Porto Alegre

2023

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firm innovativeness: the case of Agtech startups in
southern Brazil**

Ph.D. dissertation presented to the Postgraduate Program in Business Administration at the Federal University of Rio Grande do Sul as a final requirement to obtain the Ph.D. in Business Administration.

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Porto Alegre

2023

*I dedicate this study to my parents, my
sister, and my niece, who are the light of
my life.*

ACKNOWLEDGEMENTS

The process of producing a Ph.D. dissertation has its tolls on all aspects of our lives. After much reluctance, I decided to pursue an academic career due to the extreme happiness and fulfillment that teaching and research bring to my life – despite the inevitable hardships attached to this field of work.

I have to start thanking my beloved friends and fellow researchers Aline Goularte and Fernando Henrique Lermen, without whom I would never become the researcher I am today. Your constant support and encouragement made me believe in myself, the quality of my work and the value of my journey. I could never have asked for better friends and partners. You are the proof life can surprise us and deliver treasures neither our most optimistic dreams could match.

I would like to also thank Dr. Keitiline Viacava for the inspiration and encouragement in the beginning of my Ph.D. journey, when I had a lot of questions and no scholarship. The right person saying “you can get through it” can mean everything during troubling times. It was she who introduced Dr. Rosa Martins to me, who also became a reference and a welcomed presence in my life over the years. She honors me with her participation in the doctoral panel for my thesis. As far as challenges go, I must also thank my dear friend and researcher Daiane Gonçalves. I treasure our friendship and it makes me extremely happy that we both thrived together as much as we struggled together during our Masters.

I have special thanks to give to my advisor, Professor Antonio Padula, who embraced my ambitions and respected my interests of research, always giving me room to pursue my goals as a Ph.D. student, while “polishing” me to become a better professional. Along four years of partnership, I felt I was being treated with extreme respect, dignity, and comprehension. As unfortunate as it is, it pains me to say this is not the case for many colleagues in Academia. Therefore, I feel privileged and truly blessed for counting on such a brilliant companion throughout my journey in becoming a doctor.

Finally, I would like to thank my parents, Sueli and Paulo, for their enormous contribution and support during all these years. I can only hope to have enough time to repay all love and support I’ve received over the years. Thank you for believing in me. You may not understand what I do, but I’m sure you trust my judgement on what makes me happy and fulfilled.

*Who is that on the trenches by your side?
– And does it matter?
– More than the war itself.*

Ernest Hemingway

ABSTRACT

Entrepreneurs in the Agtech sector face several hardships. Apart from the intrinsic difficulties associated with startup venturing (e.g. difficulties in assessing the market, weak partnerships, poor infrastructure), these professionals need to provide solutions for a world whose growth is expected to generate an expressive demand of food and supplies that are crop-dependent. In view of this scenario, we hypothesized Agtech entrepreneurs in southern Brazil were influenced, at some level, by impulsivity. On the other hand, to survive and thrive in the face of numerous hardships, it is expected from these individuals a considerable level of personal resilience. At the same time, the need for more technological and efficient tools to increase crop production poses a challenge to a very central aspect in the survival of a startup company: its innovativeness. Hence, this study tested the impact of CEOs' impulsivity and resilience characteristics in their firm's innovativeness. The methods adopted to measure impulsivity, resilience, and innovativeness were, in order, the Barratt Impulsivity Scale (BIS-15), the Norwegian dispositional resilience scale, and Garcia and Calantone's Innovativeness Measurement Scale. Data was analyzed through Structural Equation Modeling (SEM). A number of 74 respondents participated in the study. Results indicated a prevalence of men (66%) in the sample, with 85% of participants belonging to the age group between 31 and 50 years old. The majority of respondents were located in the state of Rio Grande do Sul (45.68%), and 86.42% categorized themselves as white. Results indicate that one dimension of each construct (impulsivity and resilience) were significant measures of innovativeness: low levels of non-planning impulsivity – meaning these individuals are careful planners – and high levels of commitment resilience - a feature linked to a positive attitude and the feeling one has a meaningful life. Theoretical and practical implications are discussed and possible avenues for future research are presented.

Keywords: Entrepreneurship. Agtech. Agritech. Startups. Impulsivity. Resilience. Innovativeness.

RESUMO

Os empreendedores do setor Agtech enfrentam várias dificuldades. Além das dificuldades intrínsecas associadas ao empreendedorismo inicial (por exemplo, dificuldades na avaliação do mercado, parcerias fracas, infra-estrutura deficiente), estes profissionais precisam fornecer soluções para um mundo cujo crescimento é esperado para gerar uma demanda expressiva de alimentos e suprimentos que dependem do plantio. Diante deste cenário, apresentamos a hipótese de que os empresários de Agtech no sul do Brasil foram influenciados, em algum nível, pela impulsividade. Por outro lado, para sobreviver e prosperar diante de inúmeras dificuldades, espera-se destes indivíduos um nível considerável de resiliência pessoal. Ao mesmo tempo, a necessidade de ferramentas mais tecnológicas e eficientes para aumentar a produção agrícola representa um desafio a um aspecto central na sobrevivência de uma start-up: sua capacidade de inovação. Assim, este estudo testou o impacto das características de impulsividade e resiliência dos CEOs na capacidade de inovação da empresa. Os métodos adotados para medir a impulsividade, resiliência e inovação foram, em ordem, a Escala de Impulsividade Barratt (BIS-15), a escala de resiliência dispositiva norueguesa, e a Escala de Medição de Capacidade de Inovação de Garcia e Calantone. Os dados foram analisados através de Modelagem da Equações Estruturais (SEM). 74 respondentes participaram do estudo. Os resultados indicaram uma prevalência de homens (66%) na amostra, com 85% dos participantes pertencentes à faixa etária entre 31 e 50 anos de idade. A maioria dos respondentes estava localizada no estado do Rio Grande do Sul (45,68%), e 86,42% se classificaram como brancos. Os resultados indicam que uma dimensão de cada construto (impulsividade e resiliência) foram provadas medidas significativas de capacidade de inovação. São elas: baixos níveis de impulsividade não planejada - indicando que estes indivíduos são planejadores cuidadosos - e altos níveis de resiliência de comprometimento - uma característica ligada a atitudes positivas e ao sentimento de que se tem uma vida com significado. Implicações teóricas e práticas são discutidas e caminhos para pesquisas futuras são apresentados.

Palavras-chave: Empreendedorismo. Agtech. Agritech. Startups. Impulsividade. Resiliência. Inovadorismo.

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LIST OF ACRONYMS

GPS - Global Positioning System

RFID - Radio Frequency Identification

SEBRAE - Brazilian Micro and Small Business Support Service

EO - Entrepreneurial Orientation

AI - Artificial Intelligence

IoT - Internet of Things

AR - Augmented Realities

ICT - Information and Communication Technology

IBGE - Brazilian Geography and Statistics Institute

DRM - Design Research Methodology

SLR - Systematic Literature Review

SEM - Structural Equation Modelling

CCA- Confirmatory Composite Analysis

CSA - Covariance Structure Analysis

KMO - Keyser-Meyer-Olkin

RMSEA - Root-Mean-Squared Error of Approximation

SRMR - Standardized Root Mean Square Residuals

AVE - Average Variance Extracted

HTMT - heterotrait-heteromethod

ADHD - Attention Deficit Hyperactivity Disorder

SUMMARY

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1 Introduction

Individual behavioral aspects have been found to be essential in the understanding of themes such as entrepreneurship (Capello and Lenzi, 2016; Bissola et al., 2017), leadership (Gurd and Helliard, 2017; Villaluz and Hechanova, 2019) and team behavior (Toh and Miller, 2016; Llamas et al., 2019). The pioneer work of Stewart et al. (1999) on the differences between owner-managers and entrepreneurs indicated that the latter presents some specific psychological features. Their study demonstrated that an individual's awareness of his or her psychological profile provides a number of advantages, not only to existing entrepreneurs, but also to aspiring entrepreneurs who should assess their perceived entrepreneurial opportunities against the backdrop of their psychological proclivity for entrepreneurship.

The general increase in competition and the volatility of technological endeavors have led companies to significant challenges in the world of the knowledge economy. To tackle the constant need for innovation, firms are dependent on their creative structure and the individuals behind decision-making in innovation. Moreover, to innovate is hardly a task achievable only by individual creative efforts (Leonard and Sensiper, 1998), posing great responsibility in teams and entrepreneurial education (Toh and Miller, 2016; Park, 2017; Prasad et al., 2018).

Decision-making, a central feature of social relations, is one of the aspects that best differentiate human beings from their evolutionary ancestors. Although animals also evaluate the possibilities related to each choice they make, it is human beings' special ability to prevent their choices from incurring avoidable risks, so that their actions generate maximum gains at the lowest possible costs (Platt and Glimcher, 1999). This efficiency is, however, limited by the individual capacities of decision-makers (Elbanna, 2006), which are often influenced by the environment and by social expectations (Bruch and Feinberg, 2017), besides genetic pre-disposition (Cox and Witten, 2019). The past two centuries have concentrated a significant number of changes in the social, political and technological aspects of human routine. The complexity of such changes turned decision-making processes in business a specially challenging task (Gonçalves et al., 2018).

A startup is an organization designed to develop new products and services under conditions of extreme uncertainty, always looking for repeatable, profitable and scalable business models, aiming for rapid growth (Pantiuchina et al., 2017). According to Blank

(2018), startups are not merely a small version of a big company. Once the business model is known, the company organizes around this goal, measures its efforts to achieve it, and looks for the most efficient ways to keep improving. In some industries, market changes occur exponentially, which demands adaptations that large companies find it difficult to stay in touch with (Weiblen and Chesbrough, 2015).

For being completely compromised with an “innovation orientation”, startups are enabled to explore innovative solutions with greater speed and specialization than larger firms (Munir and Beh, 2019). The motives are two-fold: there must be mobility and agility on resource management to be in line with market’s needs and competitive advantage is mainly temporary, which demands quicker responses and dynamic processes (Freeman and Engel, 2007). These tasks, however, are unlikely to be performed without inherent setbacks. The majority of startups fail in the first 5-10 years of existence due to several management challenges related to the high risk and uncertainty conditions in which they operate (Giardino et al., 2014; Serrano and Ziedonis, 2019). Risk is not only related to unpredictable outcomes, but also to the reaction of top decision-makers to new propositions (Munir and Beh, 2019). Thus, an organization's take on risk is fundamental to provide a safe space for new ideas without incurring in irrecoverable losses (Kang et al., 2016). Realistic decisions and the overall resolutions on what risks are worth taking are particularly linked to another critical variable: impulsivity. This trait is the result of a dysfunctional performance in cognitive self-control (Steinberg et al., 2008) and leads to quick and under evaluated decisions that might trigger unnecessary risk-taking (Bechara, 2005). Wiklund et al. (2017) found that entrepreneurial behavior is related to multiple dimensions of impulsivity, including craving for short-term rewards and a sense of urgency that compromises attention. In fact, Lowe and Ziedonis (2006) indicated that impulsivity led by overoptimism, for instance, induce entrepreneurs to remain in an unsuccessful course of action longer than well-established firms would do.

Setbacks, inherent risks and proneness to impulsivity are, therefore, conditions that surround new ventures from the beginning. The way startups overcome such barriers might be explained by another critical variable for businesses: resilience (Wiklund et al., 2017; Vera et al., 2020). Resilience in itself means a stable adjustment to quick and dramatic changes (Bonanno et al., 2012). This feature is linked to sub variables intimately involved in innovative businesses such as loss acceptability and overcoming of status quo (Campos, 2021). Although previous studies have extensively

explored an organizational view of risk, impulsivity and resilience (Wiklund et al., 2017; Vera et al., 2020; Aldianto et al., 2021), a gap remains on the personal profiles of individuals behind new ventures, that is, how these two variables in human behavior might favor an innovative environment. Although previous studies have examined the climate dynamics of startups as a key to innovation outcomes (Lányi, 2016; Munir and Beh, 2019), research has not so far addressed how individual psychological features influence firm innovativeness.

Looking to verify levels of impulsivity and resilience in the entrepreneurial startup environment, our study has first developed a bibliometric and systematic literature review to address the state-of-the-art in the field. The first step of our analysis was to choose the most adequate combination of search strings. Different sequences were tried in a preliminary search on Google Scholar, and the two combinations that resulted in the most findings were chosen. According to a query made in November 2020, the number of findings of the word combinations adopted was as follows: "risk-taking" AND innovation (726.000 results) and "risk-taking" AND creativity (325.000 results). Therefore, these combinations were adopted in our research on the Scopus and Web of Science (WoS) databases. Although other databases could have been considered, these two were adopted due to (1) their compatibility with Bibliometrix, thus automatizing the analysis (Aria and Cuccurullo, 2017) and (2) being the two most relevant multidisciplinary databases available (Orduña-Malea et al., 2015) with the possibility of highly selective "browsing, searching and sorting" options (Jacso, 2005, p. 1539). Our criteria of inclusion were four. The span of time of publications was restricted until 2020. Secondly, we opted to keep only documents published in Business or correlated areas. Of these, only publications in English were considered. Finally, only articles published in journals were included. After performing the selection of 378 articles according to the criteria previously described, we employed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA, Moher et al., 2009). As expected, these three variables have not been found in the literature selected, neither in bigger firms or startups.

Secondly, we started a systematic literature review in the same standards comprehending impulsivity in Business studies. The strings adopted were impulsiv* AND startup* OR impulsiv* AND entrepreneur* OR impulsiv* AND business. The searches were performed in the same databases: Scopus and Web of Science. We repeated the previous criteria of inclusion (only articles published in journals, only

English and only Business and related areas). The next step involved excluding articles exploring impulsivity in consumerism studies, leaving only research dedicated to business management. This cut led to 477 documents whose titles and abstracts were read to select a sample for integral reading. After this filter, 174 files were selected for full reading in order to observe gaps and research agenda.

We selected a key segment of startups in the Brazilian economy as an object for our empirical study: agriculture. In this sector, three competing factors have prompted the adoption of innovative technology: the dramatic increase predicted for human population in the decades to come (Dutia, 2014), the chronic scenario of famine (and undernourished people) around the world and the pressures on land and water usage due to climate changes (Campos et al., 2021). Other equally assuaging forecasts concern the population growth estimated for the next 40 years, with some predictions indicating a 70% increase in comparison with population numbers reported in 2011 (Conforti, 2011). This picture imposes a challenge to current agricultural models and technologies, since production must reach a high volume, with high efficiency, in the shortest time possible, and following environmentally-friendly standards (Dutia, 2014). In response to that, a set of technological initiatives towards problem-solving in agriculture have already emerged, especially in the United States. These are known as “Agtechs” (Duss and Kolb, 2016). This economic sector arose to redesign agriculture worldwide in order to increase and fulfill a demand for greater productivity with a parallel concern with environmental and social issues (Dutia, 2014). Equipped with sensors and cameras, agricultural machinery now collects small field data such as soil moisture, leaf greenness, temperature, seeding, fertilizer and pesticide application rates, yield, fuel consumption, and machine performance in order to optimize the application of resources (Pham and Stack, 2018). Technological solutions deliver significant influences towards transforming the challenges of agricultural supply chain management into opportunities. Simple technologies such as Bluetooth, GPS (Global Positioning System), or RFID (radio frequency identification), combined with the communication among operators and agricultural machinery at all levels of collaboration, make it conceivable to create a self-optimizing agricultural supply chain structure (Zambon et al., 2019). Agtech involves all processes on the food supply chain, going from genetic manipulation to meal delivery sellers. There are also experiments with microorganisms to improve soil conditions, enforce environmental resilience, create protection barriers for common pests and even use artificial

intelligence to support producers and breeders (Ventures, 2017). This whole process is accompanied by data collection, which is a form of commodity in itself due to the increasing application of Big Data in the so-called “smart farming” (Wolfert et al., 2017). These ventures are assigned to more than 30 different categories of solutions, ranging from Bioenergy to social media management (Figueiredo et al., 2021). However, powering the Agtech innovation ecosystem includes the involvement of leading universities and R & D centers that produce cutting-edge scientific knowledge. As an example, the availability of venture capital and the existence of various actors dedicated solely to promoting innovation in agriculture (i.e. Agtech Business Accelerators), along with the possibility of exploring the domestic consumer market for agricultural technology testing were determinant for the thriving of the Californian Agtech Ecosystem (Mikhailov et al., 2021).

According to Brazilian Micro and Small Business Support Service (SEBRAE, 2023a), the Rate of "Established Entrepreneurs" (with more than 3.5 years of operation, as % of adult population) was of 9.9% in 2021 (a growth of 1.2% compared to 2020). The same report informed that 43 million of adults Brazilians (18 to 64 years) had or were making moves to have their own business. The profiling of entrepreneurs indicated that 54.4% were men; 62% were aged between 25 and 44 years old; 57% earned less than 3 minimum income wages monthly (~US\$ 608,61), and 47% had finished high school. The numbers on female entrepreneurship were slightly lower (0.3%) than in the previous year's reports. The numbers dropped more significantly in the age group beyond 55 years old (from 10.10% to 7.30%). However, the report revealed that Brazilians are more inclined than ever to have their own business, as it became the third most important “dream” among the surveyed. Moreover, for the first time the intention of starting a business surpassed the intention to make a career in a private company (46% versus 32%). On the reasons for venturing, 76% of interviewees affirmed they would like to “make a difference in the world”. Still, 77% admitted they saw entrepreneurship as a way to make a living due to the scarcity of jobs.

Different studies over the years indicated that Brazilian entrepreneurship data is a “black box”, with rather generalist numbers and little emphasis in specific groups of entrepreneurs (Moraes et al., 2020; de Moraes Santos et al., 2022). Even so, certain particularities of entrepreneurial activity in Brazil have been found, such as: a predominance of “self-entrepreneurship” (Rosenfield, 2018); the fact that entrepreneurs do not often move between professions and industries (Djankov et al.,

2006); individuals who turn to venturing are often associated with friends or relatives who also engaged in entrepreneurship (Djankov et al., 2006), and entrepreneurial activity coming from undergraduates is not significantly detached from the general population (Alves et al., 2019). Moreover, there is a tendency from public policies to privilege existing businesses instead of improving stimuli and infrastructure to foment business venturing (Borges et al., 2018).

In the case of startup venturing in Brazil, the scenario remains problematic for not so different factors. The poor infrastructure of initial ventures and the lack of the required capabilities, along with difficulties concerning partnerships and market positioning (Rocha et al., 2019) are among the main reasons for the high mortality rates of Brazilian startups (Moroni et al., 2018). The so-called “Agtechs” are some of the companies included in this scenario, with the aggravation of several other factors that are specific of this line of business: (a) lack of connectivity in rural areas. (b) conflicts between different devices in sharing information; (c) sensor discrepancies for different types of activity; (d) the time and investment required to disseminate the technology; and (d) the overall low level of education of farmers and farm workers, apart from the difficulty of this audience in understanding and using new technologies (Pivoto et al., 2018; Sokolova and Litvinenko, 2020; Graciano-Neto et al., 2022).

According to Wiklund (2018), impulsive people are more likely to be attracted to uncertain situations, such as entrepreneurship, and to act despite that uncertainty. Thus, impulsiveness could be hypothesized as an advantage in entrepreneurship. However, as further discussed in this study, the various attempts to verify this phenomenon led to a multiplicity of outcomes, widening the discussions in search of the most accurate theoretical relationship between impulsivity and entrepreneurship. Given the rather obscure aforementioned scenario for venturing in Agtech startups, our hypothesis was that a certain level of impulsivity is implicated in one’s choice for opening a business in this market niche. At the same time, the almost inevitable (and, in some cases, numerous) setbacks linked to venturing in the Agtech market means entrepreneurs could not survive such hardships without a great level of resilience. Although business resilience has been previously discussed by literature (Briggs and Edwards, 2006; Linnenluecke, 2017; Singh, 2022), its extension relates mostly to the ability an organization (an inanimate entity) develops to survive in the face of external threats and challenges, leaving behind the role of personal resilience in carrying out the task of shielding companies from all kinds of turmoil. Furthermore, we question

how the performance of companies who achieve great levels in innovativeness is impacted by the individual characteristics of their CEOs concerning impulsivity and resilience.

In order to extend the knowledge among these three variables – impulsivity, resilience, and innovativeness - we selected entrepreneurs from startups of the Agtech sector to answer a 30-item questionnaire in order to measure if/how their impulsivity and resilience profiles impact the innovativeness characteristics of their companies. Thus, this study aims to provide answers for the following questions: **Do entrepreneurs' impulsivity and resilience profiles affect innovativeness in their firms? If so, what is the weight of this influence?**

In order to seek for answers to both questions, we developed a research hierarchy that is structured in: (i) theoretical background; (ii) methods adopted; (iii) presentation of results; (iv) discussion, and (v) conclusions and implications of the study in both theoretical and empirical spheres.

1.1 General objective

The aim of this study is to identify and analyze personal levels of impulsivity and resilience profiles of Brazilian entrepreneurs in the Agtech sector.

1.2 Specific objectives

- To examine patterns of behavior of entrepreneurs from Agtech startups in the variables impulsivity and resilience concerning different levels of innovativeness.
- To address the influence of demographic profile of individuals (age, education, gender, region, number of employees and type of product/service) in how they perform in impulsivity, resilience, and innovativeness.
- To identify patterns of behavior that might either boost organizational innovativeness or compromise its growth in Agtech startups.

1.3 Justification

The inherent risks associated to startups (Dinesh and Sushil, 2019) have prompted our research interest in how individual decision-making profiles

(impulsivity, risk-taking and resilience) influence innovativeness in Agtech ventures. We understand that the challenges faced by new entrepreneurs engaged in agribusiness innovation might provide a proliferous scenario for profiling entrepreneurial features due to (a) the pressure for constant innovation and the threat of new competitors (Dinesh and Sushil, 2019; Campos, 2021); (b) the inherent risk associated with agriculture (von Braun et al., 2018) and (c) the presence of a plethora of business models (Figueiredo et al, 2021) that might provide considerable variability in individual profiles.

Additionally, the Agtech sector comprises an economic thriving that certainly justifies research interest. Recent data has revealed that venture capital investments in Agtech companies have increased 75% since 2014 in the United States (Maycock, 2020), raising an amount of nearly \$6.2B across 460 deals in 2020 (CB Insights, 2021). In Brazil, Agtech entrepreneurship has raised US\$70 million in investments so far, becoming a central source of shareholding interest (Montesanti, 2021). Moreover, data from 2019 showed that the digitization in agriculture has substantially increased in the country and Brazilian farmers are already, on average, the ones who most used digital media in their transactions. During the COVID-19 outbreak in 2020, Brazil grew from 36% to 46% of farmers who use some digital media, being ahead of North American and European farmers who had operation rates of 31% and 22%, respectively in the same period (Figueiredo et al., 2021).

Through a literature review, we found that impulsiveness in entrepreneurship is a 'double-edged sword'. This means that you will benefit if you dare to take risks when no one wants to. Still, this personality trait can cause more problems than it solves, due to its "combination" with other detrimental traits associated with impulsive behavior such as attention deficit disorder and narcissism. Impulsivity and Entrepreneurship Research that connects the family spirit has produced a solid literature, but Agtech startups and agriculture-focused companies are rarely mentioned. Because agriculture is highly dependent on climate change and natural phenomena, it becomes a highly volatile and dynamic environment of business, which poses several challenges to entrepreneurs. The personal characteristics of the individuals endure the hardships of Agtech venturing is the main interest of this study.

The dissertation is organized as follows. In Section 2 we discuss decision-making, impulsiveness and resilience, innovativeness, and the conceptualization of Agtech startups. Section 3 describes our design of research, methods adopted both to

collect and analyze data and the formulation of our hypotheses. Section 4 presents the results found. Finally, in Section 5 and 6, we present a discussion on the results achieved and the conclusions and limitations of this study.

2 Theoretical Background

The theoretical background adopted for this study starts with the basis of choice, discussing the fundamentals of heuristics and cognition. Next, the three variables to be measured in our model (impulsivity, resilience, and innovativeness) are described individually. We then present the concepts and updated data on Agtech startups. Lastly, we connect all the literature discussed in a conceptual framework, from which our hypotheses are then formulated.

2.1 The basis of choice: heuristics and cognition

The term *Heuristic* is believed to be an association of the Greek words *heuriskei* (inventive) and *eureka* ("I have found out"). In time, became a synonym for *serving to discover* or merely *find out* (Martí et al., 2018). For Hart (2005, p.1403), heuristics are rules of behavior that are unsophisticated, simplistic, and deceiving. The term “rules of thumb” is a representation of this idea: all in all, something that was tested multiple times become the standard action even when there is little to no rationale behind it (Stanovich, 1999). Such conceptualization of human decisions was heavily questioned by the end of the 1970s and throughout the 1980s by several scholars who proposed the cognitive model (e.g. Kahnemann and Tversky, 1974; Anderson and Crawford, 1980; Williams, 1988).

In their most primitive forms, theories on human heuristics were mostly based on the logics of maximum individual utility whenever an individual is faced with a set of different possibilities (Mathis and Steffen, 2015). In the mid of the 1970s, Simon (2000) challenged the idea created by economics the assumed perfect rationality by addressing a significant volume of empirical evidence against the classic theory. He would name his views as a “theory of bounded rationality”, that is, the notion that people’s choices are not only determined by a general knowledge, but by the limitations or extra knowledge individuals carry with themselves, along with their difficulties, limitations, abilities and disabilities. These elements shape how every individual consider their future courses of action whilst dealing with uncertain environments. Almost a decade later, Kahneman and Tversky (1974) demonstrated by vast empirical evidence that people develop risk

aversion in any situation that involves a certain gain versus an alternative with uncertain outcomes. Moreover, people employ cognitive strategies to make the process of decision making easier. However, most of these strategies are flawed due to numerous forms of cognitive biases, including the overestimation of loss expectancy (predicting that the damage caused by a specific loss will be greater than the prospective potential gain from a risky decision.) (Taylor-Gooby and Zinn, 2006).

Albeit much has been discussed since then, the most popular assumption seems to be that individual decision-making can be explained both in terms of rational choice (i.e. the use of mathematics and devices) and behavioral aspects, which consider the relationships men and women build with themselves, their environment and with each other (Mathis and Steffen, 2015). In both cases, a human decision is hardly ever reached without a certain amount of bias, be it a result of one's individual experiences or a byproduct of society's pressures and norms. Although multiple biases can affect human decisions in different dimensions of life, the most common ones in managerial strategy are discussed in Table 1, deriving from contributions from Barnes (1984), Kahneman (2011), Meissner and Wulf (2017) and Acciarini and Boccardelli (2019).

Table 1. Common biases in managerial strategy

Bias	Description	Effects in Management
Availability bias	People are limited by their capacity of visualizing the frequency of a given event. Therefore, they cling to the memories they have related to that event (memorability, imaginability), which are not statistically meaningful and do not represent the real weight of the event.	Interferes in risk estimation in strategic decisions, leading to both overestimated perspectives of risk or underestimated ones.
Hindsight	Faced with an unsatisfying outcome, the mind overly concentrates in one factor in order to isolate a predictor for a negative event and give it a greater weight than the one it bears in reality. This perception is often related with how we saw the event happening in the past, meaning “we should have known better”, when in fact our “predictors” bore little to no responsibility in either occasion.	Anytime a company is successful in identifying a profitable opportunity, other players in the market tend to look for the factors that led to such a positive outcome as if they were clear to see back in the day and not a product of several contingencies.

Illusion of control	It depicts the propensity of choice producers to efficiently overestimate their person impact on chance occasions or more absolutely their failure to distinguish between ability and chance choices.	Decision makers might become prone to see themselves as having greater agency over the business than they actually do. They might imagine having control of variables that are beyond their reach.
Misunderstanding the sampling process	Failing in estimating the amount of errors and unreliability that are intrinsic to the process of sampling (choosing a small amount of a wider population in the search of an explanation for a given phenomenon that affects such group).	Diagnoses of a company's current indicators based on historic data of other players might lead to false determinations of causal relationships.
Authority bias	A figure with positive reputation in the matter in question is considered to be trusted in their opinions despite what the facts demonstrate.	The confidence in the judgement of certain members of the organization might lead to incorrect judgements due to the cognitive biases the person might hold that are not necessarily supported by the facts, but goes unverified because of the prestige around such individuals.
Perspective bias (optimism or pessimism bias)	Good faith inclination shapes one's convictions around the long, run envisioning and judging future occasions, assessing probabilities in a distorted manner). Parallely, a negative view of reality can influence an individual's efforts towards a goal.	In Business decision-making, individuals in command tend to shape their team's goals and tasks according to their personal feelings towards a certain project (either exaggerating the likelihood of prospects or discouraging the pursuit of certain aims).
Judgements of correlation and causality	People have a tendency to confuse correlated variables with a relationship of causation, which is much more complex and demands consistent statistic evidence.	The illusion of cause and effect might lead to decisions made under illusory predictive variables, while other factors relevant to the model are ignored.
Representativeness	People predict the outcome that appears most representative of the evidence, ignoring that the data available might lack reliability or the evidence is insufficient for the assumptions made.	A collection of information from different sources might lead to the most convenient choice of data presentation, which may contain an unreliable scenario for forecasting.
Overconfidence	The tendency to overestimate one's own judgement about things, often ignoring their limitations and blindsight.	Overconfidence can be very detrimental to business decisions due to misjudged views that are not corroborated by objective data.
Desire for certainty	Decisions involving risks often lead to anxiety, which provokes serious errors in the estimation of expected outcomes.	The acceptance of risk as an inherent part of the strategic planning. Looking for a zero-risk scenario is unrealistic and detrimental to business operations.
Planning fallacy	The required time to finish a task is underestimated based on the planner's optimism, despite the individuals' previous experiences and general knowledge.	The failure in delivering tasks in time can seriously compromise budget and resources. In industries such as construction or automobilism, such errors can be fatal.

Scope neglect	The magnitude of impact of an event is not proportional do the actions taken to halt such impact. The numeric response given by humans in different points of a scale does not match the mathematical relationship (exponential or general non-linear types). It is one of the faces of representativeness bias.	The non-observance of the impact of certain variables in a process can lead to the underestimation of time, investment, and labor demanded to achieve positive results with them.
Risk perception	It influences the plausibility to sense, seize and reconfigure key choices through a cloudy perception of the risks involved in the situation.	It is critical to recognize cognitive impediments, to consider methodology dangers in connection to subjective angles and to discover expression in key plans.

Source: author (2023)

According to Stanovich (1999), the more complex organisms became, the more their heuristics evolved in terms of replacing instinct with a cognitive system, that is, using a reflective system based on the memories created of similar past situations. The word *cognition* comes from the Latin word *cognoscere*, which means “to get to know” or “to recognize” (Bayne et al., 2019). It can thus be defined as an ability to categorize things by the way we react to them, be it the food we choose to eat or the people we choose to be friends with (Harnad, 2003). The developments provided by psychometrics in the last 40 years were adamant in their critique of such interpretation given the high complexity and non-linearity present in human decisions according to several experiments. Thus, decision-making can more accurately be defined as an outcome of a process of reflection on the consequences of a certain action (Nöel et al., 2006). These considerations are possible due to the cognitive ability we own to create multiple scenarios whose comparisons lead to a choice perceived as most advantageous (Evans and Frankish, 2009; Bechara, 2005).

People tend to make projections of how their current flow of actions might affect other aspects of life that are dear to them thanks to an ability to “rehearse” actions in their mind before they take action (Kahneman, 2011; Evans and Frankish, 2009). In the case of addicts, explain Nöel et al. (2006), there is a choice between the feeling of pleasure delivered by a drug though dopamine action and the potential of this event for ruining their professional relationships, their family bond and their financial stability. A poor reflection on the outcomes of one's actions is known as “non-planning impulsivity”, that is, a short-term view of reality that enlightens momentary pleasure with little regard for future events (Patton et al., 1995).

The role of emotions in the evaluation process of decisions is central and the hedonic perception of pleasure has a heavy influence on the choices made (Cabanac, 1992). This is not only based on behavioral observations but on experiments that related frontal lobe damage (a section of the brain associated with emotions) to poor performance in decision-making (Bechara et al., 1994). Patients suffering from frontal lobe impairments constantly engaged in a “non-planning impulsivity” state, often looking for immediate reward despite the future consequences of an action in their lives (Franken et al., 2008). In his book *Noise* (Khaneman et al., 2022), Daniel Kahneman brought several examples of human emotions being pivotal in daily life, going from judge's verdicts to important business men. Whenever a person is under stress, there will be a tendency of acting impulsively, which is an appeal to System 1 to take control given the lack of energy available for System 2 to take charge. The same type of bias occurs when a worker lacks motivation to perform their job, giving room to poor judgments mostly based on striking marginal cues (Kahneman et al., 2022). However, it is not only negative feelings that lead to biased decisions. When in a good mood, people can also incur in biases that affect their receptivity to unsubstantiated information or moral beliefs. Being “positive” at the moment of a decision can also lead to a certain level of insensitivity in decisions that involve moral biases. In the example provided by Kahneman et al. (2022), individuals in a happy mood were less sensitive to harsh decisions towards ending the life of one individual in order to a larger group. A positive humor can also affect the way someone approaches a complex problem. People can become less attentive to details, which might lead once again to focus on the salient peripheral cues instead of given the problem a proper deep analysis. In other words, emotional biases lead to a temperament trait known as impulsivity, that is, the predominance of immediate responses in one’s behavior without more elaborated judgement.

In a similar form, feelings over failure or defeat can enhance different responses from different individuals, leading to growth and overcoming in some cases, but being paralyzing to others. In addition, there is evidence that not all victories and defeats are viewed equally amongst individuals. The perception of what constitutes a victory depends highly on the expectations one had before engaging into an action. Thus, some wins might be disappointing if one hoped for an even better scenario and some losses can become relieving if the expectations were initially discouraging (Larsen et al., 2004; Morrisette and Morrisette, 2022).

Loss and defeat can elicit feelings of disregard for oneself, precisely attacking self-esteem. Given the formation of one's self-esteem is highly correlated to the relationship individuals establish with their primary caregivers, childhood is determinant in how we respond to situations that put to test the way we view ourselves (Brown and Dutton, 1995; Magro et al., 2018; Kim et al., 2021). For business leaders, in specific, their primary feelings of self-worth are determinant to how they will respond to setbacks, being those an inescapable reality of entrepreneurship. People can respond to frustration in a way that maintain or restore their faith in themselves or they can let negative emotions elicited by unwanted outcomes to dominate how they perceive their own value (Rosi et al., 2019; Brown and Dutton, 1999).

In this study, we chose to explore the weight of perception bias by addressing the prominent role of impulsivity in the decision process (Ramírez-Martín et al., 2020; Morgan et al., 2006, Bechara et al., 1995), and the decisive presence of resilience in dealing with the frustrations brought by the acceptance of risks in one's endeavors (Hadjielias et al., 2022) to comprehend how a group of entrepreneurs in an area surrounded by uncertainty tend to behave like. As both variables are associated with proactive/reactive mechanisms of decision-making (Siebert et al., 2020), we theorize moderated levels of impulsivity and resilience in leaders might exert influence in the innovativeness capacity of the firms they manage.

2.2 Impulsivity

Impulsive behavior is a condition reflected on the poor evaluation of future outcomes or a deteriorated ability to foresee positive scenarios derived from the delaying of pleasures accessible at the present moment (Bechara, 2005; Morgan et al., 2006). In sum, impulsive individuals fail in dealing with expected rewards and punishments in routine decision-making because their strategies and perception of risk are poor or non-existent (Morgan et al., 2006). Whenever the outcomes of a decision are evaluated, several affective reactions interact with each other, mediated by the impulsive and reflective systems (System 1 and System 2). The functioning of these mechanisms will then define subsequent actions (Bechara, 2005). Although impulsivity is frequently related to disorders and their so-called impulsive manifestations, it is not associated with a symptomatic picture of an exclusive disorder, albeit greater manifestation of impulsive behaviors might lead to important losses (Malloy-Diniz et al., 2008). Impulsivity is

divided into three independent dimensions: motor impulsivity, attentional, and non-planning impulsivity (Malloy-Diniz et al., 2008; Patton et al., 1995). Motor impulsivity is related to a deficit in response inhibition, that is, the individual is not able to suppress a response to a given stimulus even when its context is altered (Malloy-Diniz et al., 2008; Patton, et al., 1995). The attentional dimension is related to difficulties in resisting tempting stimuli and the tendency to make decisions quickly. Finally, impulsivity due to lack of planning refers to the inability to plan for the long term, prioritizing immediate rewards (Patton, et al., 1995).

According, to Maloney et al. (2012), to be act in an impulsive manner is to cede to spontaneity, trusting intuition (or self-heuristics). It is also a characteristic of highly impulsive individuals to feel an urge to switch between tasks quickly (Brem and Utikal, 2019). Therefore, impulsivity has been summarized in four basic traits – sensation seeking, lack of premeditation, lack of perseverance (low resilience), and a sense of urgency (Wiklund et al., 2018, Brevers et al. 2017). The evolution of psychological experimentation has linked impulsivity traits with other set of behaviors common to economic relationships such as risk-taking (Michael et al., 2020; Millroth et al., 2020; Hochman and Yechiam, 2011, temporal discounting (Xu et al., 2021; Deck and Jahedi, 2015; Espín et al., 2015), self-control/self-regulation (Cavallo et al., 2012; Gambetti and Giusberti, 2019; Huang et al., 2012), psychopathy (Costello et al., 2019; Eisenbarth et al., 2018; Mathieu et al., 2013), attention deficit disorder (Lerner et al., 2019; Coetzer, 2016), narcissism (O'Reilly and Hall, 2021; Nevicka et al., 2011), venturesomeness (Lerner, 2016; Sheaffer and Brender-Ilan, 2014; Baron et al., 2012), and self-efficacy (Baciu et al., 2020).

Risk-taking propensity is related to an individual's inclination toward taking a chance before a presented set of decisions (Josef et al., 2016). This variable tends to be moderated by the amount of uncertainty surrounding each choice, with risk-aversion being the standard reaction whenever information available is scarce or unclear (Brand et al., 2007) or when rewards related to a certain choice are delayed in contrast to immediate satisfaction (Verdejo-García et al., 2019). In the same direction, temporal discounting represents the behavioral tendency to prefer short-term smaller rewards than waiting for a greater payoff in the future (Christopoulos et al., 2017; Deck and Jahedi, 2015). Moreover, impairments such as attention deficit disorders make individuals prone to poorly planned action due to a lack of awareness for detail (Lerner et al., 2019). The incidence in impulsive behavior is delimited by the self via willpower, executive control,

time preference, self-discipline, self-regulation, and ego strength (Duckworth, 2011). Thus, self-control emerges as the main force behind impulsivity, exhibiting a generally inverse correlation with that variable (Johnson et al., 2013). Even though the aforementioned traits have originated studies in various Business contexts, no other Business dimensions seems to be more related to impulsivity and its associated variables than entrepreneurship. As a start, the engagement in new ventures is intrinsically risky and surrounded by uncertainty (Yu and Chen, 2016; Zheng et al., 2020); which requires considerable venturesomeness to take the first step (Baron et al., 2012); self-control to surpass several obstacles without relinquishing from pre-set goals (Cavallo et al., 2012; Huang et al. 2012; Gambetti and Giusberti, 2019); the ability to delay gratification even when present efforts are ostensible and exhausting (Scholten et al., 2016; Read et al., 2017; Xu et al., 2021) and unwavering self-confidence to overcome social skepticism (Manolova et al., 2019). Entrepreneurs are also expected to be bold, audacious, and relentless (Alexieva and Angelova, 2020), occasionally at the cost of team cohesion (Nevicka et al., 2011). The overconfidence in entrepreneurs has been frequently linked to narcissism – a condition marked by great extraversion and low agreeableness associated with exaggerated self-esteem (Miller, 2011). Although not all narcissistic individuals are psychopaths, this variable is central in most evaluations of psychopathic disorder. Besides being impulsive – lower in self-control abilities – psychopaths exhibit shallow emotions, low consideration for the feelings of others, and lack of guilt or remorselessness for hardly taking any responsibility for their actions (DeLisi, 2009; Hare and Neumann, 2008). Amid the aforementioned influence exerted by impulsivity, it can be observed that despite the growing body of behavioral research in business, impulsivity and its associated variables to entrepreneurship remain overlooked.

2.3 Resilience

According to Merriam-Webster (“resilience”, n.d.), resilience is a term derived from the latin word *resilire*, an agglutination of the particle re- (to do something again) and the word *salire* (to go out). In everyday life, it can be defined as a “stable healthy adjustment” to traumas, disasters and general negative outcomes in one’s life (Bonanno et al., 2012). For Van Vliet (2008), resilience is about the positive emotions prompted by people to defeat the negative outcomes of a situation. By broadening one’s attention, positive emotions rescue individuals from the narrow and blurred cognitive views left by an

unsuccessful event. The ability to achieve such a relieving state generates “psychological, intellectual, social, and physical resources that promotes greater resilience in the face of future negative life events” (Van Vliet, 2008, p. 234). In the poem *Return to Tipasa* by existentialist author Albert Camus (1968), we read a metaphor on how resilience is felt by individuals in troubled times:

In the midst of winter, I found there was, within me, an invincible summer.
And that makes me happy. for it says that no matter how hard the world pushes
against me, within me, there’s something stronger – something better, pushing
right back.

One of the main characteristics of the entrepreneurial environment is the constant failure of ventures as a significant parcel of startups fail in adjusting to competitive environments, in elaborating adequate strategies or predicting harmful external factors (Hedner et al., 2011). In a business context, resilience is the flexibility to review business models and strategies following changes in the market (Elahi, 2013) or simply “the art of bouncing back when things have not gone as expected” (Southwick and Charney., 2018, p.6). Moreover, the process of recovering in business often occurs in a risky environment, surrounded by constant change and uncertain outcomes (Southwick and Charney, 2018).

In both personal and business resilience, the ability of individuals to cope with failed attempts and to react immediately in order to minimize losses is the key to avoid dysfunctional outcomes (Allred and Smith, 1989). In human beings, a lack of resilience has been linked to depressive states, as recovering from losses often depends on self-esteem and self-confidence profiles, long-term thinking and fast adaptation (Connor and Davidson, 2003), all aspects which tend to be dysfunctional in depressed individuals (Alfasi, 2019; Sowislo and Orth, 2013). Human beings differentiate themselves from other animals by the consciousness we develop of ourselves as individuals, a self-realization that we usually achieve at two years old. As we develop the ability to see ourselves as individualized beings, we also perceive that there are different versions of us through the passing of time. At some point, we become conscious of our past and, consequently, of the existence of a future. Beyond this realization, we discover that we can learn from previous experiences and, thus, act in a different manner whenever the same situation presents itself again in front of us (May, 2009).

A goal-oriented individual tends to project clear prototypes of his purposes (future), which may encourage them to face challenging tasks (present) as well as dealing

with occasional failure (present/future), as long as the prospect achievements make up for the effort (future) (DeShon and Gillespie, 2005). Thus, professionals who are goal-oriented develop greater resilience to market fluctuations and personal setbacks. Through resilience and learning from failure, these individuals achieve persistence and then, performance (Elliot and Moller, 2003).

This study adopted the three-dimensional Resilience instrument elaborated by Hystad et al. (2010). In the authors' analysis, items loaded in three constructs: Commitment (e.g. "Most of my life gets spent doing things that are meaningful"); Challenge (e.g. "I enjoy the challenge when I have to do more than one thing at a time"), and Control (e.g. "It is up to me to decide how the rest of my life will be").

In a management perspective, Kahneman et al. (2022) explains that some people are more optimistic than others, but one has a genetic predisposition to optimism, they do not need to be told they are lucky – they already feel that way. Optimism is largely inherited, and it may also be accompanied by a preference to see the bright side of things. However, the blessings of optimism are useful to a point, since some forms of positivity might become excessive and end up detaching people from reality, which is especially detrimental to business matters. Surveys of small business owners found that entrepreneurs are more optimistic about life than midlevel managers. One supposition is that having achieved success has restored their faith in their judgement and ability to control events. Based on this reasoning, we can hypothesize that those with the greatest influence on others are optimistic and overconfident (Kahneman et al., 2022).

2.4 Innovativeness

To change or to do something new is an innate characteristic of innovation, as changes lead to a cycle of firms being born at the same time others are dying. From a Schumpeterian perspective (Schumpeter and Nichol, 1934), this succession of events is the impulse to economic development and technological progress (Obschonka and Fisch, 2018). Innovation has also been described as a creative achievement (Parjanen and Hyypiä, 2019) accomplished through collaboration among cognitively diverse agents who develop mechanisms to turn risk-taking into a powerful resource in the creation of shareholder value (Low, 2009).

According to the Entrepreneurial Orientation (EO) concept introduced by Miller (1983), innovativeness refers to a firm's ability to thrive in the market by going beyond imitating competitors, that is, assuming risks of its own to pursue new products

prototypes. Innovativeness can be interpreted as the “receptivity to new ideas and innovation” in the sense of how “a group's culture affects the group's capacity to innovate” (Hurley and Hult, 1998, p. 47). For Asenge et al. (2018, p. 128) “innovativeness is an organization’s tendency to engage in and support new ideas, novelty, experimentation, and creative processes that may result in new products”. In its purest logic, innovativeness can be defined as the levels to which an individual or several agents is in the vanguards of the adoption of new ideas than their peers (Adegbite and Abereijo, 2014). It also represents how prone a company is to support the generation of new ideas, with tolerance to experimentation and creative processes (Lumpkin and Dess, 2001). Therefore, innovativeness is a byproduct of the environment and its flexibility and adaptability to change. Previous research identified three main antecedents of organizational innovativeness as managerial, organizational, and environmental nature (Kellison and Hong, 2015; Hurley and Hult, 1998). Garcia and Calantone et al. (2002) also stressed the issue of “newness” in the context of innovativeness and claimed that it “is the capacity of a new innovation to influence the firm’s existing marketing resources, technological resources, skills, knowledge, capabilities, or strategy” (p. 113). Innovativeness can also be attributed to individuals as a personality trait, meaning each individual has the ability, to some extent, to produce innovative solutions to issues that arise in their routines (Midgley and Dowling, 1978; Goldsmith and Foxall, 2003).

The relationship between innovativeness and performance was found to be positive in several studies (Rezaei and Ortt, 2018; Casillas and Moreno, 2010; Rauch et al. 2009;), and even worked as a positive moderator in turbulent environments (Kraus et al., 2012), Although innovativeness is seen by some authors as a characteristic that leads an individual to engage in changes more easily than their counterparts (Rogers, 2005; Sun et al., 2020), others see it as a group phenomenon that hinges on environment and social interactions (Leonard and Sensiper, 1998).

Albeit the existence of a “personal innovativeness” is not negligible, entrepreneurial studies have been adamant in defending the importance of organizational environment as a key-driver to innovation (Casillas and Moreno, 2010; Kraus et al., 2012; Rezaei and Ortt, 2018), a concept that is adopted in this study. Moreover, EO counts on two more dimensions that fund innovativeness: proactiveness and risk-taking. As defined by Glaub et al. (2014), to be proactive means “to think of future opportunities (and problems) and to prepare for them now” (p.358). Therefore, it would be expected from a

proactive individual a behavior of acceptance of negative outcomes and a sense of resignification of failure in order to persist in the endeavor (Frese et al., 2007). After all, innovation involves sunk costs, is vulnerable to new business methods, difficulties in predicting outcomes accurately (March, 1991) and overestimation of expected payoffs (Li and Tang, 2010). Finally, entrepreneurs face a number of challenges to bring new ideas to life, what marks risk-taking as a central feature in new ventures (Fisher et al., 2016; Chadwick and Raver, 2020). Due to conflicting results in studies that explored the three EO variables together, several authors have recommended that these dimensions be evaluated separately (Kreiser et al., 2013; Dai et al., 2014), a choice we adopted by exploring firm innovativeness individually.

2.5 Agtech startups

Several revolutions have taken place in the last 100 years that have impacted crop productivity and farming methods. An enumeration of such revolutions includes the development of fossil fuel power generation and agricultural mechanization, the introduction of hybrid and genetically modified crops, increased fertilizer use, and the development of synthetic fertilizers, pest control connectivity and improved data management (Triplett and Dick, 2008). The scheme designed by Shaharudin (2019) in Figure 1 presents the milestones that defined each era in Agricultural development. We are currently in the last milestone, which leads to the 4th great era in agriculture: the one in which technology such as Artificial Intelligence (AI), Blockchain, the Internet of Things (IoT), Big Data, biotechnology, and Augmented Realities (AR) are being incorporated to crop production (Shaharudin, 2019).

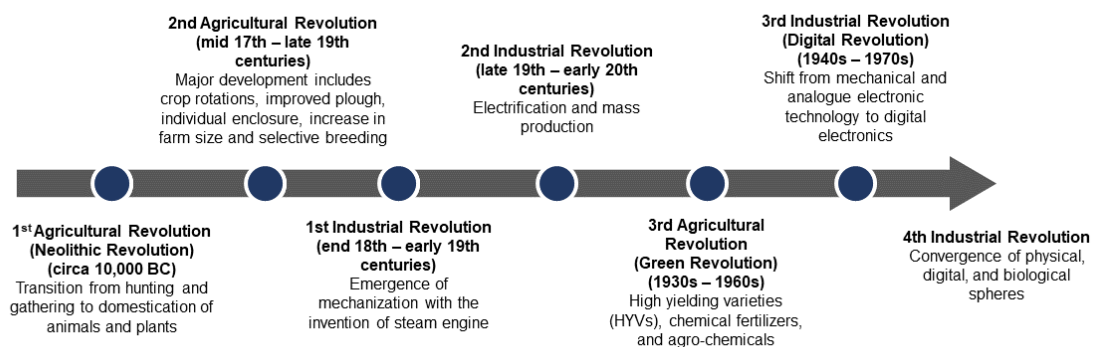


Figure 1: Technological shifts - Industrial and agricultural revolutions
Source: Shaharudin (2019)

Agriculture is both a direct food provider and a source of supply for various industries. Its range goes from smaller and less technical plantations that provide for their surrounding areas to high-technology driven crops (Mikhailov et al., 2018). Due to the intense international competition for commodities, there is the need to add value to the production chain in order to increase volume without compromising quality. Digital revolution exerts a determinant role in the transformation of agricultural industry, especially in regard of information and communication technology (ICT) alternatives (Mikhailov et al., 2018). Beyond productivity expectations, there is an ever-growing concern for the environment and the constant demand by international organizations for the adoption of more sustainable models of agriculture (Dutia et al., 2014). Nevertheless, the most palpable reason for pursuing agriculture technology is the ever-growing population and demand for food. Assuming a constant fertility rate, the world population is projected to grow by 47% from 7.4 billion in 2015 to 10.9 billion in 2050 (Shaharudin, 2019). Other projections indicate that by 2100, the world's population will be 2.5 to 4 times what it was in the middle of the 20th century (1 billion to over 11 billion). A notable difference is the growth rate. The rate of growth peaked at 2.1% around 1970 and has been steadily declining since then (Valone and Panting, 2019). Still, the world population is expected to level off at about 11 billion in 2100 as demonstrated in Figure 2.

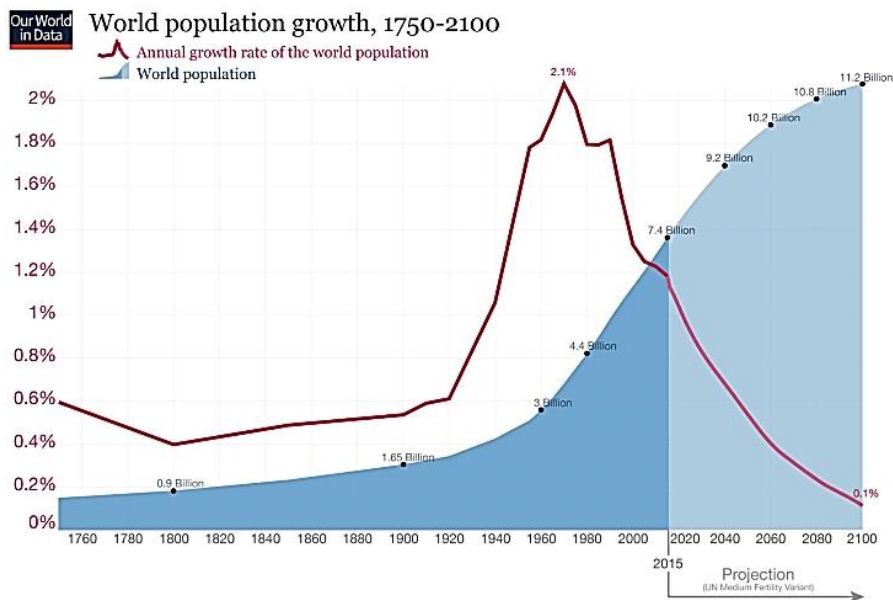


Figure 2. Projections for world population growth
Source: Roser (2015)

Different terms have made reference to this new era of high-technology in agriculture, ranging from “Agriculture 4.0” to “agritech”, or, more recently, to “Agtech”. The term

“Agtech” refers mainly to startups related to “all technical innovations affecting the data-driven, networked, digital agriculture of the future” (Von Veltheim and Heise, 2020, p. 2). Tingey-Holyoak et al. (2021) defines it as “smart agricultural technology” (p.2), while Koch (2019) sees it as the introduction of new technologies in agriculture to support its development and growth. Duss and Kolb (2016) describe those technologies as “farm equipment, weather, seed optimization, fertilizer and crop inputs, irrigation, remote sensing (including drones), farm management, and agricultural big data” (p.1). In this study, we are considering a more complex approach brought by Dutia (2014):

Sustainable agricultural technology or, more simply, “Agtech,” is an emerging economic sector that has the potential to completely reshape global agriculture, dramatically increasing the productivity of the agriculture system while reducing the environmental and social costs of current ag production practices (Dutia, 2014, p.1).

Multiple authors point to Agtech startups as a necessary answer to the challenge of food production in the future in an environment of constant climate changes. Bigger firms are increasingly interested in cost-effective solutions and alternatives for productivity bottlenecks, becoming more competitive domestically and internationally. These are the tasks that specialized startups are expected to develop (Dutia, 2014; Von Veltheim and Heise, 2020; Tingey-Holyoak et al., 2021). In the Agriculture 4.0, the use of water, pesticides, and fertilizers, are expected to be kept to a minimum. Quantities will be carefully targeted and technology will allow even arid areas to produce crops, while technology and innovative genetic techniques will enhance the optimization of resources such as sunlight and seawater, besides the development of new meat alternatives and food manipulation (De Clercq et al., 2018). Field data and information systems will be more and more connected and the adoption of drones and satellites will become routine, in order to quickly adjust to changes, prioritizing efficiency and sustainable goals (abstartups, 2021).

The interest in Agtech startups is manifested in a significant increase in funding in the last decade. In the period of 2010 to 2016 Agtech investment went from about \$150million to more than \$800 million, increasing in \$500 million the next year. In 2013, startup Climate Corp was acquired by Monsanto for \$930 million. Four years later, Du Pont Pioneer bought Granular for \$300 million, which attracted considerable interest from the stock market (Kimle, 2018).

Duss and Kolb (2016) considers Agtechs’ contributions to be threefold: action in productivity and efficiency; farm operations and logistics and financial planning,

management and analysis. In the field of productivity and efficiency, data driven optimization and fitness of equipment could help generate more yield per input. Some of the technological solutions capable of leading to such outcomes are smart irrigation, nitrogen modeling and crop sensors. As for farm operations and logistic problem-solving, Agtechs can act on weather forecasting, optimization of equipment, team management, decrease of transportation costs and adoption of AI solutions, such as robots and autonomous vehicles. Meanwhile, financial help comes in the form of heavy use of IT platforms to generate better inputs for decision-making and optimize manager involvement, offering more accurate analysis for forecasting.

A survey conducted by Embrapa, HomoLudens, SP Ventures, and SEBRAE shows that agribusiness startups have grown rapidly in Brazil. Currently, according to the survey, one out of every three companies in the sector already sells to other countries and that 43% of these businesses have invoiced more than R\$ 1 million in the last year. The segment also proved to be a strong generator of jobs, where more than half of the businesses have more than 10 employees. The research also revealed that more than 80% of Agtech startups in Brazil are present other countries in the American continent; 33% have entered the European market; 12% have business in Africa, and 4% are operating in Oceania (SEBRAE b, 2023). In regards to the number of hired employees, 52% of such companies have 50 employees or more; 44% employ at least 10 people; 2% count on only two business partners, and 2% are operated only by the owner. The revenues achieved by the agtech sector are also remarkable. Estimated 43% of agtech companies in Brazil reached more than R\$ 1,000,000 (~US\$191,749) in 2022 (SEBRAE b, 2023).

The Index of Trust in Agribusiness (IC Agro, 2021) also offer a threefold classification of how Agtechs contribute along the production process. The “before the gate” classification refers to all the physical and financial inputs, along with machinery. Seeds, nutrition, fertilizers and relationship with financial institutions also belong in this category. The next classification is “behind the gate”. This phase is related to production and management features such as handling, harvesting, improvement, maintenance of machinery and equipment, disposal and human labor. The third category in which Agtechs could offer support is called “beyond the gate” and refers to all action taken after production such as storage and distribution. In this phase, other stakeholders take action: food industry, energy companies, trading companies, cooperatives, storage and logistic operators.

There are currently 397 Agtechs registered in southern Brazil (Figueiredo et al.,

2021), distributed in 28 categories. They are spread along the three classifications mentioned before (“before the gate”, “behind the gate”, and “beyond the gate”) as illustrated in Figure 3. They are also subdivided in specific categories. These categories and the number of startups in each classification are detailed in Table 2:

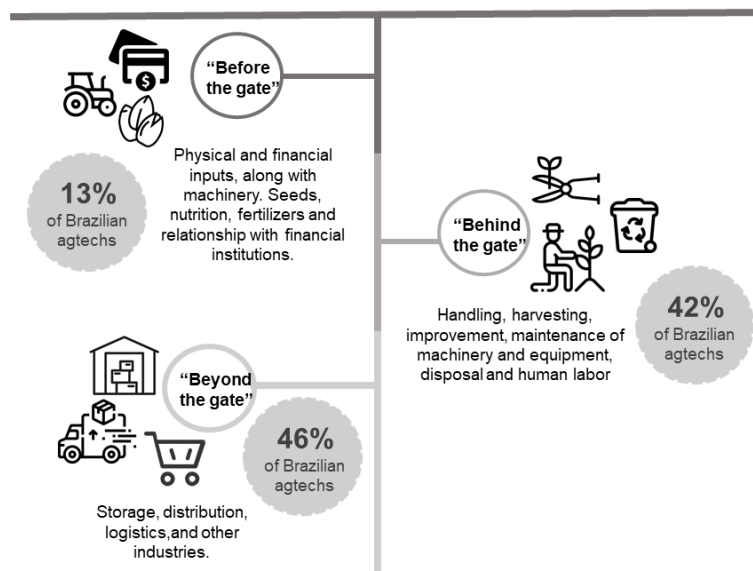


Figure 3. Overview of Agtech startups' distribution in Brazil
Source: based on Radar Agtech (2021)

Table 2. Report of Agtech startups in Brazil in each classification

Classification	Number of firms	Category
"before the gate"	33	Laboratory analysis
	42	Credit, barter, insurance, carbon credits and fiduciary analysis
	47	Fertilizers, genomics and animal reproduction
	18	Genomics and animal reproduction
	17	Marketplace for agribusiness inputs
	19	Nutrition and animal health
	24	Seeds, Seedlings and Plant Genomics
	"behind the gate"	2
6		Connectivity and Telecommunication
58		Content, Education, Social Media
32		Biological Control and Integrated Pest Management
79		Drones, Machines and Equipment
15		Shared economy
20		agricultural waste management
39		Internet of Things for Agribusiness: pest detection, soil, climate and irrigation

	34	Meteorology and Irrigation and Water Management
	111	Systems, solutions and data integrator platform
	70	Remote Sensing, Diagnostics and Monitoring by Images
	154	Rural Property Management System
	37	Telemetry and Automation
“beyond the gate”	293	Innovative food and new food trends
	56	Storage, Infrastructure and Logistics
	35	Biodiversity and Sustainability
	22	Bioenergy and Renewable Energy
	3	Cloud Cooking and Ghost Cooking
	26	Food Industry and Processing 4.0
	100	Marketplaces and platforms for trading and selling agricultural and livestock products
	22	Urban planting: plant factory and new ways of planting
	39	Online Restaurants and Meal Kits
	12	Food safety and traceability
	38	Autonomous system for managing stores and services of food
	45	Online Grocery
	26	Packaging, Environment and Recycling Systems

Source: Figueiredo et al. (2021)

The characteristics of modern economic development are shaping new understandings and attitudes towards innovation as the primary way to increase competitiveness, increase business efficiency and enhance the sustainability of economic activity. Global trends in the development of key economic drivers (labor, capital, technology) create both new opportunities and development risks for businesses. In the agribusiness sector, the details of this economic development make the impact of these factors more significant (Sokolova and Litvinenko, 2020). One of the most impactful features of high-technology is the climate related instruments, developed to identify with precision what the right time is and on the which area results can be optimized. However, the proper functioning of such technologies is highly dependent on “e collection and processing of big data, development of new cyber infrastructures, data sharing platforms, and machine learning algorithms, all of which have their own social and technical challenges” (Gardezi et al., 2022, p.225). In addition, population aging and decrease in birth rates in many countries are making agricultural labor scarce, which calls for technology that increase labor productivity with as little dependence as possible of the

human element (Sokolova and Litvinenko, 2020). This is the case in Brazil. According to Brazilian Geography and Statistics Institute (IBGE, 2023) where it is expected that the population over 60 years will reach 32% by 2060 (a percentage that was equal to 13% by 2018). On the other hand, the population of children until 14 years old is expected to decrease by 6% in 2060, meaning Brazil will have more old age individuals than young people in the space of four decades from now. In one of the states in the southern region (Rio Grande do Sul) already presents the highest mean of population age in the country (35.9 years old). (Vettorazzo, 2018).

The need for technological solutions poses significant challenges to all providers around the agricultural activity in Brazil. Some of the main barriers for Agtechs are: (a) the lack of connectivity in the countryside areas; (b) the conflict among different devices while sharing information; (c) sensor mismatches for each type of activity; (d) time and investment required to disseminate technologies, and (d) the overall low educational level of farmers and rural workers, besides their difficulties in understanding and handling new technologies (Graciano-Neto et al., 2022; Pivoto et al., 2018). Sokolova and Litvinenko (2020) argued that the lack of workforce skills is one of the most relevant barriers to innovation permeating agribusiness, and the development of work quality requirements is a necessity that cannot be overlooked by countries that aim to become competitive. The authors listed a set of desirable work skills for the work demands expected to arise by 2030 (Table 3).

Table 3. Change in demand for labor skills by 2030.

Skills	Hours worked in 2018, min hours	Change in the number of working hours by 2030, %
Manual skills	9000	-11
Basic cognitive skills	5300	-14
Advanced cognitive skills	6200	9
Socio-emotional skills	5200	26
Technological Skills	3100	60

Source: Sokolova and Litvinenko (2020, p.2).

This perspective shows that not only does the farm education system need to be restructured to focus on innovative technologies, but current workers need retraining in order to perform in pair with market needs (Pivoto et al., 2017).

In addition to the specific challenges of Agtech entrepreneurship, startup owners in Brazil already face several “difficulties in accessing the market, with weak partnerships, poor infrastructure and lack of capability” (Rocha et al., 2019, p.8). The

more technical expertise and market know-how a startup accumulates, the wider the partner network, the more diverse the customer base, and the more complex the innovation ecosystem have to be. Startups that are immature in terms of skills, partnerships, and customers will have a harder time surviving. As a consequence of limited skills, the ability to build partnerships will be compromised (Rocha et al., 2019).

2.6 Conceptual Framework

A conceptual framework is a rationale for why a particular study is conducted. First, it describes the state of the art, usually through a literature review. Secondly, it identifies gaps in our understanding of a phenomenon or problem; and, thirdly, it outlines the methodological foundations of the research project. An adequate conceptual framework is structured to answer two basic questions: “Why is this study important?” and “How do these results add to what is known?” (Varpio et al., 2020).

Based on the aforementioned scenario, it can be assumed that venturing in the Agtech sector is highly challenging and involves a considerable chance of failure in multiple fronts. From the physical and technological barriers to the delicate human handling of technology illiterate clients, an Agtech entrepreneur needs to be thoughtful, persistent, and resilient. At the same time, in order to provide solutions that fit into the immensely diverse and complex scenario of Brazilian agriculture, Agtech startup companies need to be innovative. Through literature review, we found that impulsivity in entrepreneurship is a “double-edged” sword, meaning it might provide gains when an individual dare to take risks when no one else is willing to. Still, this personality feature might bring more issues than the ones it solves due to a “combo” of other detrimental features that come attached to impulsive behavior such as attention deficit disorder and narcissism. Though the studies linking impulsivity and entrepreneurship have produced a robust literature, there is little mention of Agtech startups or companies that deal specifically with agriculture, being it a highly unstable and risky line of business due to the high dependence on climate dynamics and natural phenomena. After delineating the gap found in impulsivity in entrepreneurship research, we turned to the most fit methodology to pursue the objectives of our research. We hypothesized that Impulsivity, Resilience were related to Innovativeness in Agtech startups. This is a relevant study for two main reasons. In Graciano et al. (2022), it was found that resources in education towards entrepreneurship and innovation are few and incomplete, mostly focusing on

technical and bureaucratic aspects of venturing, without giving the adequate space to the development of creativity and risk-taking. Furthermore, our previous work established that soft skills are not being currently well-developed in education, leaving individuals with the wrong perception that capital and product/service knowledge are that is to acknowledge while starting a business. Thus, as a first reason to perform this study, we have the necessity to point to psychological features that might be lacking in individuals that have a prominent role to play in Brazilian economy (e.g. Rocha et al., 2019; Lermen et al., 2018; Pivoto et al., 2017). Secondly, we intend provide greater clarification on the profile of Brazilian startup owners. Although plenty studies were performed concerning the organizational aspects of these companies, we have not delved into their personalities and their decision-making style, a gap we expect to help fill in. Figure 4 summarizes our conceptual framework:

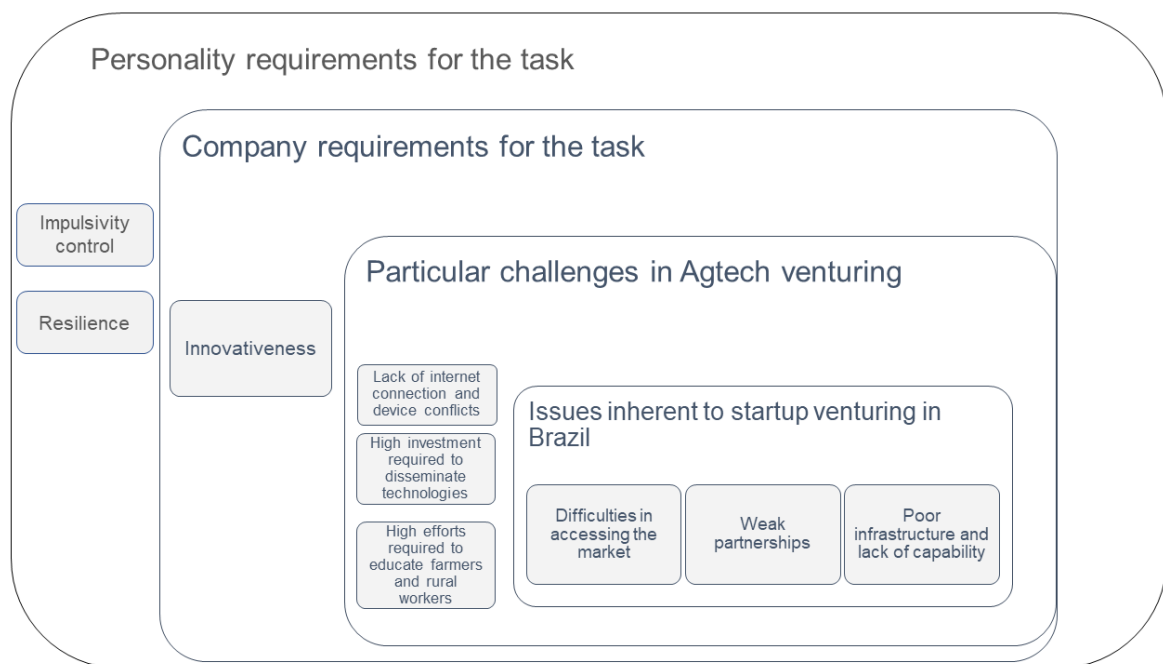


Figure 4. Conceptual framework of the study
Source: the author (2023)

2.7 Formulation of hypotheses

Given the patterns established in the theoretical background, we would hypothesize the following:

H1: *Impulsivity on CEOs would predict Innovativeness in Agtech startups.*

As we are employing the Barratt Impulsivity Scale, there is the possibility to delve into the specific types of impulsivity that might exert such influence, thus:

- **H1a:** *Motor Impulsivity in CEOs would predict Innovativeness in Agtech*

- *startups.*
- **H1b:** *Non-Planning Impulsivity in CEOs would predict Innovativeness in Agtech startups.*
- **H1c:** *Attentional Impulsivity in CEOs would predict Innovativeness in Agtech startups.*

Our second set of hypotheses refer to the impact of Resilience in Innovativeness drivers. Once again, our choice for the Norwegian dispositional resilience scale (see section 3.1.2) allowed for a more in-depth analysis of which dimensions of resilience are impactful. Thus, the formulation of hypotheses is the following:

H2: *Resilience on CEOs would predict Innovativeness in Agtech startups.*

- **H2a:** *Commitment Resilience on CEOs would predict Innovativeness in Agtech startups.*
- **H2b:** *Control Resilience on CEOs would predict Innovativeness in Agtech startups.*
- **H2c:** *Challenge Resilience on CEOs would predict Innovativeness in Agtech startups.*

3 Methods

The methodological design has four phases. First, we performed a literature review on decision making (Section 2 – Theoretical background). This variable was broken down into its main components: impulsivity and resilience. Our second step was to investigate the Innovativeness variable within the Entrepreneurial Orientation (EO) perspective, since we intend to carry out the correlation between the emotional character variables with the organizational phenomenon of innovativeness. The next step in our methodological design was the definition of a research object. Due to the importance of agriculture and livestock for the Brazilian economy and the growing role of Agtech startups in boosting the modernization of this sector, we defined these companies as the target of the research. Relying on the literature review of the three mentioned themes, we started to elaborate hypotheses to be explored with quantitative methods described in section 4.1. On stage II, we investigate previous studies in the area through bibliometric and systematic literature analysis.

Stage III of the research project was dedicated to the collection of data according to the criteria defined in section 4.2. Finally, in possession of the collected

data, we will proceed to stage IV: data analysis and validation (or invalidation) of the hypotheses through the methodology described in section 4.3. Our research workflow is fully depicted in Figure 5.

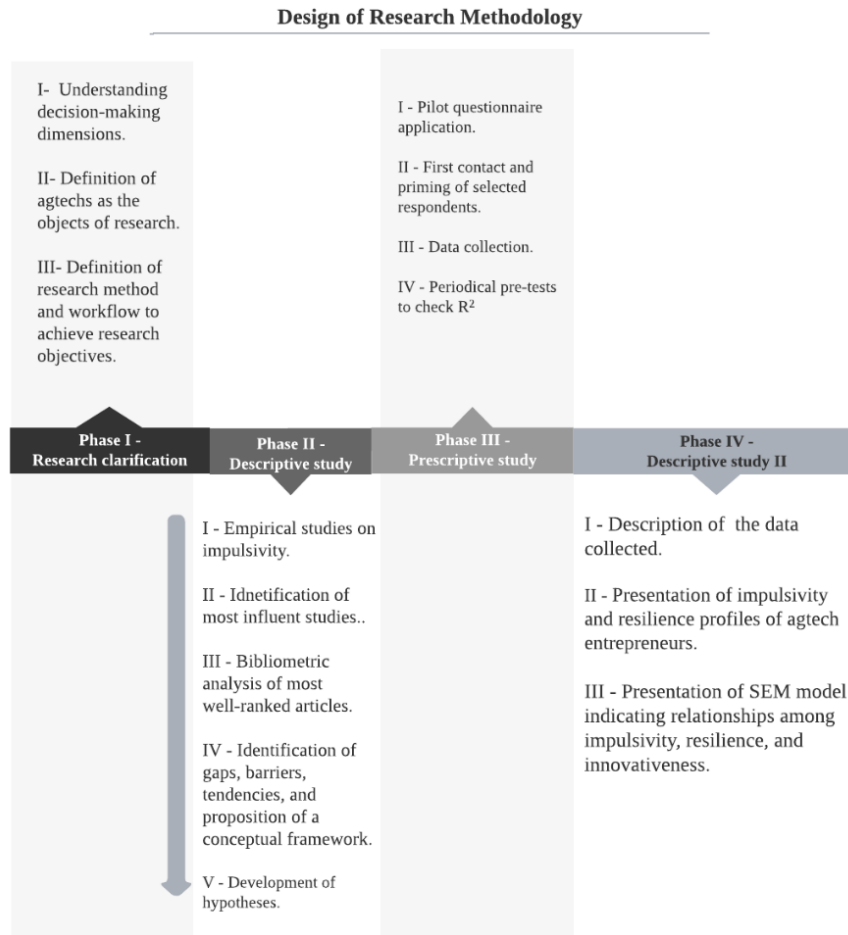


Figure 5. Design Research Methodology (DRM)
Source: based on Blessing and Chakrabarti (2009)

3.1 Qualitative methods

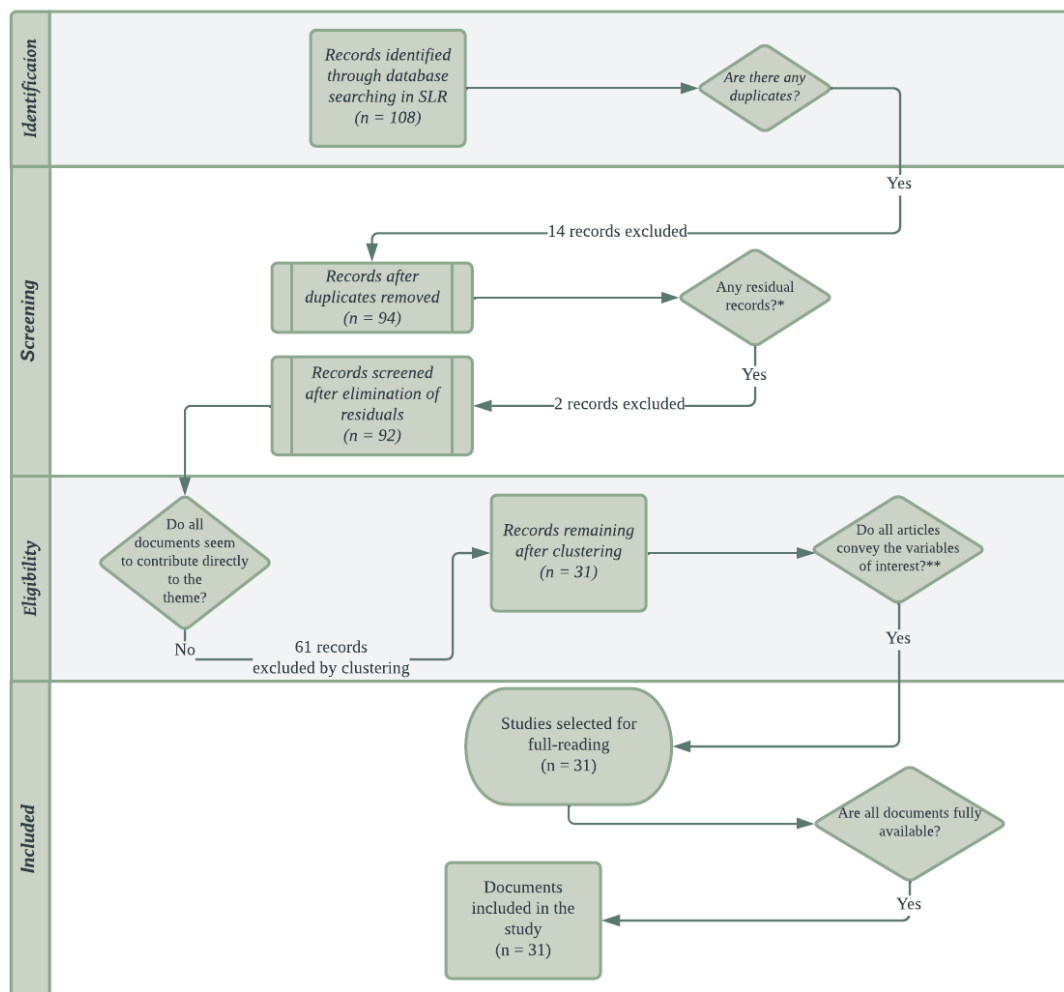
According to Sofaer (1999), Methods of qualitative analysis can be very useful in the development of theories, conceptual frameworks, or, in other words, in the generation of hypotheses. Moreover, Preliminary tests of theories and hypotheses can also be conducted using these methods. Qualitative methods emphasize complete understandings, how people (the social aspect of our field) understand, experience, and operate in dynamic and social environments (Richard, 2013).

There are distinct techniques available to pursue qualitative research, namely: participatory research (knowledge built in association with stakeholders); in-depth approaches (interviews and group discussions), and systematic techniques, which can be

performed through participatory research or through the collection of documents and relevant data on a specific theme (Dongre et al., 2009). In this study, we opted for the third model, employing a systematic literature review.

3.1.2 Systematic Literature Review

In order to fulfill the objectives of this study, we performed a Systematic Literature Review (SLR), a technique employed to identify, evaluate and interpret available research relevant to a specific topic of interest (Kitchenham, 2009; Parola et al., 2020). Moreover, SLRs are appropriate for the elaboration of maps and summarizations of literature to improve knowledge in the field (Tranfield et al., 2003). Gough (2017) highlighted the necessity of clear steps in the application of this procedure, avoiding that documents be inexplicably excluded without well-justified criteria. Figure 6 exhibits the sequence of steps taken in this study's SLR following the model by Moher et al. (2015).



*Conference papers or book chapters.

** In either title AND/OR abstract AND/OR keywords.

Figure 6. Systematic Literature Review Workflow

Source: based on Moher et al. (2015)

3.1.1 Search strings

A search string is a grouping of keywords, truncation symbols, and Boolean operators entered in academic search engines in order to capture information around a certain topic of interest (Mergel et al., 2015). The authors suggested a workflow to extract the most useful keywords to access knowledge in the desired field. This step-by-step guide proposed a partial review that identifies the main studies around the topic of interest to extract the keywords adopted by the authors of those papers. This procedure would then lead back to the formulation of the “real” systematic literature review, now observing how central papers defined their keywords.

3.1.2 Data extraction

The Bibliometrix Package created in R language offers the possibility of automating many bibliometric analyses and even to create new functions due to its accessible open-source platform (Aria and Cuccurullo, 2017). Bibliometrix works in combination with the two main scientific databases: Clarivate Analytics Web of Science and Scopus. The screening of articles in the Systematic Literature Review phase (described next) was considerably optimized by the adoption of the bibliometrix clustering tool to select only articles that involved impulsivity in an entrepreneurship context (or behavioral findings that could be applied to such context).

3.1.3 Content Analysis

Qualitative content analysis is a useful method to turn a considerable amount of information into a more ordered and succinct summary of prominent results (Erlingsson and Brysiewicz, 2017). This makes it possible to identify the data units that are categorized, recorded, contrasted, and compared in order to draw a conclusion about the communication's content. Verbal data units can be broken down into phrase, word, or image analysis (Kolbe and Burnett 1991). It is a method for the analysis of the communication message itself, rather than the sender's or receiver's interpretation of that message (Kassarjian, 1977). After the selection of articles to be included in the study, several codes and thematic observations were applied to the texts. Following the protocol from Erlingsson and Brysiewicz (2017), articles were first coded according to the dimension of impulsivity they approached.

As impulsivity is part of other behavioral conditions, we pointed out the contexts and how the variable exerts impact in each case. Secondly, the papers' main aims and results were condensed in order to visualize the contributions in a leaner form as presented in the Results section.

3.2 Quantitative methods

A research method is normally divided among quantitative techniques, qualitative techniques or a blending of both. Quantitative research is based on data collection in order to test hypothesis, by applying numerical mediation and statistical analysis able to provide support for previous theorized outcomes in the hope of achieving minimal standards for forecasting. (Sampieri et al., 2010).

This study is based on two quantitative instruments. First, we employed the Barratt Impulsivity Scale (BIS-11), an instrument that has been employed in recent business studies such as post-purchase consumer regret (Sokić et al., 2020), entrepreneurial differentiation (Baciu et al., 2020) and effects of training programs on decision-making (Alkozei et al., 2017). Secondly, we measured resilience using the Norwegian dispositional resilience (hardiness) scale by Hystad et al. (2010), following its successful use in several studies (i.e. Bartone et al., 2012; Sandvik et al., 2013; Gucciardi et al., 2015) and the fact its items are related to work dynamics, an important differentiation from other similar instruments. Finally, innovativeness was inferred using an instrument developed by Calantone et al. (2002). The three instruments are detailed in the next sections.

3.2.1 Barratt Impulsivity Scale (BIS-15)

The Barratt Impulsiveness Scale (BIS-30; Patton et al., 1995) is an instrument that measures impulsivity as a whole and in three separated subscales: Motor Impulsiveness (MI), Non-Planning Impulsiveness (NPI), and Attentional Impulsiveness (AI). The original instrument contained 34 items developed to infer self-reported impulsive behavior. In this study, we chose to employ a shorter version of the questionnaire based on Spinella (2007). The questionnaire is expected to be answered on a 5-point scale, being 5 the most impulsive response. Higher scores mean a high level of impulsivity.

The items among the three different dimensions (motor, non-planning and attentional impulsiveness) are mixed to avoid response bias.

Physical anomalies in the cognitive systems such as the dorsolateral prefrontal cortex, the ventromedial prefrontal cortex, amygdala and insula might be associated with “motor impulsivity” (Redish et al. 2008; Verdejo-García and Bechara, 2009; Noël et al. 2013). This profile is characterized by a tendency to “act without thinking” and interpret situations with a greater demand of urgency than they actually present. This leads to chronic avoidance of risk in certain cases of high anxiety (Corr, 2002; Broman-Fulks et al., 2014), producing an “uncontrollable worry” that suppresses quick action even when there is an advantageous outcome in sight (Pawluk and Koerner, 2013). This feature has shown significant correlation with extraversion (Lange et al., 2017)

The next impulsivity dimension is “non-planning impulsiveness”. This profile is characterized by a disregard for the future, with focus on present events and short-term rewards. People under this condition tend to make disadvantageous choices and behave rashly, ignoring foresight (Koff and Lucas, 2011) and conscientiousness (Lange et al., 2017). Finally, the dimension of “attentional impulsivity” is related to difficulties in concentrating in the task at hand (Pawluk and Koerner, 2013), binge eating disorders (Hege et al., 2015) and neuroticism (Lange et al., 2016). Our questionnaire adopted the translated version of the scale published by Malloy-Diniz et al. (2010), which has been reproduced again in Brazil in two other peer-reviewed studies (Gonçalves et al., 2018; Malloy-Diniz et al., 2015) The complete questionnaire is available in Appendix A.

3.2.2 Norwegian dispositional resilience (hardiness) scale

The Norwegian dispositional resilience (hardiness) scale is a 15-item questionnaire containing three factors related to resilience: Commitment, Control, and Challenge (Hystad et al., 2010). Items were evaluated by respondents in a 5-point scale, being 5 the highest level of agreement with the statements and 1 the least. This instrument was selected for two main reasons: (1) it involves statements that directly impact the work-life routine (i.e. If you work hard, you can almost always reach your goals), and (2) it was one of the most cited resilience scales according to Google Scholar in work contexts (i.e. Søbstad et al., 2021; Frey et al., 2018; Natvik et al., 2011; Flo et al., 2012).

As no peer-reviewed translation of the scale from English to Portuguese was found, we performed an independent translation and submitted it to the group of specialists participating in the pilot study, as recommended by Xavier et al. (2009). Items

from this scale were exhibited to participants in the form of personal statements such as “By working hard you can nearly always achieve your goals” or “I feel that my life is somewhat empty of meaning”. The preliminary version of the questionnaire is available in Appendix B.

3.2.3 Innovativeness measurement scale

In order to explore Innovativeness, we chose to employ an instrument created by Calantone et al. (2002). The choice for this instrument was justified by its objectivity and relatively shortness, given the large number of items presented in the other constructs evaluated in this study. The selection of the instrument was also inspired by its successful application by several authors (e.g. Palacios-Marqués et al., 2015; Zehir et al., 2015; Tajudeen et al., 2018). A search on Google Scholar pointed to only one document with the application of such scale in Portuguese. However, the paper was not peer-reviewed. Thus, we opted to translate the instrument independently and submit it to the validation of a group of specialists fluent in both languages, as recommended by Xavier et al. (2006).

Respondents were presented with a five-point scale questionnaire ranging from “it does not describe my company at all” = 1 to “it describes my company perfectly” = 5. The instrument contains six drivers: “our company frequently tries out new ideas”; “our company seeks out new ways to do things”; “our company is creative in its methods of operation”, “our company is often the first to market with new products and services”, “innovation in our company is perceived as too risky and is resisted”, and “our new product introduction has increased over the last five years”. The complete questionnaire is available in Appendix C.

3.3 Data Analysis

The data analysis phase comprises two essential steps. It is necessary to perform a factorial analysis to obtain indices of validation that allow for the data to be submitted to Structural Equation Modelling (SEM). Each phase is discussed next.

3.3.1 Factorial analysis and comparisons of medians

One of the methods to analyze Likert scales is factorial analysis. This method of evaluation “supposes that the observed variables (measures) are linear combinations

from some underlying source-variables (factors). Namely, it supposes the existence of a system of underlying factors and a system of observed ones” (Kim and Mueller, 1978, p. 7-8). Besides that, there are two important distinctions in factorial analysis: there is a confirmatory and an exploratory strategy. (Tabachnick and Fidell, 2001). According to Henseler and Schuberth (2020, p. 148):

“The only difference between the two is that whereas CFA [Confirmatory factor analysis] helps to assess a latent variable structure of observable variables, CCA [Confirmatory composite analysis] helps to assess an emergent variable structure. Similar to all types of CSA [covariance structure analysis], CCA examines the discrepancy between the empirical and the model- implied variance–covariance matrix of observable variables, i. e., the model’s goodness of fit”.

The CFA was to method selected for the analysis of our data, given the latent variables in each scale had been validated previously by other studies (e.g. Fossatti et al., 2002; Kahn et al., 2019) and there was an expected behavior for the relationship among them.

In Figure 7, there is a representation of the steps taken to perform a confirmatory factor analysis according to Henseler and Schuberth (2020). This phase precedes the application of Structural Equation Modeling (SEM), which will be discussed next.

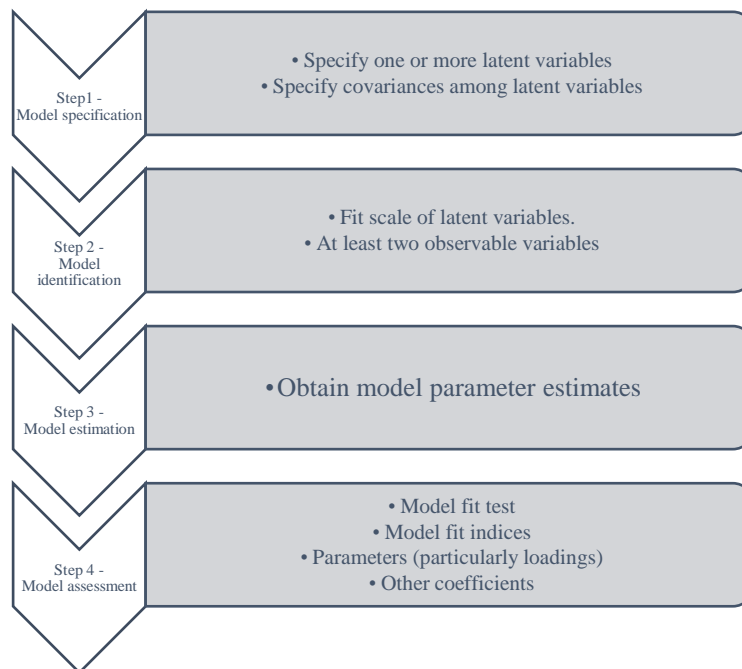


Figure 7. Confirmatory factor analysis step by step
Source: adapted from Henseler and Schuberth (2020)

In order to verify significant differences between classes of individuals (e.g. sex, race), the Kruskal-Wallis test is the most appropriate measure. This is an appropriate test for nonparametric data, which tends to be the case for Likert oriented studies, although

a formal verification must be performed with Kolmogorov-Smirnov and Shapiro-Wilk tests. Kruskal-Wallis test “assesses the differences among three or more independently sampled groups on a single, non-normally distributed continuous variable (e.g. ordinal or rank data)” (McKight and Najab, 2010, p.1). All the analyses mentioned were performed on Jasp® Software.

3.3.2 Structural Equation Modeling (SEM)

Structural Equation Modeling (SEM) is a technique that blends factorial analysis and analysis of regression, thus allowing researchers to test correlations among different measurement instruments through a Confirmatory Factor Analysis (Klem, 2000; Ullman and Bentler, 2012). In sum, SEM hinges on several traditional multivariate analysis seeking to find possible explanatory relationships among multiple simultaneous variables (Hox and Bechger, 1998). These variables can be of two types: latent or observed. Latent variables are those that cannot be measured via direct observation, thus hinging on observed indicators. In psychometric studies, these variables are related to instruments adopted to infer behavioral profiles (Pilati and Laros, 2007).

Figure 8 embodies a typical SEM design. Latent variables are represented by the letter “F”, observed variables are indicated by the letter “V” and errors associated to observable variables are noted with “E”. The error associated to a dependent variable is not by “D” due to its “disturbance” effect. The explicative relationships among variables are described by unidirectional arrows, which represent paths of regression (or factorial loads related to Confirmatory Factor Analysis). Bidirectional and curved arrows are representing covariances.

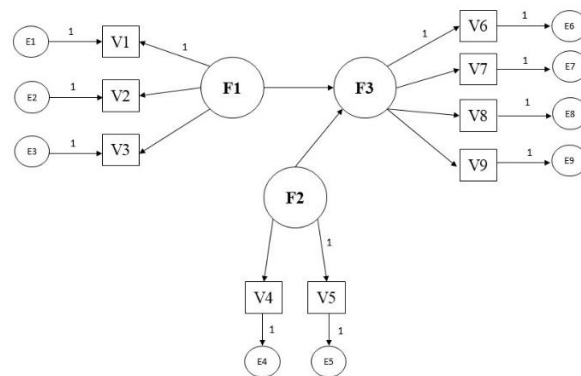


Figure 8. Graphic representation of SEM
Source: based on Pilati and Laros (2007)

The variables receiving unidirectional arrows are called endogenous variables (or dependent variables), while the variables from which arrows come from are identified

as exogenous variables (also known as predictive or independent variables) (Kaplan, 2008). We adopted this model to our study defining Innovativeness as the endogenous variable, while Impulsiveness dimensions and Resilience dimensions play the role of exogenous variables towards it. Each construct is linked to observable variables as represented numerically in Figure 9.

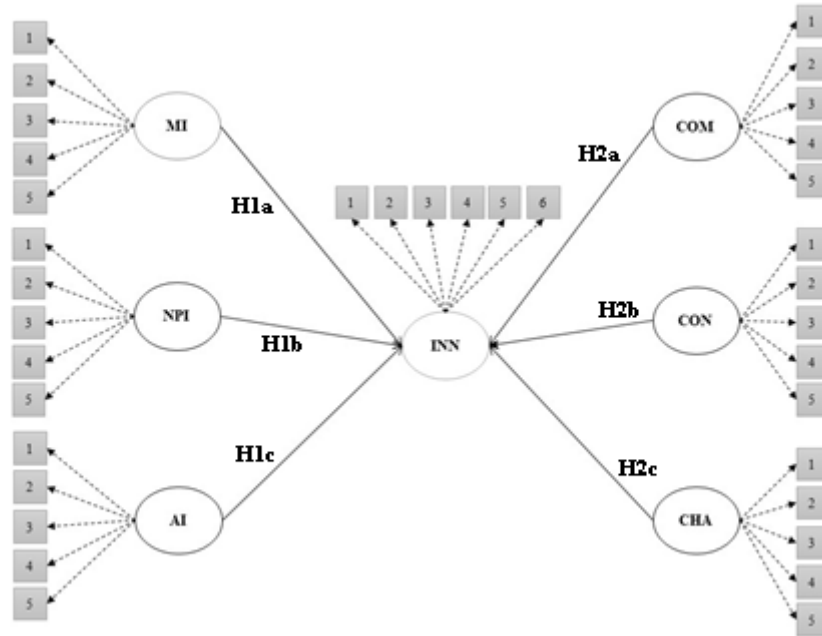


Figure 9. Theoretical model and hypotheses

Note: MI = Motor Impulsivity; NPI = Non-Planning Impulsivity; AI = Attentional Impulsivity; COM = Commitment; CON = Control; CHA = Challenge; INN = Innovativeness.

3.4 Sampling and data collection

Sampling is a technique that selects a subset of individuals from a wider population to estimate the general behavior of such population a given aspect. Its size is crucial to determine statistical power, that is, the chance that the statistical tests performed will identify a significant difference when it is due (Singh and Masuku, 2014). The population for this study was defined by the number of registered Agtechs startups in southern Brazil, which was found to be 397, according to Radar Agtech 2021 (Figueiredo et al., 2021).

In order to determine the most appropriate number of respondents, we explored several approaches on the application of Structural Equation Modelling (SEM). According to Gignac (2006), skepticism may exist among scholars as to how SEM can be applied to data derived from a sample of less than 100 participants, but such disbelief is partly unfounded, as several published studies were successful in the analysis of

smaller samples (e.g. Browne et al., 2002; Palmer et al., 2002; Pedhazur, 1997). Gignac (2006) stated that several simulation studies have indicated that SEM solutions based on sample sizes of approximately 100 will produce interpretable solutions for models with latent variables defined by three or more indicators, with non-biased parameter estimates and no convergence problems, particularly when the observed variables are less moderately intercorrelated. Parallel to this source, we studied the Cohen’s power primer model (Cohen, 1992), which is based on R^2 , that is, the explicative power of the resulting model generated by the data. According to different levels of R^2 , a certain number of participants might be sufficient (see Figure 10). Therefore, we performed partial tests with our collected data in order to check if the explicative power was fit. When we reached an R^2 of 0.5 (within a universe of five independent variables linked to each construct), we stopped our data collection. At the time, the number of respondents was 74, which was sufficient for a statistical power of 80%.

Maximum Number of Arrows Pointing at a Construct	Significance Level											
	1%				5%				10%			
	Minimum R^2				Minimum R^2				Minimum R^2			
	0.10	0.25	0.50	0.75	0.10	0.25	0.50	0.75	0.10	0.25	0.50	0.75
2	158	75	47	38	110	52	33	26	88	41	26	21
3	176	84	53	42	124	59	38	30	100	48	30	25
4	191	91	58	46	137	65	42	33	111	53	34	27
5	205	98	62	50	147	70	45	36	120	58	37	30
6	217	103	66	53	157	75	48	39	128	62	40	32
7	228	109	69	56	166	80	51	41	136	66	42	35
8	238	114	73	59	174	84	54	44	143	69	45	37
9	247	119	76	62	181	88	57	46	150	73	47	39
10	256	123	79	64	189	91	59	48	156	76	49	41

Figure 10. Sample size recommended in PLS-SEM for a statistical power of 80%
Source: Cohen (1992)

The full list of Agtechs to be contacted was the one published by Radar Agtech 2021 (Figueiredo et al., 2021). participants were asked to provide specific data (Appendix D) such as gender, age, educational background, number of full-time employees (firm size was not found to be representative variable for Brazilian startups according to Gonzaga et al., 2020), firm age (years in operation), current Agtech sector (according to Radar Agtech’s classification), previous industry (where and if they were employed before the current position) and performance (respondents were asked to compare their level of performance relative to their main competitors in the last 3 years

in a 5-point scale ranging from “much lower” to “much higher”) following the procedure adopted by Naldi et al., (2007) and Wiklund and Shepherd (2003) to monitor firm innovation profile. The questionnaires were available through the platform Qualtrics®, which accepts both computer and mobile access.

Due to the psychometric nature of this research, the Ethics Committee at Universidade Federal do Rio Grande do Sul must approve our proposed study previously to the collection of data. We aim to address professionals directly involved with innovation decisions at firms. The questionnaires and the IGT shall be first pilot-tested on five executives from general startups, and ten PhD-level academics (whose expertise gravitates around agribusiness, Agtechs, and psychometrics). Participants received the link to test the instruments and an online meeting was held to discuss their impressions and suggestions to generate the final version of the questionnaire. The clearness of questions and the effectiveness of our translation from the original source were addressed, as well as the adequacy of the control variables to the target audience (i.e. sex, race, education, etc.).

4 Results

The presentation of our results starts with the findings in our systematic review involving impulsivity and entrepreneurship. In this initial subsection, the methods employed are discussed in three levels: search and filtering; characteristics of the sample of documents; and summary of results achieved in this phase. Next, we discuss the results achieved by the quantitative phase, which involved a pre-test of the questionnaire adopted, along with the statistical characteristics of the sample, the descriptive data, and Confirmatory Factor Analysis followed by the Structural Equation Modelling phase, in which the results from the test of hypotheses is presented.

4.1 Systematic review on impulsivity and entrepreneurship

Based on the objective of this study, a specific methodology was adopted to collect data, choose documents for analysis, and clarify research questions. To this end, we performed a Systematic Literature Review (SLR), a procedure typically used to identify, evaluate and interpret all available research relevant to a specific topic of interest (Kitchenham 2004; Parola et al. 2020). The step-by-step construction is discussed next.

4.1.1 Search and filtering

The first consultation of databases with the strings exhibited in Table 4 resulted in 162 documents (WoS) and 63 documents (Scopus). After filtering with the criteria of exclusion, the number of remaining documents was 62 (WoS) and 45 (Scopus).

Table 4. Keyword search

Search string	Criteria	WoS records	Scopus records
[all fields] impulsiv* AND [all field] startup* OR [all fields] impulsiv* AND [all fields] entrepreneur*	Document type: articles; Language: English; Timespan: until 2021; Areas: Business, Economics and behavioral areas.	62	45

No duplicated documents were found; thus, the final number of articles was 107. The next step was to select an adequate strategy to obtain a taxonomy of the theme. In that direction, we used bibliometrix tool biblioshiny to generate clusters of documents in order to select only articles that related impulsivity to the entrepreneurial/management concept. The graphic distribution of such clusters is exhibited in Figure 8.

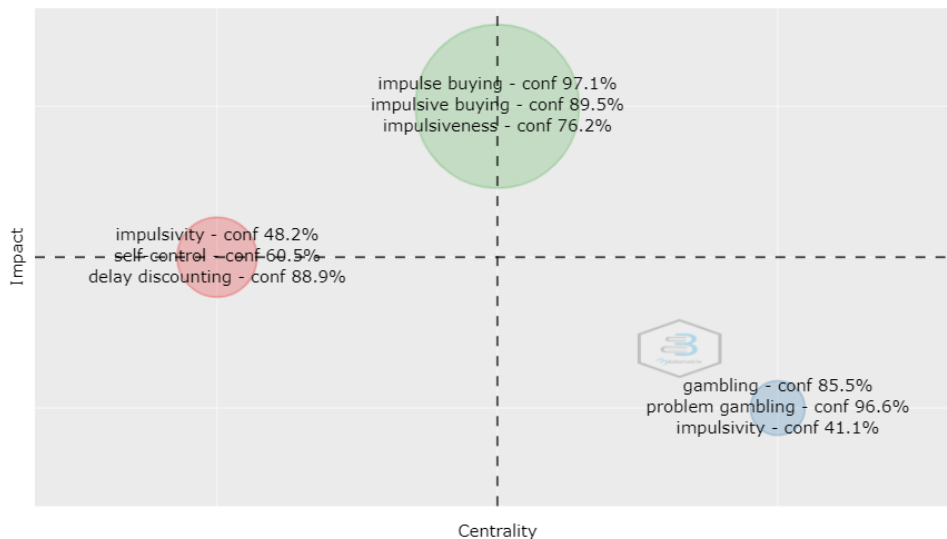


Figure 8. Clusters by documents coupling

We then opted to examine only articles belonging to the cluster Impulsivity/Self-Control/Delay discounting. This choice was due to the nature of the other two clusters. The cluster “impulse buying/impulsive buying” dealt with consumer behavior, which is not the focus of the present study. As for the “gambling/problem gambling” cluster, it dealt almost exclusively with gambling addiction, passing only briefly through the theme Business., that is, the correlations we were looking for were not found in those studies.

After reading the titles, removing residual articles on consumption, gambling, and neurological studies unrelated to the objectives of this study, 92 files – from the original 107 - remained to be examined in relation to their titles, abstracts, and keywords. In order to find connections between impulsivity and entrepreneurship, the criterion to include articles in the pool of readings was to contain both terms in either their titles AND/OR abstracts AND/OR their keywords. This first attempt generated only 13 articles. Due to the fact that impulsivity is involved in various other behavioral traits (not always being mentioned nominally), we opted to include not only studies that explicitly employed impulsivity/impulsiveness as a variable, but also its associated traits based on Wiklund et al. (2019). The validation of this choice is provided in Table 5 by assigning the given associated variable to the authors who established its connection to impulsivity. By including such variables, other 19 articles were added to the selection. However, one document was not accessible through researchers' credentials, leading to a final number of 31 articles. This classification also involved the nature of the methodological procedures, with E = experimental, and C = conceptual/review of literature (Burton et al., 2020).

Table 5. Evaluation by variable in focus

#	Author/year	Method	Variable in focus		Nature of relationship /authors
			Impulsivity	Associated variables	
1	Hochwalder (2009)	E	X		
2	Cannarella and Piccioni (2010)	C	X		
3	Tzagarakis et al. (2013)	E	X		
4	Brown et al. (2018)	C	X		
5	Boada-Grau et al. (2021)	E	X		
6	Manesh et al. (2021)	C	X		
7	Pietersen and Botha (2021b)	E	X		
8	Fisch et al. (2021)	E	X		
9	Joseph (2013)	E	X		
10	Brighetti and Lucarelli (2015)	E	X		
11	Wiklund et al. (2018)	C	X		
12	Doan et al. (2021)	E	X		
13	Pietersen and Botha (2021a)	C	X		

14	Yu et al. (2021)	E	X		
15	Soto-Simeone et al. (2021)	C	X		
16	Quan (2012)	E	X		
17	Baron et al. (2012)	E		X Venturesomeness	Direct (Piko and Pinczés, 2014)
18	Wiklund et al. (2017)	E		X Venturesomeness	
19	Soto-Simeone et al. (2021)	C		X Venturesomeness	
20	Baciu et al. (2020)	E		X Self-efficacy	Inverse (Stevens et al. 2016)
21	Basinska et al. (2018)	E		X Self-efficacy	
22	Bouncken et al. (2020)	E		X Narcissism/Psychopathy	Direct (Miller et al., 2009; Weidacker et al., 2017)
23	Lerner (2016)	E		X Disinhibition	Direct (Lattimore and Malinowski , 2011)
24	Lerner et al. (2018)	E		X Disinhibition	
25	Wiklund et al. (2017)	E		X Attention deficit disorder	Direct (Rodriguez-Jimenez et al., 2006)
26	Peltonen et al. (2020)	E		X Attention deficit disorder	
27	Stappers and Andries (2021)	E		X Attention deficit disorder	
28	Lerner et al. (2019)	E		X Attention deficit disorder	
29	Rajah et al. (2021)	E		X Attention deficit disorder	
30	Doan et al. (2021)	E		X Attention deficit disorder	
31	Yu et al. (2021)	E		X Attention deficit disorder	

4.1.2 Characteristics of the sample

We found nine articles on impulsivity related to entrepreneurship and a total of five sub-variables of impulsivity in the articles examined: attention deficit disorder was discussed in six articles whereas narcissism, venturesomeness, disinhibition, and self-efficacy were found in four different articles. The methodological analysis identified 24 experimental articles and seven conceptual or review articles.

The most relevant sources were: Journal of Business Venturing Insights (7 publications), Journal of Business Venturing (4 publications), and Small Business Economics (2). The division of articles by clusters using bibliometrix multiple correspondence analysis led to two well-defined clusters exhibited in Figure 9. The majority of articles belonged in the red cluster, which concentrated attributes directly or indirectly related to entrepreneurship and explored in previous research with a robust body of literature already available. The small cluster (blue) is dedicated to most recent research trends such as cognition and emotion in business studies. Albeit this group of documents provide useful insights to research, they are not directly linked to entrepreneurship, only offering useful findings.

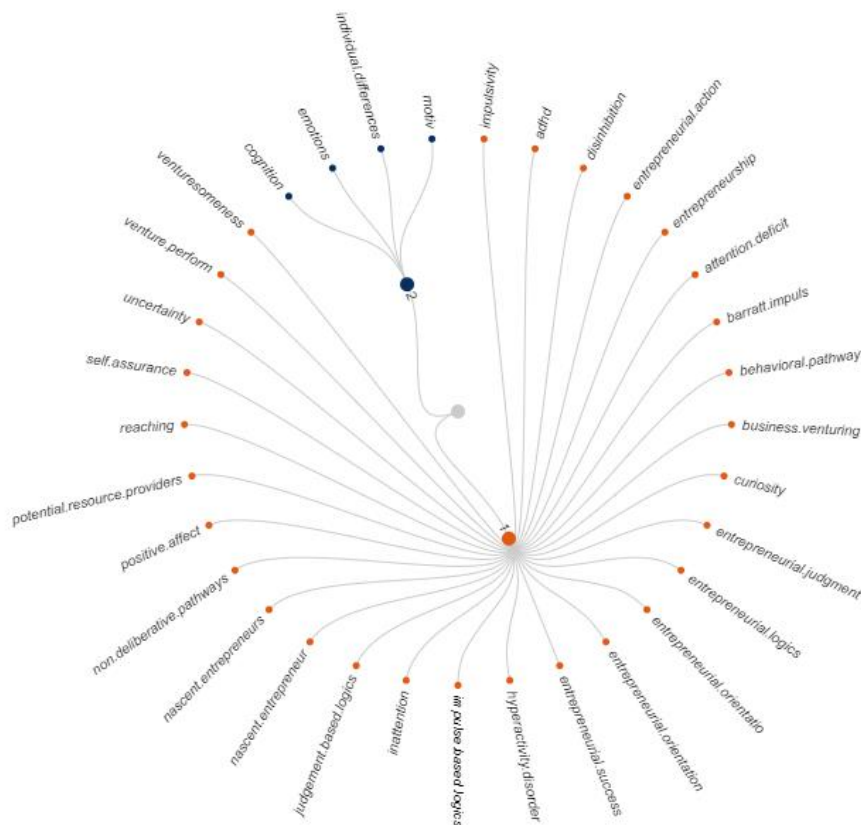


Figure 9. Multiple correspondence analysis by authors' keywords

4.1.3 Summary of results

The articles in the sample were read in ascending chronological order to guarantee that contributions were up to date with most recent research. The papers were analyzed following their classification, enhancing a summarization of contributions around the variable in focus. This structure and the proposed agenda for future research are described in Table 6.

Table 6. Summary of findings and research agenda

Theme	References	Correlation with entrepreneurship	Outcome	Implications	
Impulsivity /Impulsiveness	Hochwalder (2009) Cannarella and Piccioni (2010) Tzagarakis et al. (2013) Brown et al. (2018) Boada-Grau et al. (2021) Manesh et al. (2021) Pietersen and Botha (2021b) Fisch et al. (2021)	Quan (2012) Joseph (2013) Brighetti and Lucarelli (2015) Wiklund et al. (2018) Doan et al. (2021) Pietersen and Botha (2021a) Yu et al. (2021) Soto-Simeone et al. (2021)	Albeit impulsivity is generally a negative behavioral condition linked to lack of reasoning, short-term reward mindset, and desires over feasibility, it might suit entrepreneurship in some specific aspects, such as venturing initiative and the formation of an “entrepreneurial intuition”. Conversely, higher risk aversion (lower impulsivity and higher levels of neuroticism) implies a lower entrepreneurial orientation Hence, not all entrepreneurial traits are reasonable, which deserves further exploration.	The limit between functional and dysfunctional impulsivity might be moderated by other variables such as curiosity (Boada-Grau et al., 2021), and perseverance (Pietersen and Botha, 2021a). Furthermore, Brown et al. (2018) theorized impulsive behaviors might be under two types of rational judgement (fast and slow).	What other behavioral and environmental variables could moderate dysfunctional impulsive behavior in entrepreneurs? Impulse-driven behavior remains to be empirically explored in entrepreneurship, such as biases and delusions in the assessment of choices in decision-making. Moreover, the complete irrationality of impulsive behaviors is disputed*. Methodologically, behavioral and electrophysiological measures for entrepreneurship should be further explored (Fisch et al., 2021).
Venturesomeness	Baron et al. (2012)	Wiklund et al. (2017) Soto-Simeone et al. (2021)	Venturesomeness is related to functional impulsivity in entrepreneurship. Thus, affect attachment has a curvilinear relationship with such trait, indicating that excessive attachment crosses the frontier between functional and dysfunctional impulsivity.	There is an optimum level for the effect of positive affect over venturesomeness. Excessive attachment tends to be detrimental.	By identifying entrepreneurs’ levels of affectional involvement with ventures, future research may help clarify the positive potentials and warn about hazardous levels of attachment.

Self-efficacy	Baciu et al. (2020)		There are significant differences between entrepreneurs in successful and unsuccessful ventures both in human capital and personal traits.	Successful entrepreneurs exhibited more self-efficacy, greater problem-solving ability, high level of self-trust in challenging tasks, besides being more adaptable.	More confirmatory studies are required given the substantial literature indicating sex and age differences in entrepreneurial action (not found in this study).
Narcissism/ Psychopathy	Bouncken et al. (2020)	Walker et al. (2020)	Psychopathy, narcissism, and Machiavellianism are detrimental in the moderation between Entrepreneurial Orientation and firm performance.	EO requires relationship-oriented leaders, which is threaten by the so-called “Dark Triad” (psychopathy, narcissism, and Machiavellianism).	Personality traits should be adopted as moderators in firm performance in future studies, not as independent variables.
Disinhibition	Lerner (2016)	Lerner et al. (2018) Walker et al. (2020)	Behavioral disinhibition has a positive effect in entrepreneurial performance, even though it can be also linked to detrimental traits such as psychopathy and narcissism.	Even though it tends to boost entrepreneurial performance, disinhibition may affect negatively the ability of entrepreneurs to organize other people towards a goal.	Is the difficulty of leading groups related to narcissistic features? The adoption of the behavioral inhibition system (BIS) and behavioral activation system (BAS) in future research is recommended.
Attention deficit hyperactivity disorder (ADHD)	Wiklund et al. (2017) Peltonen et al. (2020) Stappers and Andries (2021)	Lerner et al. (2019) Rajah et al. (2021) Doan et al. (2021) Yu et al. (2021)	ADHD was found to positively affect the likelihood of venturing. However, individuals with ADHD should focus on activities that privilege risk-taking and proactive styles.	The venture may not prosper due to impairments caused by ADHD. Besides, high levels of attentional issues predict business failure and lower take-home income, whereas hyperactivity leads to negative earning’s growth.	Is there a stream of entrepreneurial action (e.g. new product development) in which individuals with ADHD present positive influence?

*See Wiklund (2019).

3.4 Control variables

Studies were also evaluated concerning the performance of control variables. The three most mentioned were gender, age, and education.

3.4.1 Gender

Even though psycho-physiological tasks under risk-ambiguity found no gender differences, women who self-assessed their levels of risk-taking still deemed themselves as risk averse (Brighetti and Lucarelli, 2015) and as less prone to entrepreneurial personal attitude (Fisch et al., 2021). Similarly, behavioral inhibition seems to operate differently between genders (Lerner, 2016), which directly impacts entrepreneurial performance. This finding reinforces the theory that social molds and stereotypes constitute heavy variables in the evaluation of risk among genders with “negative, pathologized, portrayals of women as impulsive shopaholics on one hand and paralyzed non-investors” (Joseph, 2013, p. 43) playing a decisive role in discouraging the female audience to engage in risky activities such as entrepreneurship. Albeit the study of Basinska and Daderman (2018) found men to be positively correlated with venturesomeness and self-efficacy, gender did not play a determinant role in the mediation between the two variables. Moreover, the instrument was once again an explicit questionnaire, which suffers from the aforementioned biases concerning self-assessment of risk in women. In contrast to such results, Tzagarakis et al. (2013) found significant differences in how men and women behave under different levels of uncertainty. Whereas women tend to commit early errors in low uncertainty scenarios, men commit early errors more often in high uncertainty surroundings. Wiklund et al. (2018) took a step ahead, formulating that impulsive men act on their entrepreneurial pulses more often than impulsive women, meaning the fewer female entrepreneurs out there probably belong to the impulsive kind. When we move to clinical studies, however, evidence of significant differences between men and women in risk-taking are common ground due to testosterone interference (Bechara et al., 2005; Stanton et al., 2011; Starcke et al., 2017; Singh, 2021) and the fact that “females suffer for a stronger emotional reaction to losses under (...) ambiguity” (Brighetti and Lucarelli, 2015, p. 78). Therefore, the more studies adopting parallel instruments to infer gender differences, the clearer the differences between biological and social inclination to risk shall become. All in all, the success rate in successful

established firms was found to be slightly higher for ventures led by women (Baciu et al. 2020).

3.4.2 Age

The impact of age on entrepreneurship varies, but the general idea inferred from our selection of articles indicates that as age increases, so does the probability of becoming successful as an entrepreneur. Rajah et al. (2021) found the rate of success to be at its peak in the age group of 23 to 35 years old, which is in line with studies on Entrepreneurial Intention (EI). Doan et al. (2021) and Quan (2012) found age to be inversely related to the intention to pursue a venture due to higher level of risk aversion in older individuals, whereas Fisch et al. (2021) revealed a positive and significant correlation between age and EI (a limit in this relationship, however, was not discussed). Less disputable were the studies evaluating personality traits in relation to age. Neuroticism, extraversion, and personal accomplishment in entrepreneurs were positively correlated with age (Hochwalder, 2009), while sensation-seeking (Wiklund et al., 2017; Doan et al., 2021; Pietersen and Botha, 2021b) and narcissism (Bouncken et al., 2020) were found to decrease over time. Entrepreneurial action (i.e. the series of actions taken in the process of starting a new venture) was found to be positively related to age (Lerner et al., 2019; Pietersen and Botha, 2021b), which supports the scenario of middle-aged individuals being more prone to pursue new ventures (Baciu et al., 2020), but disputes the tendency of older subjects to avoid risk and, thus, show diminished rates of EI. Once again, the relationship between age and disposition to start a new venture seems to behave in an S-shaped form (with peaks in early 20s to early 30s and then in mid-forties). Traits such as lack of perseverance and lack of premeditation were not significant in relation to age (Wiklund et al., 2017; Doan et al., 2021). The complete description of variables tested towards age is exhibited in Appendix 2.

3.4.5 Education

Even though entrepreneurs have a considerably higher level of education compared to the general population (Baciu et al., 2020), no significant differences in education were found between successful and unsuccessful entrepreneurs concerning their educational background. Yet, the effect of education was found to be larger for the reaction towards losses than the effect of gender (Brighetti and Lucarelli, 2015). Furthermore, the age in which an individual with ADHD leaves education might be a predictor of their likelihood

of success in entrepreneurship as an adult (Rajah et al., 2021), indicating education as a possible moderating variable in the relationship between inattention and entrepreneurship. Hence, exposition to education might be relevant in how individuals in the spectrum of impulsivity traits will shape their attitudes in management. All in all, educational background was explored as a control variable in much fewer studies than gender and age, which is a meaningful input for future research.

4.2 Pre-test of the questionnaire

Pre-testing is important for identifying survey problems. Problems with question content include confusion about the overall meaning of the question and misunderstanding of individual terms and concepts. Difficulties in skipping questions or navigating from question to question can lead to missing data and dissatisfied interviewers and respondents. Survey formatting issues are particularly relevant to self-administered surveys and can lead to the loss of important information if not addressed (Aziz and Kamaludin, 2015). Moreover, the resulting changes to the questions improve the effectiveness, reliability, and responsiveness of the questionnaire, having a significant influence on the subsequent statistical interpretation of the data (Charlton, 2000).

Our complete questionnaire was published on the online platform Qualtrics[®] and tested with the help of a group of 15 individuals: 10 academics in the fields of agriculture and/or Psychology and five startup entrepreneurs (not specifically related to Agtech). Participants were questioned on the clarity and cohesion of the questionnaire, besides validating the translation performed in the two instruments that had not been validated in Portuguese so far. The questionnaire was divided in five sections: (a) demographic questions and firm profiling questions; (b) comparison with competitors; (c) Innovativeness measurement scale; (d) Barratt Impulsiveness Scale, and (e) Norwegian dispositional resilience scale. The latter three refer directly to the latent variables that allowed for our test of hypotheses.

The questionnaire started being widely shared in July 2022, mainly through LinkedIn and having as targets the CEOs from the companies listed in the Radar Agtech 2021 (initially 397). In the course of the research, 76 companies were found to be either inoperant, which reduced our initial list of contacts to 321. Overall, 182 individuals were contacted via LinkedIn (i.e. received an invitation to join the researcher's network). From these, 159 accepted the request for connection and, thus, received the link to participant in the research. Other 139 individuals were contacted via Whatsapp[®], although we

cannot affirm with precision those groups were completely apart, meaning some professionals could have been contacted twice.

As the data collection progressed, we performed periodical tests (every 15 days) to verify if R^2 had achieved the adequate level for data analysis. A suitable result was achieved in December 2022, leading to the phase of data analysis to be performed in the 60 days that followed. At that point, 74 valid responses were extracted from the platform.

4.3 Statistical characteristics of the sample

Our first analytical procedure was to attest the parameters of distribution of the data. For this step, Shapiro-Wilk test was adopted. The test indicates that the data is normal if the significance value is greater than 0.05. (Ghasemi and Zahediasl, 2012). All variables in our sample presented an indicator below 0.05, thus being considered non-parametric. According to Wende and Becker (2015), non-parametric data is a pre-requisite for performing Structural Equation Modeling (SEM) using Partial Least Squares (PLS). Therefore, this step was necessary to validate the fitness of our data for Smart PLS use (Smart PLS, 2016).

The next analysis was performed using the A Keyser-Meyer-Olkin (KMO) test was conducted to determine whether the data was factorable. In the test, sampling adequacy is assessed for each variable in the model as well as for the complete model. KMO values between 0.7 and 0.79 are middling, while those between 0.6 and 0.69 are considered mediocre. In a sample size ≤ 100 , an average value of 0.6 or greater is acceptable (Shrestha, 2021). The average value in our data was 0.702. Hence the potential for factorial analysis was validated. We also tested the sample with the Bartlett's Sphericity Test ($p < 0.001$). The test examines the hypothesis that variables in a population are not correlated. The results in our data indicated that it was adequate to perform Factorial Analysis (Lee and Morrison, 2005).

In order to determine whether the variables were internally consistent, Cronbach's alpha was calculated (Cronbach, 1951). As shown in Table 7, the coefficients generated for each dimension are greater than or equal to 0.7, indicating that the dimensions can be grouped and measured as components. (Landis and Koch, 1977). In some cases, variables have to be dropped so that the construct could reach an acceptable index. This happened with the constructs Attentional Impulsivity and Non-Planning Impulsivity, in which variables A3 (“I concentrate easily”) and NP1 (“I make plans not to lose my job”) had to be discarded to improve the constructs' internal cohesion.

Table 7. Instrument validation analysis by Cronbach's alpha

Dimension	Total items	Cronbach's alpha
Control Resilience	5	0.732
Commitment Resilience	5	0.758
Challenge Resilience	5	0.701
Innovativeness	6	0.801
Attentional Impulsivity	4*	0.779
Motor Impulsivity	5	0.870
Non-Planning Impulsivity	4**	0.732

*with item A3 dropped.

**with item NP1 dropped.

4.4 Descriptive data

Along with the scales, demographic and additional business profile data were collected from respondents. Results indicated a prevalence of male entrepreneurs (66%), with 85% belonging to the age group between 31 and 50 years old. The majority of respondents were located in Rio Grande do Sul (45.68%), followed by Paraná (37.04%) and 86.42% categorized themselves as white in terms of ethnicity. As for 2019, 73.9% of the southern region's population were white (IBGE, 2023), showing an alignment with the results found in this study.

Half of the individuals surveyed informed their companies had from one to five employees (50.42%). Around 58% of these companies have been operating between one and 5 years. The most relevant data, however, was revealed when individuals were questioned about their previous job before venturing. More than 44% indicated they had never had a job before starting their business in the Agtech sector. In second came the food industry and the IT (Information and Technology) industries, both with 9.88%. The totality of results is exhibited in Table 8.

Table 8. Demographic data and business profiles of participants

Variable	Frequency	Valid (%)
<i>Gender</i>		
Male	66	70.97
Female	27	29.03
<i>Age</i>		
22-30	8	9.88
31-40	40	49.38
41-50	29	35.80
51-60	4	4.94

<i>State</i>		
Paraná	30	37.04
Rio Grande do Sul	37	45.68
Santa Catarina	14	17.28
<i>Race/Ethnicity</i>		
White	70	86.42
Black	2	2.47
Dark-skinned/ Brown	5	6.17
Other	4	4.94
<i>Number of employees (company)</i>		
1 – 5	41	50.62
6 – 10	14	17.28
11 -20	6	7.41
21 – 49	8	9.88
50 or more	12	14.81
<i>Years in activity (company)</i>		
Less than 1 year	3	3.70
1 – 2	20	24.69
3 – 5	27	33.33
6 – 9	16	19.75
10 or more	14	17.28
<i>Last industry before starting the business</i>		
Never worked before	36	44.44
Food	8	9.88
Information and Technology	8	9.88
Agriculture and Livestock	6	7.41
Energy	5	6.17
Research and Education	5	6.17
Construction	2	2.47
Automotive	2	2.47
Government employee	2	2.47
Armament	1	1.23
Other industries	6	7.41

Additional information was also collected on the subsectors of the Agtech companies owned by respondents (see Table 9). The most prominent class of businesses belonged in the “Rural Property Management Systems” (14%), followed by “Innovative foods and new food trends” (12%).

Table 9. Agtech subsectors represented in the sample

Subsector	Perc.	Count
Rural Property Management System	14%	11
Innovative foods and new food trends	12%	10
Telemetry and Automation	6%	5
System integrator platform	6%	5
Fertilizers	5%	4
Laboratory analysis	5%	4
Credit, swap, insurance, carbon credits and fiduciary analysis	5%	4
Animal Nutrition and Health	5%	4
Bioenergy and Renewable Energy	4%	3
Content	4%	3
Biological Control and Integrated Pest Management	4%	3
Marketplaces and platforms for trading and selling agricultural products	4%	3
Biodiversity and Sustainability	4%	3
Remote Sensing	4%	3
Agricultural waste management	2%	2
Marketplace for Agribusiness Inputs	2%	2
Storage	1%	1
Drones	1%	1
Industry and Food Processing 4.0	1%	1
Internet of Things for Agric: Pest detection	1%	1
Food safety and traceability	1%	1
Seeds	1%	1
Apiculture and Pollination	1%	1
Connectivity and Telecommunications	1%	1
Shared economy	1%	1
Online grocery store	1%	1
Urban planting: plant factory and new ways of planting	1%	1
Online Restaurants and Meal Kits	1%	1

Another aspect verified by the questionnaire was how the respondent would classify the performance of their company in relation to their competitors in the last three years from 1 to 5, with 5 being “much superior” and 1 “much inferior”. The mean attributed to this variable was 3.548 (SD = 0.913). Only 11% of the sample considered their companies to be “much superior” to their competitors (see Figure 11). Meanwhile, 4% considered their company's performance to be “much inferior” to their competitors.

Individuals who answered 1 or 3 to this question exhibited lower means in the Innovativeness construct.

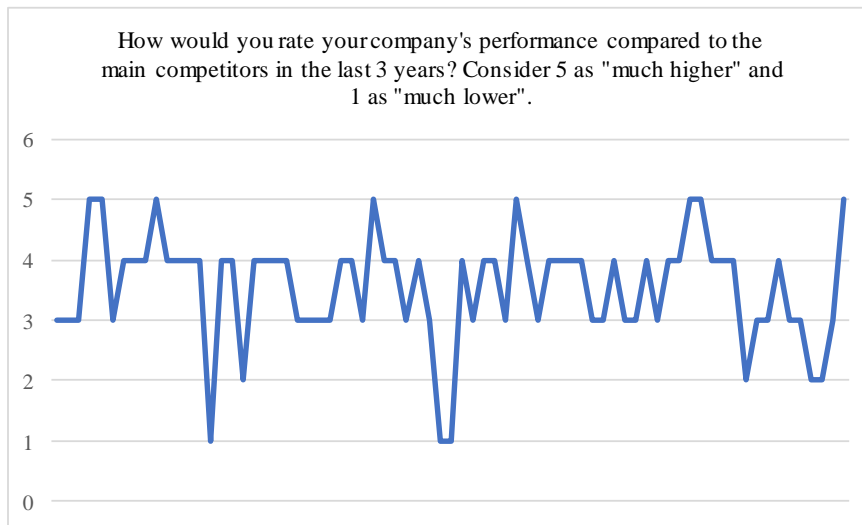


Figure 11. Comparison of company's performance with main competitors

4.5 Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) was used to investigate construct validity. Several fit indices can be adopted to attest validity, such as root-mean-squared error of approximation (RMSEA), comparative fit index (CFI), and chi-squared. RMSEA measures the average of residual variance and covariance; good models have RMSEA values of 0.08 or less (Atkinson et al., 2012). Due to an initial verification that indicated inadequate fitness ($RMSEA > 0.08$), we discarded independent variables with loadings below 0.4. This procedure is in accordance with Hair et al. (2021). According to the authors, researchers should carefully explore the implications of indicator removal on other reliability and validity metrics rather than automatically removing indications when their loading is initially unsatisfactory. In general, indicators with loadings between 0.40 and 0.708 should only be taken into account for elimination when doing so results in an increase in internal consistency reliability or convergent validity beyond the advised threshold value.

The impact that an indicator's deletion will have on content validity—the degree to which a measure accurately captures all aspects of a certain construct—is another factor to take into account when deciding whether to remove it. As a result, signs with weaker loadings are occasionally kept. As expected, the strategy of keeping indicators with loadings ≥ 0.4 provided an improved indicator ($RMSEA = 0.07$). Additionally, CFI was equal to 0.897, which is slightly inferior to the minimum desirable index of 0.9 (Hu

and Bentler, 1999; West et al., 2012). The final configuration of factors is exhibited in Table 10.

Table 10. Factor loadings and parameter estimates

Factor	Indicator	Mean	Estimate	Std. Error	z-value	P	95% Confidence Interval	
							Lower	Upper
Control Resil.	CON2	4.04	0.671	0.105	6.378	<.001	0.465	0.877
	CON6	4.16	0.856	0.094	9.129	<.001	0.672	1.040
	CON12	4.14	0.848	0.097	8.756	<.001	0.658	1.038
	CON15	4.41	0.771	0.084	9.200	<.001	0.606	0.935
Commitment Resil.	COM1	1.53	0.421	0.084	4.983	<.001	0.255	0.586
	COM4	1.24	0.512	0.065	7.821	<.001	0.384	0.640
	COM7	1.92	0.440	0.107	4.108	<.001	0.230	0.650
	COM13	1.41	0.695	0.084	8.328	<.001	0.532	0.859
Challenge Resil.	CHA11	2.19	0.531	0.110	4.829	<.001	0.316	0.747
	CHA14	2.42	0.753	0.126	5.993	<.001	0.507	0.999
	CHA3	1.99	0.761	0.105	7.249	<.001	0.555	0.967
Innovativeness	INNO_1	4.14	0.723	0.106	6.802	<.001	0.515	0.932
	INNO_2	4.22	0.767	0.096	8.009	<.001	0.580	0.955
	INNO_3	4.03	0.913	0.098	9.298	<.001	0.721	1.105
	INNO_4	3.78	0.883	0.115	7.649	<.001	0.656	1.109
	INNO_6	3.85	0.838	0.119	7.064	<.001	0.605	1.070
Attentional Imp.	A4	1.85	0.667	0.122	5.463	<.001	0.428	0.907
	A5	1.97	0.649	0.123	5.255	<.001	0.407	0.891
	A2	1.99	0.909	0.120	7.599	<.001	0.674	1.143
	A1	2.47	0.813	0.125	6.496	<.001	0.568	1.058
Motor Imp.	M1	2.01	0.753	0.093	8.099	<.001	0.571	0.935
	M2	2.20	0.890	0.107	8.287	<.001	0.679	1.100
	M3	1.69	0.701	0.088	7.944	<.001	0.528	0.874
	M4	1.66	0.685	0.083	8.236	<.001	0.522	0.848
	M5	1.95	0.664	0.119	5.568	<.001	0.430	0.897
Non-Planning Imp.	NP2	3.91	0.725	0.107	6.759	<.001	0.515	0.936
	NP3	3.39	0.644	0.126	5.119	<.001	0.397	0.891
	NP5	3.76	0.602	0.115	5.210	<.001	0.375	0.828
	NP	3.51	0.620	0.106	5.838	<.001	0.412	0.828

4.6 Structural Equation Modelling

The model estimation was performed using partial least squares structural equation modeling (PLS-SEM) (Hair et al. 2021). As a result of its ability to handle complex models, irregular data, and small samples, PLS-SEM is a viable alternative technique (Shmueli et al. 2019). The software of choice in this study was Smart-PLS version 4.

Fixed latent variable scores are provided via PLS-SEM. It provides the overall effect of the structural model on a predictor variable in contrast with the predictors' average latent variable scores (Hair et al. 2014; Ringle and Sarstedt 2016). As a start, researchers need to situate their models between reflective and formative. A reflective model is more appropriate when is the cause of the observed measures. Although the construct cannot be measured directly, it nonetheless exists without the help of its effect markers (Simonetto, 2012). When the opposite happens, that is the phenomenon is defined by, or is a product of, the observed variables, the most appropriate model is the formative (Simonetto, 2012). The first case (reflective) is the one approached by our study. In order to build a reliable reflective model, Hair et al. (2021) recommends the steps in Figure 10.

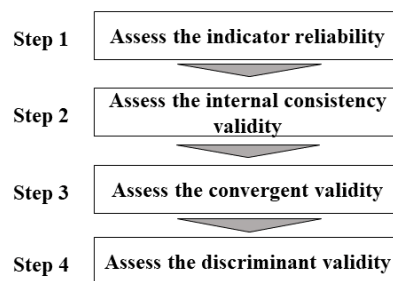


Figure 10. Reflective measurement model assessment procedure
Source: Hair et al. (2021)

4.6.1 Tests of global model fit

As part of Confirmatory Factor Analysis, standardized root mean square residuals (SRMR) are used as an adjustment measure. The SRMR evaluates the fit of the CFA model to the sample data. The distance between the correlations predicted by the CFA and the correlations found by the study's sample is shown by this indicator. This distance is referred to as the residuals. The SRMR accepts values in the range of 0 and 1, with zero denoting an ideal match. Therefore, the better the match, the smaller the SRMR value (Perry et al., 2015). SRMR in our sample was 0.080, thus it can be considered a good enough model by PLS-SEM standards.

Another important indicator of global model fit is the variance inflation factors (VIF's). These indicators provide a diagnose of issues of multicollinearity, that is a statistical phenomenon (also known as near-linear dependency) that occurs when the correlation between two or more predictor variables in a multiple regression model is substantial (Daoud, 2017). All VIF indicators in our sample stood in the tolerance

interval, being greater than 1 and lower than 3.7. Therefore, the fit indices for the global model are acceptable, and there is no common method bias or multicollinearity problems.

4.6.2 Reliability and Validity Analysis

For reliability and validity, PLS-SEM adopts four indicators: Cronbach's alpha, Composite reliability (ρ_a and ρ_c), and Average Variance Extracted (AVE). The values of ρ_a and ρ_c must be above 0.70. The AVE of every construct should be above 0.5 (Smart PLS, 2016).

Cronbach's alpha gives an estimation of the reliability based on the correlations between the observed indicator variables. Values above 0.7 are considered good fit, even though the desirable indicator is above 0.9. Assessment of reflective measurement models (the most common case for behavioral studies) includes composite reliability to evaluate internal consistency, individual indicator reliability, and AVE to evaluate convergent validity (Smart PLS, 2016). All indices are exhibited in Table 11.

Table 11. Measurement models, convergent validity, and reliability.

Variables and items	Outer Loadings	VIF
<i>Attentional Imp</i> ($AVE = 0.484^*$, $C. \alpha = 0.778$, $Rho_A = 0.067^*$, $CR = 0.783$)		
A 1: I feel uneasy in lectures or classes.	0.507	1.896
A 2: I get squirmy in my chair in plays or lectures.	0.891	1.811
A 4: I don't pay attention	0.667	1.367
A 5: I get bored easily when I'm solving problems mentally.	0.663	1.422
<i>Challenge Resilience</i>		
<i>(AVE = 0.597, C. alpha = 0.743, Rho_A = 0.789, CR = 0.873)</i>		
CHA 3: I do not like to make changes in my routine activities.	0.953	1.573
CHA 11: It bothers me when my daily routine is interrupted.	0.516	1.363
CHA 14: I like to have a daily schedule that doesn't change much.	0.786	1.577
<i>Commitment Resilience</i>		
<i>(AVE = 0.597, C.alpha = 0.743, Rho_A = 1.009, CR = 0.808)</i>		
COM 1: Most of my life is spent doing meaningless things.	0.510	1,387
COM 13: Life is generally boring for me.	0.707	2.231
COM 4: I feel my life is somehow empty of meaning.	0.634	2.130
COM 7: I am always excited about my work activities.	0.893	1.249

Control Resilience

(AVE = 0.746, C. alpha = 0.855, Rho_A = 0.901, CR = 0.921)

CON 12: It's up to me to decide what the rest of my life will be like.	0.875	2.969
CON 15: My choices make a real difference to the intended results.	0.906	2.813
CON 2: If you work hard, you can almost always achieve your goals.	0.775	1.682
CON 6: How things happen in my life depends on my own actions.	0.892	2.996

Innovativeness

(AVE = 0.683, C. alpha = 0.883, Rho_A = 0.887, CR = 0.915)

INNO 1: Our company frequently tries out new ideas.	0.779	1.922
INNO 2: Our company seeks new ways of doing things.	0.840	2.388
INNO 3: Our company is creative in its methods of operation.	0.895	3.090
INNO 4: Our company is often first to market with new products and services.	0.814	2.257
INNO 6: Our introduction of new products to the market has increased over the last five years.	0.800	2.045

Motor Impulsivity

(AVE = 0.627, C. alpha = 0.875, Rho_A = 0.835, CR = 0.895)

M 1: I act on impulse.	0.634	2.281
M 2: I act in the "spur" of the moment.	0.792	2.852
M 3: I do things without thinking.	0.899	2.259
M 4: I say things without thinking.	0.875	2.474
M 5: I buy things on impulse.	0.730	1.542

Non-Planning Impulsivity

(AVE = 0.549, C. alpha = 0.733, Rho_A = 0.765, CR = 0.892)

NP: I plan tasks carefully.	0.753	1.354
NP 2: I prepare for the future.	0.822	1.487
NP 3: I save (money) regularly.	0.691*	1.452
NP 5: I think about things carefully.	0.691*	1.347

Notes: *below recommended standards but kept due to the models' best fit for reliability indicators. Average of Variance Extracted (AVE), Cronbach's alpha (C. alpha), and reliability indices Rho A and Rho A for each construct; Composite Reliability, or CR; Variance Inflation Factor at the item level, or VIF.

4.6.3 Discriminant Validity Analysis

For discriminant validity analysis, the most common indicator is heterotrait-heteromethod (HTMT) correlations. According to a formal definition of the HTMT statistic, it is the mean of all correlations between indicators measuring various constructs (i.e., the heterotrait-heteromethod correlations) in comparison to the (geometric) mean of the average correlations between indicators measuring the same construct (i.e., the monotrait-heteromethod correlations) (Henseler et al., 2015). Technically speaking, the HTMT technique is a projection of the true correlation between two entities, assuming perfect measurement of both (i.e., if they were perfectly reliable). A high HTMT value

indicates a lack of discriminant validity. A lower and hence more conservative threshold value of 0.85 seems required when the constructs in the path model are conceptually more different (Henseler et al., 2015). As per Table 12, HTMT measures were found to be fit in our sample, since all indices in the diagonal line of the table are below 0.85.

Table 12. Heterotrait-heteromethod correlations

	1	2	3	4	5	6	7
Attentional Impulsivity (1)							
Challenge Resilience (2)	0.380						
Commitment Resilience (3)	0.484	0.549					
Control Resilience (4)	0.137	0.118	0.292				
Innovativeness (5)	0.115	0.121	0.404	0.546			
Motor Imp.(6)	0.736	0.305	0.455	0.150	0.172		
Non-Planning Imp. (7)	0.134	0.258	0.307	0.651	0.708	0.340	

4.6.4 Tests of the Measurement Models

Once a reflective model meets the criteria discussed in the previous subsections, it can be considered fit for a PLS-SEM model. Figure 12 demonstrates the outcomes of tests conducted using the consistent PLS algorithm on measurement models. According to Huber et al. (2007), path coefficients must be ≥ 0.100 (with $p < 0.05$) to be considered acceptable.

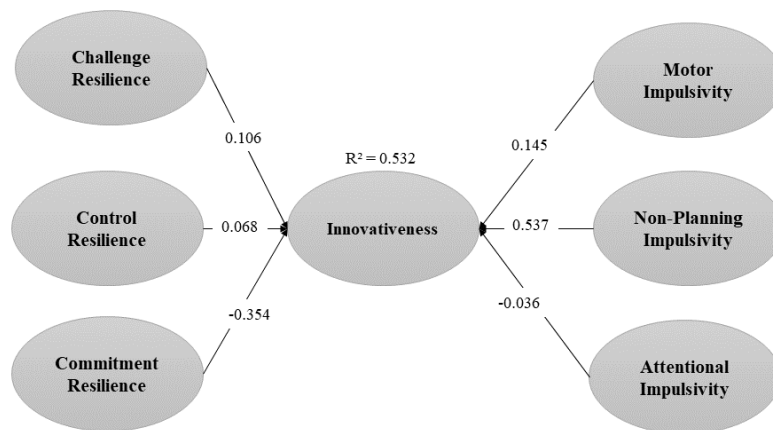


Figure 12. PLS algorithms results

4.6.5 Structural Path Significance (hypotheses testing)

This section presents the statistical data that allow for the verification of our hypotheses by the adoption of a process known as bootstrapping, SmartPLS can produce T-statistics for significance testing of both the inner and outer model. In this method, a sizable subsample (e.g., 5000) of the original sample is obtained with replacement to produce bootstrap standard errors, which in turn produces approximative T-values for the structural path's significance test. The Bootstrap result comes close to representing normalized data (Wong, 2013). When T-values are larger than 1.96 with $p \leq 0.05$, the path coefficient can be considered statistically significant. As exhibited in Table 13, two relationships were considered statistically relevant: Commitment Resilience and Non-Planning Impulsivity were found to be relevant predictors of Innovativeness. Another important aspect provided by this model is the estimation of effect sizes (f-square). Effect sizes are classified as modest, moderate, and strong at 0.02, 0.15, and 0.35, respectively (Li et al., 2020).

Table 13. Significance test of path coefficients for the structural model (hypotheses testing)

Hyp.	Relationship	Beta	f-square	t-value	p	Remarks
H1a	Motor Imp. → Innovativeness	0.145	0.023	1.084	0.278	Not supported
H1b	Non-Planning Imp. → Innovativeness	0.537	0.362	4.900	0.000	Supported
H1c	Attentional Imp. → Innovativeness	-0.036	0.002	0.240	0.811	Not supported
H2a	Commitment Resil. → Innovativeness	-0.354	0.195	2.967	0.003	Supported
H2b	Control Resil. → Innovativeness	0.068	0.006	0.478	0.633	Not supported
H2c	Challenge Resil. → Innovativeness	-0.106	0.019	0.976	0.329	Not supported

As at least one dimension of Impulsivity and Resilience was meaningful in the analysis, we can consider hypothesis **H1** and **H2** to be partially correct. Hypotheses **H1a** and **H1c** were not supported, but **H1b** was supported, due to Non-Planning Impulsivity being inversely related to Innovativeness, that is, individuals the sample showed higher scores in statements linked to planning and provision, meaning they are on the opposite side of this condition.

Commitment Resilience was found to be correlated to the dependent variable, which means CEOs who attested high levels of Innovativeness in their companies mostly disagreed with statements that indicate dissatisfaction with daily life or a lack of existential meaning. That is not to say they are always excited about work activities (COM7), but eventual dissatisfaction with their routine did not show significant detrimental effects to their view of life. Therefore, the correlation is coherent and the

effect size is moderates, which confirms **H2a**. In regards to Control and Challenge Resilience, the path coefficients in both cases were below 0.1, which means **H2b** and **H2c** cannot be supported.

4.7 Significant differences in medians

Differences among demographic and business profile groups were tested using the Kruskal-Wallis test. Items CON2 (“If you work hard, you can almost always reach your goals”) and CON6 (“How things happen in my life depends on my own actions”) showed relevant median differences among states, with Rio Grande do Sul having greater scores in both items. A third difference was found concerning the variable NP5 (“I think about things carefully”), with male respondents scoring higher than female respondents. Moreover, the perception of company’s performance in relation to main competitors (COMP_1) was significantly influenced by the five items in the Innovativeness Scale. Complete results are disclosed in Table 14:

Table 14. Kruskal-Wallis test with significant results

	Factor	Statistic	df	p
CON2	STATE	6.815	2	0.033
CON6	STATE	8.092	2	0.017
NP5	SEX	4.888	1	0.027
INNO1	COMP_1	13.003	4	0.011
INNO2	COMP_1	15.200	4	0.004
INNO3	COMP_1	15.489	4	0.004
INNO4	COMP_1	16.987	4	0.002
INNO6	COMP_1	10.638	4	0.031

5 Discussion

This study started with a compilation of relevant research linking impulsivity to entrepreneurship by integrating Business and Psychology studies. The review has identified not only impulsivity as a direct variable, but other conditions to which this trait is an antecedent. The interdisciplinary nature of impulsivity demanded a wider view of possible interactions for future studies. The myriad of opportunities in entrepreneurship research is linked to the inherent scenario of risk and uncertainty faced by those who decide to engage in new ventures. Thus, the human character behind entrepreneurs offers

plenty of psychological nuances of high research potential, especially those related to Resilience.

When impulsivity was employed as the main variable, several outcomes were identified. Wiklund et al. (2018) acknowledged different facets of impulsivity throughout a new venture. Overall, uncertainty seems to increase curiosity in some individuals, whereas others succumb to non-planned action (Boada-Grau et al., 2021) or greed (Seuntjens et al., 2015). The engagement in a scenario of uncertainty becomes attractive to impulsive individuals, especially due to the sensation seeking attribute, which encourages the pursuit of “novel, dangerous and risky activities” (Wiklund et al., 2018, p. 8). This sensation-seeking for entrepreneurship can be translated as a feeling of “venturesomeness” (Basinska and Daderman, 2018), and while it favors initial stages of an enterprise, its effect becomes harmful due to an impaired ability to prepare for and deal with scenarios of crisis (Sheaffer and Brender-Ilan, 2014), as well as managing teams towards a common goal (Lerner, 2016).

The associated variable mostly explored in studies was attention deficit disorder. The lack of impulse inhibition, expected in cases of ADHD, was found to be negatively associated with time management and other central organizational abilities that require self-control (Boada-Grau et al., 2021). Furthermore, even though venturing might attract individuals with this condition, the success of the enterprise seems unlikely (Lerner et al., 2019).

In short, the opportunities for future investigation become abundant in face of the many impacts of impulsivity in entrepreneurial behavior, both as boosting force or as a saboteur mechanism, depending on (a) the stage of the venture; (b) the educational background profile of entrepreneurs; (c) entrepreneurs' stage in life (early 20s to early 30s or middle age), and (d) whether entrepreneurial intention is derived from innovative proposals or from a subsistence context (Venugopal and Madhubalan, 2021).

One of the main methodological approaches to impulsivity is the Barratt Impulsivity Scale (BIS-15) (Patton et al., 1995), a questionnaire with 15 statements on personal attitudes in which the respondent indicates the frequency of incurrence in each behavior. The instrument is divided in three subscales: Motor Impulsiveness Non-Planning Impulsiveness, and Attentional Impulsiveness

Based on the perception that an innovation environment is inherently characterized by speed, risk and uncertainty (Lumpkin and Dess, 2001; Yu and Chen, 2016; Zheng et al., 2020), the organization, like the human brain, needs to develop

“neurons” and nerve stimuli that can optimize the circulation of information in the firm to avoid becoming bound by set standards in innovation decisions and to stimulate team creativity in problem-solving. Even among entrepreneurs, different levels of risk-taking and risk aversion are observed, depending on what motivates their endeavors. According to Block et al. (2015, p.184), “necessity entrepreneurs are found to be more risk averse, whereas entrepreneurs motivated by a high level of creativity are found to be less risk averse”. Moreover, a high level of anxiety sensitivity is linked with risk-avoidance in decision-making due to several sensations exerted by risk-taking that are undesirable to individuals with anxiety-related pathologies (Broman-Fulks et al., 2014). In sum, impulsivity, depression, anxiety and stress are strongly interrelated variables and all tend to decrease with age (Moustafa et al., 2017). In our samples, most of the aforementioned findings were proved correct.

In this study, eight hypotheses were proposed. First, for H1 and H2, we assumed that impulsivity and resilience, were, respectively, predictors of innovativeness. Then, we developed a more in-depth approach presenting three sub-constructs of impulsivity (H1a – motor impulsivity is a predictor of innovativeness; H1b – non-planning impulsivity is a predictor of innovativeness; H1c – attentional impulsivity is a predictor of innovativeness) and resilience (H2a – commitment resilience is a predictor of innovativeness; H2b – control resilience is a predictor of innovativeness; H2c – commitment resilience is a predictor of innovativeness).

Results show entrepreneurs did not score highly on pathological levels of impulsivity (H1a and H1c were not supported). Their behavioral pattern seemed prone to caution and well-analyzed action (H1b supported), indicating a certain distancing from decisions taken abruptly (irrational risk-taking). Following the tendency of diminished levels of depression and anxiety as age progresses, our sample was composed mostly of individuals between 31 and 50 years (85%). In what concerns neuroticism patterns, men showed a larger concern with planning for job security. This might be related with cultural figure of “the provider” that is still a strong trace of the highly patriarchal Brazilian culture (Freitas et al., 2009). Overall, individuals in our sample demonstrated a positive view of life and considered their lives to be meaningful (H2b confirmed). However, they did not consider their own attitude towards life to be a predictor of their success (H2a not supported). Neither were they significantly attracted to irregular routines and multitasking (H2c not supported).

Albeit impulsivity is generally a negative behavioral condition linked to lack of reasoning, short-term reward mindset, and desires over feasibility, it might suit entrepreneurship in some specific aspects, such as venturing initiative and the formation of an “entrepreneurial intuition”. Conversely, higher risk aversion (lower impulsivity and higher levels of neuroticism) implies a lower entrepreneurial orientation. The limit between functional and dysfunctional impulsivity might be moderated by other variables such as curiosity (Boada-Grau et al., 2021), and perseverance (Pietersen and Botha, 2021a). Even though such moderation relationships were not tested in this study, the delineated behavior of entrepreneurs in the sample did not indicate proneness to detrimental forms of impulsivity, hence our research cannot endorse such outcomes.

As per quantitative findings in our study, it was found that neither impulsivity nor resilience are complete predictors of innovativeness in Brazilian Agtech entrepreneurs. What our results indicate is that two dimensions of these conditions are significant measures of innovativeness, i.e. low levels of Non-planning impulsivity – meaning these individuals are careful planners – and commitment resilience, a feature linked to a positive attitude and a meaningful life in general. Another important quantitative outcome was the high correlation between one's perception of the innovativeness in their company and how they rate the company's performance in relation to competitors. The individuals who rated their companies as low in innovativeness drivers were mostly the same who considered their company's performance to be low in comparison to competitors.

The fact that individuals considered multitasking as undesirable is in pair with the significant percentual of companies with one to five employees (50.62%) in the sample. Several studies discussed the high cost of labor in Brazil (e.g. Coslovsky, 2017; Ulyseia and Ponczek, 2018), as well as the heavy taxation on businesses (70% of the profit in Brazil is spent on taxes as of 2017) and on external investments (Martinez et al., 2014; Paes, 2017; Martinez and Ferreira, 2019). Moreover, in the course of data collection, some informal conversations were had with entrepreneurs concerning their routine. Five of them revealed they still had regular jobs and did not feel ready yet to devote themselves fully to their companies. The high number of startups who closed down during the publication of Radar Agtech in 2021 to the period of data collection in our research is an indicator of how vulnerable this sector is (or how vulnerable startups are, in general, in Brazil). The COVID-19 also took a significant toll on these companies (Mota et al.; 2022)

To illustrate the problematic state of things in Brazilian entrepreneurship, while US\$ 24 bi were invested in startups in the US during 2017, only US\$ 250 mi were invested in Brazilian startups in the same period. Whilst Brazil's grade in access to venture capital is 2.5 (in a scale between 0 and 7), Israel, a much smaller country, reached 4.7. The average time to open a business is also significantly slow. While in places like Singapore, an individual can formalize a business in a maximum of three days, the period can be extended to three months in Brazil. As previously reported, the volume of taxation is also a determinant barrier for entrepreneurship. Brazilian legislation was rated 2 (in a scale from 0 to 7) in its flexibility on hiring and firing workers. The educational system is also very poor, which discourages international investment due to the high cost of finding and compensating high-qualified individuals (Monteiro et al., 2019). Other perspectives can be brought to this discussion, such as (a) whether high-planning entrepreneurs are a general reality in entrepreneurship or it is a typical trace of Brazilian entrepreneurship dynamics; (b) how detrimental can it be to startups to be maintained as a side hustle to be tended to with the spare time of their owners?; and (c) are entrepreneurs' previous experiences (market or Academia related) determinant for the success of their startups? Is it being a newbie a disadvantageous aspect or does it bring freshness and an open-mind to the business?

6 Conclusions and implications

In this section, we summarize the main findings of this study, followed by general and specific guides. In addition, we present theoretical and practical contributions from our findings. Finally, we discuss the limitations of this study and further research on it to complement our results.

6.1 Main Findings

This study sought to identify the profile of entrepreneurs in the specific sector of Agtech startups in relation to the variables Impulsivity and Resilience. The first step was to update our theoretical background with a compilation of findings linking Impulsivity to Entrepreneurship. From the tendencies presented in this review, we proposed hypotheses of the expected behavior from our respondents while performing two instruments: the Barratt Impulsivity Scale (BIS-15) and the Norwegian dispositional resilience scale.

Based on a survey with 74 respondents from Agtech startups (in a universe of 321 active companies), we found characteristics that delineate a more conservative type

of entrepreneur, who are prone to planning and foresight. Thus, an impulsive behavior was not verified overall in such individuals. The dimensions of Motor and Attentional Impulsivity were not even significant in a statistical level, and the performance on the Non-Planning type was on the opposite direction of what the variable intends to indicate. It is possible to assume Agtech entrepreneurs in the south of Brazil do not behave impulsively.

In what concerns the Resilience profile, respondents varied in their answers on the Control and Challenge dimensions, but showed consistency in items related to Commitment, which measured their views of life and how they choose to look at reality. This is a positive trait that might indicate these individuals do not lack meaning in their lives and certainly have a source of motivation towards their goals. The non-conformity with the other two dimensions might indicate respondents are not consistent as a group on believing their own actions can significantly influence reality. Their view of how much their choices can in fact influence their routine seems to demonstrate they consider other variables to be more influential in their success than their own efforts. Although respondents presented a certain level of cohesion in variables linked to dynamics routines and lack of predictability (being mostly accepting of both), the profile of these entrepreneurs does not look to be so aggressive, as they show resistance to multitasking and certain aspects of routine change.

The findings in the demographics of the sample corroborated with the general profile of entrepreneurs in Brazil: a predominance of adult-middle aged males. The number of women venturing in this category of business was rather small. What might differentiate the sample, however, was the predominance of highly-educated individuals, although they seemed quite inexperienced judged by the number of respondents who declared never having worked before the current venture. This result, however, might reveal some biases. Most academics do not identify themselves as workers in the traditional sense of the word, or at least they absorb the public perception of them as students. Nevertheless, this is but a hypothesis and further studies are necessary to fully comprehend how these individuals in fact interpret their activities.

On the more objective aspects of the research, the way entrepreneurs rated their company's performance in relation to competitors was statistically correlated with how they perceive their companies in terms of Innovativeness. Companies rated below 3 in relation to competitors were also evaluated poorly in terms of how innovative is their environment according to five indicators of the Innovativeness scale.

6.2 Theoretical and Empirical Contributions

This study contributes to both theoretical and empirical spheres. In the first, it adds up to previous research that indicate entrepreneurs tend to be low in impulsivity (e.g. Bouncken et al., 2020; Walker et al., 2020) and that these individuals are in fact typical planners. Although less explored, personal resilience in entrepreneurship proved to be questionable according to our results. Entrepreneurs were found to have overall meaningful lives, but the extension of their belief in themselves as agents of change were smaller than expected. Neither were they especially attracted to atypical routines. That is why, empirically, we believe there are plenty of possibilities concerning the use of new types of instruments to measure Resilience. They would have to come, undoubtedly, from new theoretical approaches, mainly initiatives that englobe the context of business choices, with more objective measures of an entrepreneur's actual routine. Cultural differences are also of high relevance. As discussed before, Brazil is marked by several restraints to entrepreneurship and innovation. In our previous published work (Graciano et al., 2022), we delved into the initiatives around the foment of creativity and risk-taking in all levels of education and results once again indicated that psychological aspects of the preparation of future entrepreneurs are still overlooked by educational institutions. Thus, we hypothesize it might be the case for the Brazilian context. We need public and private institutions to engage to an entrepreneurship mentality that permeate all levels of education, allowing students to be in contact with the whole reality of entrepreneurship and innovation from an early stage, thus avoiding misunderstandings that either overestimate or underestimate the reality of venturing.

6.3 Limitations and further studies

Our study was concentrated in a specific group of entrepreneurs, which comes with certain difficulties. First, a significant number of companies we contacted following Radar Agtech's 2021's report were not operating anymore. This reality directly impacted our hopes of reaching a high number of respondents due to the fact that samples are normally a small portion of the total universe of potential respondents. Being the latter such a small group, the first became an even smaller number, which brings statistical limitations. Even though our explained variance (R^2) was satisfactory for a further analysis using Structural Equation Modelling, this study represents only an initial exploration of the themes and the repetition of such instruments (or others representing

the same variables) are highly recommended. It is also of utmost importance that future studies, especially in the Brazilian context, consider the general market knowledge of entrepreneurs and their awareness of how, when, and where to advertise their products.

It would be also prolific to explore how these entrepreneurs perceive their category of business and if they are truly aware of the market niche they represent. Moreover, the presence of highly educated individuals in the sample do not discard the existence of necessity entrepreneurship cases. The harsh reality in careers related to academic and private research in Brazil might have a role to play in this scenario, which produces a path for more studies in the future. Moreover, extended education in a given field does not qualify professionals to start their own business. There are particular realities of venturing that might challenge the common world views of highly specialized individuals, which means “entrepreneurship illiteracy” might be the common denominator for many individuals who venture in Agtech. The exploration of this issue could be an insightful opportunity for future studies.

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Appendix A

Em uma escala de 1 a 5, o quanto você se identifica com as afirmações abaixo?
Considerando:

- 1 - Isso não tem nada a ver comigo.
- 2 - Isso me descreve pouco.
- 3 - Isso me descreve moderadamente.
- 4 – Isso me descreve consideravelmente.
- 5 - Isso me descreve perfeitamente.

Cod	Item					
A4	Eu não presto atenção.	1	2	3	4	5
M1	Eu ajo por impulso.	1	2	3	4	5
NP	Eu planejo tarefas cuidadosamente.	1	2	3	4	5
A3	Eu me concentro facilmente.	1	2	3	4	5
NP1	Eu faço planos para me manter no emprego (cuido para não perder meu emprego).	1	2	3	4	5
M2	Eu ajo no “calor” do momento.	1	2	3	4	5
A5	Eu fico entediado com facilidade quando estou resolvendo problemas mentalmente.	1	2	3	4	5
A1	Eu me sinto inquieto em palestras ou aulas.	1	2	3	4	5

M3	Eu faço coisas sem pensar.	1	2	3	4	5
A2	Fico me contorcendo na cadeira em peças de teatro ou palestras.	1	2	3	4	5
M4	Eu digo coisas sem pensar	1	2	3	4	5
NP5	Eu penso nas coisas com cuidado.	1	2	3	4	5
NP3	Eu economizo (poupo) regularmente.	1	2	3	4	5
M5	Eu compro coisas por impulso.	1	2	3	4	5
NP2	Eu me preparo para o futuro.	1	2	3	4	5

Appendix B

Norwegian dispositional resilience scale

Por favor, analise cuidadosamente cada uma das afirmações fornecidas no questionário. Julgue se a declaração em questão é verdadeira no seu caso ou não. Marque seu julgamento em relação a cada uma das afirmações do questionário considerando:

- 1 - Isso não tem nada a ver comigo.
- 2 - Isso me descreve pouco.
- 3 - Isso me descreve moderadamente.
- 4 – Isso me descreve consideravelmente.
- 5 - Isso me descreve perfeitamente.

Cod	Item					
CON2	Se trabalhar duro, você quase sempre pode alcançar seus objetivos	1	2	3	4	5
CON6	Como as coisas acontecem na minha vida depende das minhas próprias ações	1	2	3	4	5
CON8	Eu não acho que posso fazer muito para influenciar meu próprio futuro	1	2	3	4	5
CON12	Cabe a mim decidir como será o resto da minha vida	1	2	3	4	5
CON15	Minhas escolhas fazem uma diferença real nos resultados pretendidos	1	2	3	4	5
COM1	A maior parte da minha vida é gasta fazendo coisas sem significado	1	2	3	4	5
COM4	Eu sinto que minha vida é de certa forma vazia de sentido	1	2	3	4	5
COM7	Estou sempre empolgado para minhas atividades de trabalho	1	2	3	4	5
COM10	Na maioria dos dias, a vida é realmente interessante e excitante para mim	1	2	3	4	5
COM13	A vida é, em geral, chata para mim.	1	2	3	4	5
CHA3	Não gosto de fazer mudanças em minhas atividades de rotina	1	2	3	4	5
CHA5	Mudanças de rotina são interessantes para mim	1	2	3	4	5
CHA11	Me incomoda quando minha rotina diária é interrompida	1	2	3	4	5

CHA9	Eu gosto do desafio de ter de fazer mais de uma coisa ao mesmo tempo	1	2	3	4	5
CHA14	Eu gosto de ter uma programação diária que não muda muito	1	2	3	4	5
CON15	Minhas escolhas fazem uma diferença real nos resultados pretendidos	1	2	3	4	5
COM1	A maior parte da minha vida é gasta fazendo coisas sem significado	1	2	3	4	5
COM4	Eu sinto que minha vida é de certa forma vazia de sentido	1	2	3	4	5
COM7	Estou sempre empolgado para minhas atividades de trabalho	1	2	3	4	5
COM10	Na maioria dos dias, a vida é realmente interessante e excitante para mim	1	2	3	4	5
COM13	A vida é, em geral, chata para mim.	1	2	3	4	5
CHA3	Não gosto de fazer mudanças em minhas atividades de rotina	1	2	3	4	5
CHA5	Mudanças de rotina são interessantes para mim	1	2	3	4	5

CHA11	Me incomoda quando minha rotina diária é interrompida	1	2	3	4	5
CHA9	Eu gosto do desafio de ter de fazer mais de uma coisa ao mesmo tempo	1	2	3	4	5
CHA14	Eu gosto de ter uma programação diária que não muda muito	1	2	3	4	5

Appendix C

Responda ao questionário abaixo, indicando de 1 a 5 o quanto a afirmativa descreve a realidade de sua empresa, sendo:

- 1- Isso não tem nada a ver com a minha empresa.
- 2 – Isso descreve pouco a minha empresa.
- 3 - Isso descreve moderadamente minha empresa.
- 4 – Isso descreve consideravelmente a minha empresa.
- 5 - Isso descreve perfeitamente a minha empresa.

INO1	Nossa empresa frequentemente experimenta novas ideias.	1	2	3	4	5
INO2	Nossa empresa busca novas maneiras de fazer as coisas.	1	2	3	4	5
INO3	Nossa empresa é criativa em seus métodos de operação.	1	2	3	4	5
INO4	Nossa empresa é frequentemente a primeira a comercializar novos produtos e serviços.	1	2	3	4	5
INO5	A inovação em nossa empresa é percebida como muito arriscada e há resistência.	1	2	3	4	5
INO6	Nossa introdução de novos produtos no mercado tem aumentado nos últimos cinco anos.	1	2	3	4	5

Appendix D

Descriptive Statistics

	Valid	Missing	Mean	Std. Deviation	Minimum	Maximum
CON2	74	0	4.041	0.999	1.000	5.000
CON6	74	0	4.162	0.993	1.000	5.000
CON8	74	0	1.743	1.293	1.000	5.000
CON12	74	0	4.135	1.011	1.000	5.000
CON15	74	0	4.405	0.890	1.000	5.000
COM1	74	0	1.527	0.744	1.000	4.000
COM4	74	0	1.243	0.637	1.000	5.000
COM7	74	0	1.919	0.918	1.000	5.000
COM10	74	0	1.986	0.914	1.000	5.000
COM13	74	0	1.405	0.826	1.000	4.000
CHA3	74	0	1.986	0.944	1.000	5.000
CHA5	74	0	2.378	1.107	1.000	5.000
CHA11	74	0	2.189	0.932	1.000	4.000
CHA9	74	0	2.203	1.110	1.000	5.000
CHA14	74	0	2.419	1.098	1.000	5.000
INNO_1	74	0	4.135	1.025	1.000	5.000
INNO_2	74	0	4.216	0.969	1.000	5.000
INNO_3	74	0	4.027	1.046	1.000	5.000
INNO_4	74	0	3.784	1.150	1.000	5.000
INNO_5	74	0	2.297	1.321	1.000	5.000
INNO_6	74	0	3.851	1.155	1.000	5.000
A4	74	0	1.851	1.081	1.000	5.000
M1	74	0	2.014	0.944	1.000	4.000
NP	74	0	3.514	0.969	1.000	5.000
A3	74	0	3.608	1.070	1.000	5.000
NP1	74	0	2.959	1.457	1.000	5.000
M2	74	0	2.203	1.098	1.000	5.000
A5	74	0	1.973	1.085	1.000	5.000
A1	74	0	2.473	1.149	1.000	5.000
M3	74	0	1.689	0.890	1.000	5.000
A2	74	0	1.986	1.141	1.000	5.000
M4	74	0	1.662	0.848	1.000	5.000
NP5	74	0	3.757	1.031	1.000	5.000
NP3	74	0	3.392	1.120	1.000	5.000
M5	74	0	1.946	1.097	1.000	5.000
NP2	74	0	3.905	1.009	1.000	5.000

Appendix E

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Prezado respondente,

Você está sendo convidado(a) para participar do projeto de pesquisa intitulado "O efeito da impulsividade e da resiliência empresarial na capacidade de inovação firma" do Programa de Pós-graduação em Administração da Universidade Federal do Rio Grande do Sul.

O objetivo geral da pesquisa é identificar os reflexos da impulsividade e resiliência pessoais dos gestores na capacidade de inovação das startups de tecnologia agrícola. Sua contribuição é de extrema importância para a realização de nossa pesquisa.

Nenhum indivíduo estranho à equipe de pesquisa terá acesso aos questionários preenchidos. Ao responder este questionário, não haverá necessidade de informar seus dados pessoais, somente os números presentes em sua **data de nascimento (sem barras)** para cruzamento de dados entre os diferentes instrumentos de pesquisa.

Enquanto respondente, você estará assegurado os seguintes direitos:

- da liberdade de retirar o consentimento, a qualquer momento, e deixar de participar do estudo, sem que isso lhe traga prejuízo de qualquer ordem;
- da segurança de que não será identificado (a) e que será mantido caráter confidencial das informações relacionadas a sua privacidade;
- do compromisso de ter acesso às informações em todas as etapas do estudo, bem como aos resultados, ainda que isso possa afetar seu interesse em continuar participando da pesquisa;
- de que não haverá nenhum tipo de despesa ou ônus financeiro relacionada com a sua participação nesse estudo;
- de que não está previsto nenhum tipo de procedimento invasivo ou coleta de material biológico.

Ciente de tais condições, indique se deseja prosseguir com o preenchimento do

questionário.

- Sim, desejo prosseguir e responder ao questionário.
 - Não, prefiro não participar deste questionário.
-

01. Por favor, informe sua data de nascimento com seis dígitos e *sem as

02. Informe o gênero que mais se identifica:

- Masculino
- Feminino
- Não- binário/outro gênero
- Prefiro não declarar

03. Informe a cor/raça/etnia com que mais se identifica:

- Branca
- Preta
- Parda
- Outra

04. Informe sua faixa etária:

- Entre 18 e 25 anos.
- Entre 26 e 35.
- Entre 36 e 45 anos.
- Entre 46 e 60 anos.
- Mais de 60 anos.

05. Informe sua formação educacional:

- Ensino fundamental completo.
- Ensino médio incompleto.
- Ensino médio completo.
- Ensino superior incompleto.
- Ensino superior completo.
- Especialização *latu sensu* (profissional) incompleta.
- Especialização *latu sensu* (profissional) completa.
- Mestrado incompleto.

- Mestrado completo.
- Doutorado incompleto.
- Doutorado completo.

06. Indique o número de funcionários de sua empresa:

- 1 a 5
- 6 a 10
- 11 a 20
- 21 a 49
- 50 ou mais.

07. Indique o número de anos em que sua empresa está em atividade:

- 1 a 2 anos
- 3 a 5 anos
- 6 a 9 anos
- 10 anos ou mais.

08. Setor específico de atividade da empresa: *[a ser exibido em drop-down]*

Alimentos inovadores e novas tendências alimentares

Análise laboratorial

Apicultura e Polinização

Armazenamento, Infraestrutura e Logística

Biodiversidade e Sustentabilidade

Bioenergia e Energia Renovável

Conectividade e Telecomunicação

Conteúdo, Educação, Mídia Social

Controle Biológico e Manejo Integrado de Pragas

Cozinha na nuvem e cozinha fantasma

Crédito, permuta, seguro, créditos de carbono e análise fiduciária;

Drones, Máquinas e Equipamentos

Economia compartilhada

Fertilizantes, Inoculantes e Nutrição Vegetal

Genômica e Reprodução Animal

Gestão de resíduos agrícolas

Indústria e processamento de alimentos 4.0

Internet das Coisas para o Agro: detecção de pragas, solo, clima e irrigação
Marketplace de Insumos para o Agronegócio;
Marketplaces e Plataformas de negociação e venda de produtos agropecuários
Mercearia online
Meteorologia e Irrigação e Gestão de Água
Nutrição e Saúde Animal
Plantio urbano: fábrica de plantas e novas formas de plantio
Plataforma integradora de sistemas, soluções e dados
Restaurantes online e Kit de refeições
Segurança e rastreabilidade de alimentos
Sementes, Mudas e Genômica Vegetal
Sensoriamento Remoto, Diagnóstico e Monitoramento por Imagens
Sistema autônomo de gerenciamento de lojas e serviços de alimentação
Sistema de Gestão de Propriedade Rural
Sistemas de embalagem, Meio Ambiente e Reciclagem
Telemetria e Automação

09. Última indústria em que você trabalhou antes da atual:

- Energética
- Alimentícia
- Construção Civil
- Bélica
- Informacional
- Nunca trabalhei antes.

10. Como você classificaria a performance de sua empresa em relação aos principais competidores nos últimos 3 anos? Considere 5 como “muito superior” e 1 como “muito inferior”.

- 1 2 3 4 5