LUISS

Department of Business and Management
Chair of Corporate Strategy

Head or Gut in entrepreneurial decision-making:

A quantitative investigation into the relation between cognitive processes and innovation, and the moderating role of personality.

Prof. Evangelos Syrigos
THESIS SUPERVISOR

Prof. Luigi Laura
CO-SUPERVISOR

Tedone Roberta – Matr. 732321
CANDIDATE

Academic Year: 2020/2021

"And most important, have the courage to follow your heart and ***intuition****. Everything else is secondary"*

(Steve Jobs, 2005)

TABLE OF CONTENTS

INDEX OF FIGURES

INDEX OF TABLES

1. ABSTRACT

Purpose

Innovativeness is one of the unique entrepreneurial characteristics, defined as a tendency to engage and support new ideas, novelty, and creative processes that may result in new products or services (Gabrielsson e Gabrielsson 2013). As the definition suggests, innovativeness also involves decision-making to gather intelligence, design alternatives, and make decisions about how best to reach the entrepreneurial goal (Wu e Shang 2020). It is particularly difficult to perform this task when decisions are time sensitive. Is the decision a matter of head or gut? Some studies demonstrated that, in these circumstances, people usually prefer to formulate a faster and more intuitive response (Kahneman 2011; Tversky e Kahneman 1974). The reason for this choice must be sought in an even more human dimension, that of personality traits. The Big Five Model of Personality (Costa e McCrae 2012) shed light on the relationship between entrepreneurs' personality and their behaviours.

Design

An experiment has been developed and virtually distributed to collect data about innovation and personality traits (using the NEO-PI-R Inventory) in two random groups (one for intuitive entrepreneurs and one for the analytical ones). Data have been later analyzed using different tests. Firstly, One-Way ANOVA and Kruskal-Wallis test were used to identify any statistically significant difference in Innovation levels between groups of intuitive and analytical entrepreneurs together with groups defined by Age and Occupation. Finally, a Moderated Regression Analysis has been conducted on the same groups to explore the outcome of possible interactions with personality traits.

Findings

The analysis was divided into two parts according to the two main hypotheses of the study. Firstly, the analysis of variance demonstrated that there was no statistically significant difference in the level of innovation reached by intuitive *vs* analytical or more experienced *vs* less experienced. However, considering mean differences in the sample's data, analytical participants proved to be more innovative under time pressure (taking less than 10 minutes to brainstorm ideas). Similarly, those with more experience leveraged intuition to obtain better results in terms of innovation. These first results already indicated that neither cognitive processes nor employment status alone can explain the complexity of this entrepreneurial task. Several factors are involved in the process of innovation. The moderated regression model suggested that divergent behaviours in decision-making can be explained by different personality traits. When analytical decision-makers are more conscientious, they are very innovative. In particular, more experienced decision-makers are more innovative when open to new ideas while less experienced ones when emotionally stable.

2. INTRODUCTION

2.1 Research Rationale

The younger generation of the beginning 21st century has been defined as *Generation X* for its refusal of traditional opportunities. However, according to Kuratko (2003), the correct name should be *Generation E* because it turned out to be the most enterprising generation since the Industrial Revolution. Currently, it is common to acknowledge the entrepreneurs' major role in fostering economic growth and job creation in the entire society. In addition, the economic relevance of entrepreneurship also gained the interest of the academic world. The development of new knowledge about entrepreneurship can help individuals, firms, and societies to reach growth more rapidly (Busenitz, West, et al. 2003). Evidence of numerous entrepreneurship articles in management journals supports the belief that *Generation E* has emerged as a distinct domain of study.

A completely new body of research has been called Entrepreneurship Theory to achieve this goal. Initially, the theory adopted the definition of a *firm-organizing entrepreneur* – more similar to an investor that creates and organizes a new business, even if there is nothing innovative in this act. Later, with the contribution of Schumpeter, the entrepreneur became more a '*creative destroyer*' – an innovator who transforms ideas into economic value, both in an existing firm or in a *de novo* start-up (Baumol 1993). The Schumpeterian entrepreneur has been analysed from different viewpoints. Busenitz, West, et al. (2003) classified the number of articles related to entrepreneurship in four broad categories: the constructs of entrepreneurial *opportunities*, the characteristics of *individuals and teams*, the management practices and systems that allow transforming an opportunity into a viable product or service (*mode of organizing*) and, finally, the *environment* which enhances or inhibits entrepreneurship. The real value of research lies in the intersection of different domains which provides a more complete picture of a multi-faceted phenomenon. One way to productively explore this intersection is to combine entrepreneurship with decision-making and personality theories. The final goal is to get insights into why and how entrepreneurs can create economic value for society.

Even though over the past decade, most studies have leveraged these theories to identify the unique characteristics that distinguish an entrepreneur from a non-entrepreneur, it appears that scholars have not been interested in the differences existing within the group of entrepreneurs. The category of entrepreneurs has been considered as a single block for a long time, failing to recognize why some entrepreneurs are more innovative than others. Nevertheless, the successful exploitation of new ideas is crucial for a business that wants to improve its internal processes, bring new and better products or services into the market, and, more importantly, improve its efficiency and profitability.

Considering the gaps left in the literature, this dissertation arises from the desire to respond to specific needs. Firstly, some studies have demonstrated that imperfect knowledge negatively influences the innovator's success. Entrepreneurs must be trained to adjust their decision-making strategies and overcome systematic errors generated by biases. This is possible only if they are aware of their decision-making process, the factors influencing it, and its possible outcomes. Recognizing the importance of their cognitive processes and the moderator role played by personality is the first step to set up self-fulfilling loops that lead them to use head-based over gut-based decision-making or vice versa (Soosalu, Henwood e Deo 2019). Secondly (and consequently), if one specific cognitive process is linked to innovation, it must be educated and cultivated in the light of a more innovative society. Since the individual and cognitive attributes influence the entrepreneur's behaviours, it is worth focusing the research on (1) exploring if decision-making styles are predictors of Innovation and (2) understanding if and how personality can act as a moderator in the process. Far from being exhaustive, the analysis, findings, and theorizing provide only an initial step in the direction of creating awareness among entrepreneurs and nurturing the cognitive processes and personality traits that enhance innovation. The final goal of the study is to contribute elaborating a decision-making model that helps entrepreneurs to discover new opportunities and make judgmental decisions faster.

After introducing the main concepts, literature, and expected findings of this thesis which define the big picture, the following paragraphs will provide a general roadmap into the research and its contributions to knowledge. The real value of research lies in the combination of different disciplines and perspectives to return a complete image of a complex phenomenon. For this reason, the present study is aimed at combining Entrepreneurship theory, Cognitive theory, and Psychological theory. The third chapter will analyze, in detail, each of these theories and their intersections together with the hypotheses they suggest. With a solid theoretical basis and a clear picture of what the research intends to achieve, the thesis will proceed with a more analytical chapter. The *Research Design* paragraph will include a description of the sample, the variables used in the analysis with related measures, and the statistical methods used to examine data.

Subsequently, some *Descriptive Statistics* will summarize the data's main characteristics (mean, standard deviation, distribution, and so on). The following section (*Analysis and Results)* will represent the core of the thesis since it is aimed at providing empirical data to support or refute the initial hypotheses. Finally, in the *Discussion*, the research findings will be linked to theory to assess how the analysis advanced the literature. The *Conclusions* will recap the main results of the literature review and analysis. Finally, a brief description of the limits and both the theoretical and practical contributions of the dissertation will hopefully provide some food for thought for future research in the domain of entrepreneurship.

2.2 Conceptual Model

Building on the entrepreneurship and innovation literature, the premise of this study is that the discovery of new opportunities is an essential requirement for entrepreneurs to move to the growth phase. It is necessary to highlight that most business activities (from discovery to exploitation) take place under a regime of uncertainty and time constraints. Time can be both a challenge and an opportunity. The dynamic context in which the entrepreneur operates often forces him/her to lose as little time as possible to gain a competitive advantage. For example, the advantageous position of the first mover allows the entrepreneur to buy resources and raw materials at a cost lower than its equilibrium price and earn entrepreneurial profit by recombining and selling them (Shane e Venkataraman 2000). Considering time constraints is also important from a more human perspective because it involves stress, anxiety, and other related emotions which may influence the decision taken. In this perspective, losing time becomes a cost from different viewpoints.

When facing an opportunity, the entrepreneur has to decide whether to spend more time for a deliberate analysis or simply follow its first intuition before the window of opportunity closes (Busenitz, West, et al. 2003). There are several advantages and drawbacks in choosing one way or the other. This mainly occurs because decision-makers are boundedly rational. They are limited in making decisions and accurately acknowledging their mental processes by silent factors called *biases* (Zacharakis e Meyer 1998). On the other hand, decision-makers usually rely on biases and heuristics as support mechanisms to simplify their decision-making. When actions precede thinking – as it usually occurs to entrepreneurs having to make quick decisions with almost no past information and trends to rely on – biases and heuristics may be an effective guide to approximate a proper decision. Researchers like Busenitz and Barney (1997) agree in believing that those more inclined to use biases and heuristics as tools of simplification are more likely to become successful entrepreneurs – defined as creative destroyers in Schumpeter's words. Generalization is usually needed because of time constraints and the impossibility to have immediately available data – if there are any. Managers are, instead, those who are more susceptible to conscious and deliberate decision-making. This study is expected to confirm the null hypothesis, thus showing a positive relationship between intuition and innovation in situations of time pressure.

Other factors are capable of influencing entrepreneurs' decision-making. The judgment on the value of an opportunity is a subjective interpretation influenced mostly by experience and the ability to make cause-effect connections. All these elements contribute to creating opportunity beliefs which then influence the entrepreneurial behaviours and outcomes (Wood, McKelvie e Hayne 2014). The decision of whether to exploit an entrepreneurial opportunity usually involves weighing costs and benefits, but the process is not as straightforward as it may seem.

The yardstick to decide if costs and benefits are in balance depends, for example, on the information that the entrepreneur has acquired from experience. Many studies have already demonstrated that the level of experience influences the decisions of an entrepreneur. Similarly, we assume that also personality traits may get in the way. Individual differences in perception of risk and optimism may influence the outcome of the decision. A risky opportunity will be accepted more likely by a risk-taker rather than a risk-averse individual. In the same way, over-optimism may lead an entrepreneur to overestimate the chances of success and, indeed, end up in failure. A more sceptical individual will take more time evaluating all the possible alternatives, thus increasing the probability of success (Shane e Venkataraman 2000). Ambition, optimism, scepticism, locus of control, and so on are unique individual characteristics that significantly influence decisions. This research has no intention to declare what is right and what is wrong. The ultimate goal is simply to provide entrepreneurs with a new level of consciousness to fill the gap left by their imperfect knowledge.

The research represents an attempt to investigate the nature of entrepreneurial decision-making with a double goal: (1) finding empirical evidence about the cause-effect relation between Intuition and Innovation under time pressure, and (2) assessing whether the Big Five personality attributes – in particular, Openness to Experience, Conscientiousness, and Neuroticism – interfere in the aforesaid relation (*Figure 1*).

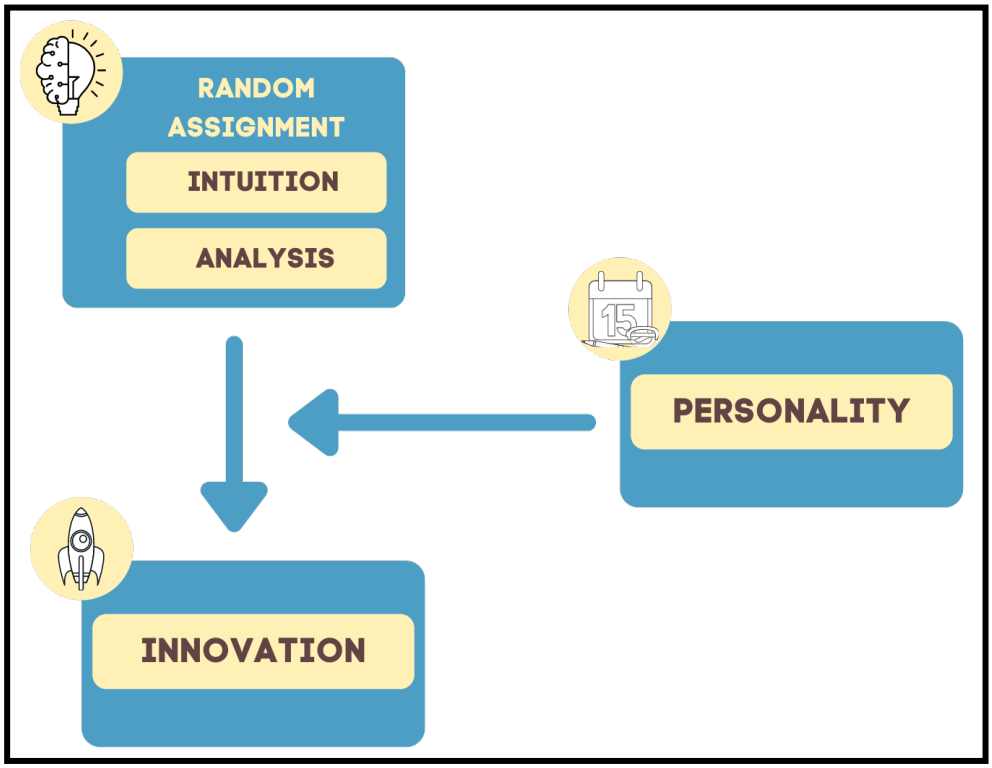


Figure 1 - *Study's conceptual model*

2.3 Contributions and Future Research

According to the first main hypothesis of the study, the choice of one decision-making process over the other has an impact on entrepreneurial innovative behaviour. This largely depends on the experience of the entrepreneur and the time at this/her disposal. To provide a complete picture of the phenomenon, the research also investigated the moderator role of personality traits in the previously identified relationship. By doing so, the study contributes to the scholarly conversation on Entrepreneurship and Innovation by integrating the Cognitive and Psychological Theories.

Theoretically, this is a great advance for the Entrepreneurship literature which alone is not sufficient to grasp the nuances of such a complex phenomenon. Making innovative decisions is a matter of choosing the correct cognitive process (head or gut) and control the interference of personality. At the same time, also the other kinds of literature can benefit from this research. Personality traits have been underestimated for a long time in the Psychological Theory, even if they proved to be good predictors of individuals' behaviours. Similarly, for the Cognitive Theory intuition has always been the cognitive process related to creativity and innovation in situations of time lack, uncertainty, and scarce information. The new findings of this study – according to which analysis proved to give more innovative results under time pressure– demonstrated further that the combination of different perspectives can overturn completely the state of the art.

Practically, entrepreneurs gained a deeper understanding of the mechanisms at the basis of their innovative activities. They became more aware of the influence that also the personal dimension plays in the execution of their tasks and, consequently, should be more prepared to face difficult decisions regarding innovation. At the same time, organizations obtained another proof of the importance of keeping the working environment opened to new experiences. Finally, students and educators should have gained more insights into which skills and personality traits need to be educated to survive in a data-driven world. Working on students' analytical capabilities as well as on emotional stability are both fundamental if they want to be more innovative.

Future research may investigate further the relation between cognitive processes and innovation, testing other measures of Innovation, considering other personality traits, or introducing external factors. The experiment could be replicated with another target, for example, employees of a multinational company, to confirm or deny that more intuitive workers are also more innovative. Similarly, another research could focus more on experience, considering it as a possible moderator of the relation between intuition and innovation (as personality was in this study). Moreover, other streams of research may focus on the working environment and how it influences the performance of innovative entrepreneurs as well as on universities to think of new ways to educate future entrepreneurs in the light of a more innovative society.

3. THEORETICAL FRAMEWORK

3.1 Entrepreneurship and Innovation

An *entrepreneur* is usually defined as an individual who takes initiative even under uncertainty and accepts risks, an individual who is independent, creative, open-minded, and motivated by the willingness to make an impact (Johnson 2001). It was Schumpeter in *The Theory of Economic Development* (1934) to originally establish a positive relationship between entrepreneurship and innovation. In this perspective, entrepreneurs need to possess superior skills for identifying and seizing entrepreneurial opportunities which, in turn, contribute to creating new products, processes, or markets (Ireland, Hitt e Sirmon 2003). Entrepreneurship and innovation collaborate with the ultimate goal of enhancing economic and organizational growth (F. Zhao 2005). Newness and novelty are the main drivers of the value creation process which consists of discovering and exploiting profitable opportunities (*Figure 2*).

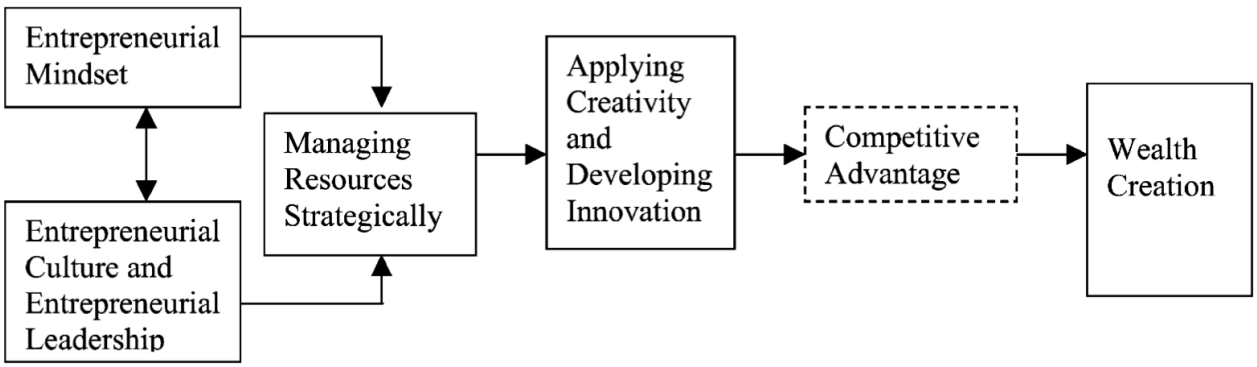


Figure 2 - *A model of strategic entrepreneurship (Ireland, Hitt e Sirmon 2003)*

After almost a century, it is still the entrepreneur as an innovator to whom we refer to when we think about the '*crucial engine'* that challenges the status-quo, drives change, and allows the entire economic system to evolve (Croitoru 2012). The Schumpeterian '*creative destructor'* is not merely an inventor who makes breakthrough discoveries or finds new and more effective ways of doing things, but an innovator able to combine and transform basic innovations into economic ones. The innovator is motivated by the desire to conquer, the impulse to fight, the joy of creating, and getting things done. His or her most distinguishing feature is the courage to explore the unknown and discover the unexpected (Schumpeter 1936). The adoption of Schumpeter's definition changed completely the theoretical paradigm. The concepts of entrepreneurship and innovation became complementary. Innovation was seen as a tool for entrepreneurs to find new opportunities and exploit change; while entrepreneurship, in turn, supported innovation to realize its economic value (F. Zhao 2005).

Until the 90s no generally accepted Entrepreneurship theory existed. Many papers from diverse disciplines constituted the empirical data on which the research was based. The modern Entrepreneurship Theory kept this heterogeneity while broadening its scope beyond the simple creation of companies – which is a necessary but not sufficient condition to define an entrepreneurial activity. According to Bull and Willard (1993), the existing entrepreneurship literature focuses on the definition of "entrepreneurship"; on the strategies used by existing organizations or new ventures; or on entrepreneurs' psychological traits. In trying to define a theory of entrepreneurship, the last stream of research – the so-called *trait approach* – has been considered non-significant. Nevertheless, while innovation literature is keener to explore the external environment in which transformations take place, the entrepreneurship literature has always been more interested in investigating how cognitive processes and psychological traits influence entrepreneurial behaviours (Autio, et al. 2014).

All in all, the interplay of many factors influences how opportunities are discovered and in which some people and not others can profit from them (Shane e Venkataraman 2000). This is the reason why the research community is seeking to advance the quality of its theoretical effort by combining non-traditional perspectives with the Entrepreneurship Theory. As a result, a new and fully integrated theory will reveal the hidden side of entrepreneurs (Sánchez 2011) – as to say, the methods, practices, and styles of their decision-making.

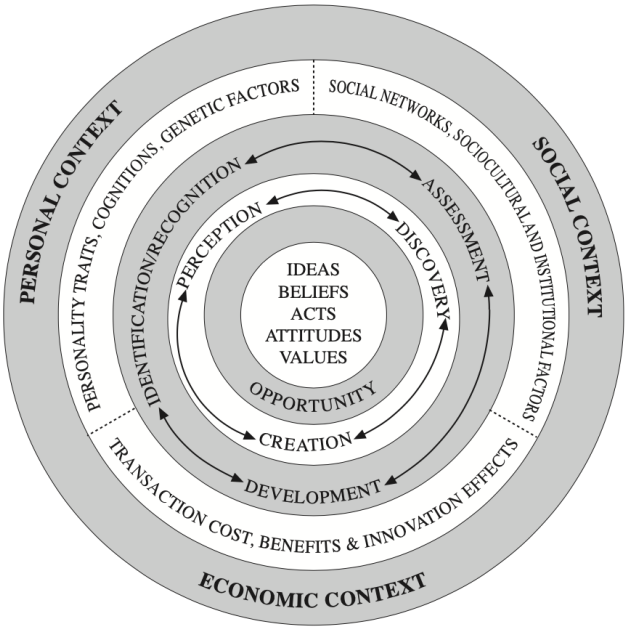


Figure 3 - *Theoretical Structure of entrepreneurship (Sánchez 2011)*

Considering the positive relationship between entrepreneurship and innovation as a premise, this analysis will further investigate the personal dimension of the phenomenon (*Figure 3)* integrating the Cognitive Theory – the study of the mental processes behind decision-making – and Psychological Theory – the study of the person of the entrepreneur itself.

3.2 Thinking fast or Thinking slow?

The combination of Entrepreneurship and Cognitive Theories is meant at exploring the knowledge structures applied by entrepreneurs "*to make assessment, judgments or decisions involving opportunity evaluation*"[1] (Mitchell, et al. 2002). It is a common belief that opportunity recognition is a fundamental requirement for entrepreneurship, but less attention has been paid to the subjective judgments underneath this process. Different factors influence the entrepreneurs' probability to benefit from such opportunities, including the possession of the necessary cognitive properties to exploit them (Shane e Venkataraman 2000). In particular, the fact that some people are more skilled at identifying opportunities where no one could see them (Busenitz, West, et al. 2003), suggests that some unique cognitive capacities possessed by those individuals exist. Initially, research has focused on distinguishing entrepreneurs from non-entrepreneurs.

Starting from the beginning of this century, instead, research in entrepreneurship cognitions is aimed at explaining how entrepreneurs apply their mental models to transform unconnected information into breakthrough ideas. Baron (2006) defined *Pattern Recognition* as the process "*through which specific persons perceive complex and seemingly unrelated events as constituting identifiable patterns*"[2]. Information gathered through experience is a "plus" to enhance the process of opportunity recognition by looking at past examples. This model suggests that individuals who encounter new stimuli are then able to compare them with past events stored in memory. In some cases, the connection is made quickly and intuitively, but in some other cases, intuition only gives an input which is then carefully analysed. This is especially true in problematic environments. When opportunities are created by exogenous shocks, then the decision-maker should analytically examine the environment in search for gaps to be filled. However, when talking about innovative opportunities – those that pioneer something unprecedented rather than simply expand the actual state of the art – the environment is uncertain, and no data can be easily collected (Gabrielsson e Gabrielsson 2013).

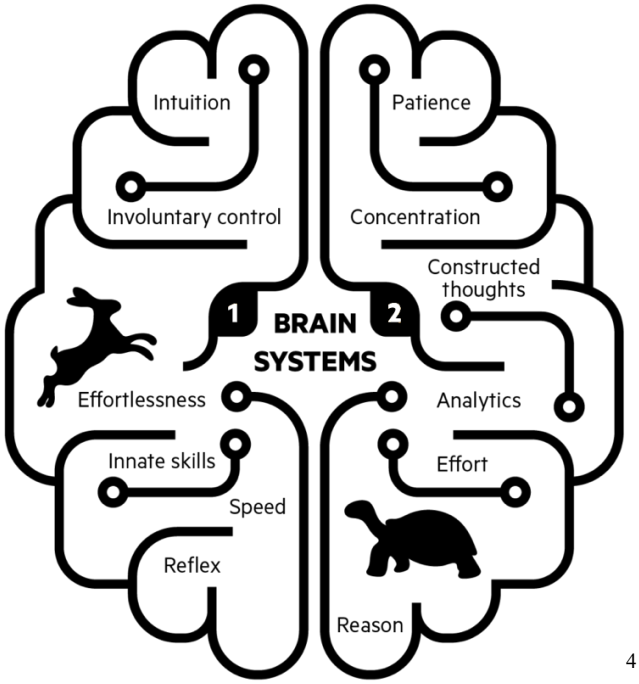
Therefore, the Schumpeterian entrepreneur – operating in dynamic environments – cannot be, by definition, an optimality calculator which compares the present values and the stream of discounted revenues and costs to assess whether entrepreneurial opportunities will be profitable. The range of options available is unknown and unexpected. The work of the innovating entrepreneur is much more linked to instinct and intuition rather than to a slow and deliberate process of calculations in response to a set of given alternatives (Baumol 1993).

---

[1] Mitchell, Ronald K., Lowell Bousenitz, Theresa Lant, Patricia P. McDougall, Eric A. Morse, and J. Brock Smith. 2002. "Toward a Theory of Entrepreneurial Cognition: Rethinking the People Side of Entrepreneurship Research." Entrepreneurship Theory and Practice 27 (2), p. 97.

[2] Baron, Robert A. 2006. "Opportunity recognition as pattern recognition: How entrepreneurs «connect the dots» to identify new business opportunities." Academy of Management Perspectives 20, p. 106.

Daniel Kahneman (2011) adopted the terms *System 1* and *System 2*, originally proposed by the psychologists Keith Stanovich and Richard West, to refer to the two mental processes characterizing the human brain (*Figure 4*). According to Kahneman, *System 1* "*operates automatically and quickly, with little or no effort and no sense of voluntary control*", while *System 2* "*allocates attention to the effortful mental activities that demand it, including complex computations*" [3] (Kahneman, 2011). When we think about how we make choices and decide what to do, we usually identify ourselves with *System 2*. However, *System 2* is usually in a low-effort mode. It is activated by *System 1*'s impressions and intuitions which are then transformed first in beliefs and then into actions. In other words, *System 1* is much more complex than *System 2* and deserves further analysis.



[4]

Figure 4 - *Graphic representation of System 1 and System 2*

System 1 is always active, fuelled by its ability to create complex associations of ideas, to understand all the aspects of social situations, and to access the knowledge stored in memory without any effort. Kahneman (2011) describes *System 1* as "*an associative machine that represents reality by a complex pattern of links*"[5]. Put differently, this mechanism is based on a system of triggers and impressions of causality which connect one idea to another based on the principle of coherence. An unexpected word or event immediately triggers memory which starts scanning past experiences in search for a causal-effect relation with other words or events. Bear in mind that this process causes a cascade activity in people's brains with several ideas born from connections with many others. These newly found relations are then fertile ground for future developments.

[3] Kahneman, Daniel. 2011. Thinking, Fast and Slow. New York: Farrar, Straus and Giroux, p. 20-21.
[4] (http://www.pseudoparanormal.com/2017/08/book-report-thinking-fast-and-slow_8.html)
[5] Kahneman, Daniel. 2011. Thinking, Fast and Slow. New York: Farrar, Straus and Giroux, p. 77.

All of this happens in a very short amount of time and mostly unconsciously. Even experts are often unable to explain how they went from the diagnosis of a problem to its solution so rapidly (H. Simon 1987). Consequently, intuitive decision-making can't be deactivated. Notwithstanding, it is a fundamental decision-making process that creates a flow of ideas, a series of connections later transformed into creative and innovative solutions. At the end of the process, the result of *System 1*'s activity is again stored in memory as an updated model of how we perceive the world. In this way, the new links become keystones for future interpretations of similar phenomena. Sometimes this mental model is questioned by norms or surprise (when the unexpected occurs). In these cases, people usually engage in *System 2* to analytically search for an answer to what *System 1* seems not to know.

The division of tasks between the two systems makes them work perfectly in symbiosis. Nevertheless, there are some pitfalls. *System 1* performs well in familiar situations and is better in short-term rather than long-term predictions. Usually, people rely on heuristic principles which "*reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations*"[6] (Tversky e Kahneman 1974). *Heuristics* are, in sum, shortcuts that decision-makers use when they have to think fast. However, they are often exposed to systematic errors called *biases*. Sometimes the impressions we have, the beliefs we create are '*cognitive illusions'*, opinions originated from misinterpretations that shouldn't be trusted. Especially in uncertain or decontextualized circumstances, *System 1* deals with cognitive limitations by creating its context and guessing the answer to a particular problem. What should be highlighted is that even if it is a less-reasoned impulse to drive the decision-making process, the decision that results from either of the two systems is rational. What does change is the perception – conscious or automatic – that the decision-maker has of his or her mental processes (H. Simon 1987).

Tversky and Kahneman (1974) described three particular heuristics that are usually employed when making decisions under uncertainty: (1) *Representativeness* which is used to predict if an object or event belongs to a particular process – decision-makers are more prone to select the outcome that is more representative of the input –; (2) *Availability* which is, instead, typical of judgments regarding the plausibility of a particular development – people judge an event as likely if it can be easily recalled, so connections between events are made more easily when the events co-occur frequently – ; (3) *Adjustments from an anchor* occurs in numeric estimations – people often adjust the initial value but this is not sufficient. What may also occur is that not only do individuals believe in their first beliefs, but they also use any possible argument to confirm them. This is called *confirmation bias*. These are different ways to simplify a decision-maker's mental process.

[6] Tversky, Amos, and Daniel Kahneman. 1974. "Judgment under Uncertainty: Heuristics and Biases." Science 185 (4157), p. 1124.

What they have in common is the insufficient ability of *System 1* to judge the quality of the data gathered. This happens simply because *System 1* can't gather data. Its only task is to make a coherent story among the information stored in memory, coming from past experiences. Coherence is the only quality measure for *System 1* (H. Simon 1987). However, given how *System 1* works, people are naturally tempted to believe their intuition and impressions. It makes the best representation and interpretation possible of a phenomenon, without showing any alternative. In this way, individuals cannot know if their first impression is correct or not. As a consequence, even if they could involve systematic errors, people are usually very confident about the judgments they make. This means that people are not aware of their limited knowledge and do not seek additional information (Barnes 1984). Many decision-makers value more their intuitive decisions since they consider knowledge and experience responsible for such rapid judgments. Experience and knowledge are formed directly from studying, research, and hard work. However, they also include unconscious beliefs which are formed from the external environment as soon as we are born. Both experience and beliefs guide human beings in making decisions.

Overconfidence represents a particularly dangerous aspect of heuristics and biases. It should be *System 2*'s task to question and "unbelieve" false sentences, but it is often busy or simply lazy. *System 2* is, by definition, the laziest mental process in the sense that, if there are two possible alternatives to reach the same result, it is reluctant to invest more time than needed and it will choose the less demanding. *System 1* takes over in situations of emergency, uncertainty, or under time pressure. For the purpose of the analysis, situations of time pressure are more interesting. When time is lacking, *System 1* is more used to think fast, make connections, integrate information, and reach a conclusion. All in all, intuition's ability to jump to conclusions may be beneficial in the sense that it saves time and effort, but it can also be risky.

The truth is that searching for new data – that would confirm or reject the correctness of the logic – would be too demanding in terms of energy and time. Laziness is embedded in human nature and effort is a cost. It is easier to find arguments supporting the initial thesis than to change it because found to be incorrect. This creates a self-sustaining cycle that confirms the first impression – the confirmation bias mentioned before. Surely, not everyone is the same and there are some differences among individuals. Those who follow more intuition without questioning it are more impulsive and impatient – they are seeking immediate gratification. On the other hand, calculator people are cautious and value more future rewards. It is then possible to assume that an individual's personality has a certain impact on an individual's preferences between the decision-making styles (Kahneman, 2011).

3.3 The Role of Personality

After having explored the relationship between entrepreneurship and innovation as well as the role of mental processes in entrepreneurial innovative decisions, there is still one aspect to consider. The psychological point of view can contribute significantly to complete the picture of entrepreneurship, for instance enhancing the understanding of the entrepreneur's nature behind actions and the drivers for success (Gorgievski e Stephan 2016). Personality traits have been defined in several ways. Traditionally, personality traits were considered psychological dimensions such as emotional stability and curiosity (Vazire 2014). Caprana and Cervone (2000) defined them as dispositions to manifest a certain response to different scenarios while McCreae and Costa (1990) considered them as propensities to act. Past research on the psychology of entrepreneurs concentrated mostly on five areas: career perspective, personal differences, health and well-being, cognition and behaviour, and entrepreneurial leadership (Gorgievski e Stephan 2016).

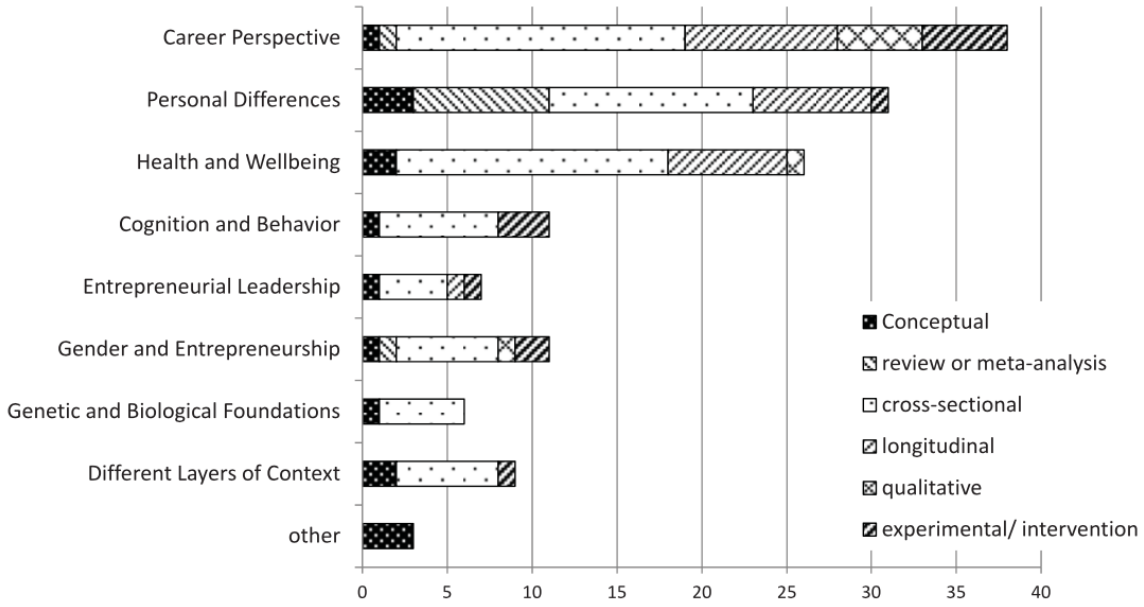


Figure 5 - *Count of research themes and methodologies in manuscripts published in leading psychology journals between 2000–2015 (Gorgievski e Stephan 2016)*

In *Figure 5* the stream of research that counts the highest number of studies is the one about *career perspective*. It investigates the factors (both competencies and motives) influencing the career choice of entrepreneurs and their relative success. The second biggest stream of research – in terms of publications – adopted a *personal differences approach* to identify which personality traits could have possibly helped to differentiate entrepreneurs from non-entrepreneurs (Hisrich, Langan-Fox e Grant 2007), or managers (Zhao e Seibert 2006). However, asking "*Who is an entrepreneur?*" is no longer enough (Gartner 1988, 62).

This method assumes that entrepreneurs are part of a homogeneous group, a fixed state of existence. Consequently, it seeks to define an average profile of entrepreneurs that, according to Gartner, can't exist. On the contrary, the *trait approach* – investigating the personality characteristics of the entrepreneur – considers all individuals as different. There are no distinct groups or types of personalities, but rather a continuum of personality traits (Vazire 2014). Recently, there has been a change of direction in the research community. Elaborating on Gartner's thinking, many other scholars agreed that personality traits have been underestimated for a long time (Rauch e Frese 2007). Thus, a more advanced approach was needed to reshape entrepreneurship literature. The *behavioural approach* was developed to fill this gap. In this perspective, it is not the person of the entrepreneur to be at the centre, but the link between personality characteristics and behavioural outcomes. In sum, the main goal of this approach is to describe and categorize all dimensions of personality and use this catalogue to predict people's patterns of thinking, feeling, and behaving (Vazire 2014). Great strides have been made regarding the relationship between personalities and entrepreneurial tasks. Entrepreneurs often have to face fast decisions under uncertainty or time-pressure dealing also with the scarcity of resources. For these reasons, they must master some core skills including innovation, proactiveness, internal locus of control, and risk-taking (Rauch e Frese 2007). In this thesis, the entrepreneur's innovative behaviour is the subject of the analysis (Gartner 1988). In Schumpeter's view, this behaviour is defined as the introduction of '*new combinations'* – new goods, new methods, new markets, new sources of supply, etc. (Schumpeter 1936).

In several pieces of research, people were asked to rate themselves. Data were then analysed through factor analysis to establish which rates tended to be similar. One globally accepted research was carried out by Costa and McCrae who first reviewed the personality literature as a whole, and then tested new scales developed using factor-analytical methods. The result was the publishment in 1985 of the first NEO Personality Inventory (NEO PI) which consisted of 180 transparent items accurately measured through a five-point Likert scale. At first, the inventory consisted of three factors – Neuroticism (N), Extraversion (E), and Openness to Experience (O). Soon, it became clear that five factors of personality were needed to cover most measures of individual differences. In 1992, the NEO Personality Inventory-Revised (NEO PI-R) appeared including Conscientiousness (C) and Agreeableness (A). In the following years, other versions were released to allow its completion by an increasing slice of the population. The NEO-PI-3 and NEO-FFI-3 could be used by both adolescents and adults (Costa e McCrae 2008). Diverse measures including the NEO-PI-R and its derivatives have been integrated into the Five-Factor Model (FFM) – an account of individual personality differences. Similarly, the Five-Factor Theory (FFT) was developed to explain individual differences in the light of FFM's research findings (Costa e McCrae 2012).

The Five-Factor Theory (FFT) was introduced as a new version of the *trait approach* to synthesize the multitude of research born in the wake of the Five-Factor Model (FFM). It is based on four main assumptions: *knowability*, *rationality*, *variability,* and *proactivity*. While some theorists firmly believe in the uniqueness of individuals thus rejecting any attempt to categorize human traits, the FFT assumes that research having the personality as a subject of study can be highly valuable. Secondly, the theory believes that, notwithstanding possible errors and biases, individuals own sufficient rationality to describe their personalities. In this sense, psychology is an unusual science that is based on self-judgment. Thirdly, the assumption of variability implies that there is no single answer to what human nature is like because all individuals are different and such differences are evident also in psychological terms. Finally, proactivity means that individuals are not passive victims of the events or of the environment in which they form themselves. Personality also plays a role in shaping individuals' life. All things considered, the main goal of the theory is to explain human personality mechanisms through categories, taking into account the dynamicity of such processes across time. FFT defines a framework to make sense of the development of psychological mechanisms and the resulting behaviours (Costa e McCrae 1999).

The premise of the Five-Factor Model, indeed, is that the totality of personality dimensions can be classified into 5 groups (known with the acronym OCEAN): Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. These factors proved to be heritable, recurrent across cultures, and easily assessable by self-reports. Moreover, they can characterize individuals stably during adulthood (Costa e McCrae 2012). An *extrovert* person tends to be self-confident and energetic, in need of constant stimuli, and guided by positive emotions. *Agreeableness*, instead, characterizes cooperative people who trust others and are involved in satisfying relationships with others. On the contrary, being *neurotic* means experiencing negative emotions – insecurity, anxiety, stress, depression, etc. – and having difficulties in performing well due to impulsiveness and underestimation. Finally, Conscientiousness and Openness are two traits that regard more the way of doing rather than the way of being. A *conscientious* person is a hard worker who is always well-organized, responsible, goal-oriented, competent, and self-disciplined. An *open* person is more a free spirit, always looking for new ideas, creative, curious, impulsive, and imaginative (Bayram e Aydemir 2017). As said before, personality traits can be considered as predictors of certain entrepreneurial behaviours. For example, extrovert people tend to take leadership roles; neurotic people are not emotionally stable, so they won't feel confident and secure in risky and uncertain situations; agreeable entrepreneurs gain more easily the trust of investors, suppliers, etc. (Ciavarella, et al. 2004). High scores on Openness denote a progressive and innovative individual who values novelty and variety and generates remote associations of ideas.

One outstanding contribution of the FFM is the distinction between *basic tendencies* and *characteristic adaptations*. Personality traits are part of the first group and are not influenced by the external environment – this is why they remain the same even across diverse cultures. Notwithstanding, the environment still plays a key role. In this perspective, the behaviour is shaped by both others' behaviours and by pre-existing characteristic adaptations – i.e., knowledge, skills, beliefs, routines, values, and so on (Riaz Naveed, Riaz Akram e Batool 2012) – which reflect and are, in turn, shaped by personality traits (Costa e McCrae 2012). Note that personality traits do not directly influence individuals' behaviours, but they can have a strong impact on them. The personality traits of the Five-Factor Model proved to be good predictors of decision-making styles – intuitive, dependent, rational, avoidant, and so on. Moreover, some studies demonstrated that certain personality traits can improve innovativeness while others do not. Being a risk-taker or being optimistic as well as having previous experience in the field or the ability to take initiative are all decisive factors for the success of innovative activities.

Even in this case, time is a significant variable to be added because it can smooth entrepreneurs' personal traits (Leonelli, Ceci e Masciarelli 2016). A lack of time – considered both as the subjective perception of time pressure as well as the imposition of a deadline – can kill creativity, especially when accompanied by workload pressure. The effect of time pressure on creativity is two-fold: it affects individuals' motivation and their cognitive processes. What usually occurs is that individuals prefer exploitation to exploration. When time is limited, it is easier to find a direct path to solving a problem rather than spending more energy in finding alternative ways to overcome an unfamiliar territory. In these situations, it is common to leverage on shortcuts – heuristics and biases – which can alter the outcome of creative thinking (Amabile, et al. 2002). All these findings suggest that personality traits play a role in shaping the relation between intuition and innovation under time pressure.

It is important to further notice that there are no right or wrong personality traits. However, there can be *positive* or *negative* examples of each trait. Moreover, personality traits do not represent a type of person. More correctly, every person owns different levels of each personality trait, thus talking about types is misleading (Vazire 2014). In other words, every entrepreneur has a multifaceted personality, usually including a dark side (Klotz e Neubaum 2016). Costa and McCrae's NEO framework includes six facets for each of the personality traits. Some criticized the Big Five Model for being too broad to correctly predict criteria such as performance, success, or innovation. Alternatively, one can think that the Big Five Model is a multidimensional construct in which several dimensions are combined (Judge, et al. 2013).

For the application of this thesis which deals more with the relationship between cognitive ability and innovation, it makes little difference between utilizing a broad categorization or a very specific one. However, it may be interesting to know which are the sub-facets that explain the categories of the model (*Table 1*). For example, achievement and control are aspects of conscientiousness, and (over)confidence and mistrust are facets of neuroticism, just to cite a few (Klotz e Neubaum 2016).

NEO facet	Description
	Conscientiousness
Competence	Sense that one is adept, prudent, and sensible
Order	Neat, tidy, and well-organized; methodical
Dutifulness	Governed by conscience; ethical; fulfill moral obligations
Achievement striving	High aspirations and work hard to achieve goals; driven to succeed
Self-discipline	Ability to begin and carry out tasks, self-motivating; persistent
Deliberation	Ability to think carefully before acting; cautious and deliberate
	Agreeableness
Trust	Belief that others are honest and well intentioned; not skeptical
Straightforwardness	Sincere; unwilling to manipulate through flattery or deception
Altruism	Active concern for others' welfare; helpful, generous, and considerate
Compliance	Cooperative; seek to inhibit aggression; forgiving; mild-mannered
Modesty	Humble and self-effacing
Tender-mindedness	Sympathy for human side of social policies; concerned for others
	Neuroticism
Anxiety	Apprehensive, fearful, prone to worry, tense, jittery
Angry hostility	Quick to anger; easily frustrated and irritated by others; bitter
Depression	Depressive affect, guilt, sadness, hopelessness; prone to dejection
Self-consciousness	Shame and embarrassment, sensitive to ridicule
Impulsiveness	Inability to control cravings or urges; susceptible to temptation
Vulnerability	Susceptibility to experience stress; easily panicked
	Openness
Fantasy	Active imagination; tendency toward daydreaming; lost in thought
Aesthetics	Appreciation for art and beauty, moved by poetry and music
Feelings	Receptive to inner feelings and emotions; empathetic
Actions	Willingness to try different activities; preference for variety to the routine
Ideas	Intellectual curiosity; willingness to consider new ideas
Values	Readiness to reexamine values; liberal; antitradition and antiauthority
	Extraversion
Warmth	Affectionate and friendly; informal and unreserved around others
Gregariousness	Sociable; preference for company of others; "the more the merrier"
Assertiveness	Dominant, forceful, and socially able; take charge and assume leadership
Activity	Prefer fast-paced life; high energy level; vigorous
Excitement-seeking	Crave excitement and stimulation; sensation-seeking
Positive emotions	Experience joy; laugh easily; cheerful and optimistic; high-spirited

Table 1 - *Definition of NEO facets (Judge, et al. 2013)*

3.4 Study's Hypotheses

Now that we have briefly presented and discussed the theories underneath this thesis, we can continue by integrating all of them in a single conceptual model. This paragraph constitutes a bridge between the theoretical framework and the empirical results of the research. The aim is to assess *how is intuition related to innovation* and *if this relationship changes according to personality traits.*

The starting point of the analysis is the crucial triumvirate of creativity, intuition, and innovation. Each of these elements has been well described in past research, but usually as separate subjects. Conversely, there is empirical evidence of a direct and positive relationship between an intuitive cognitive process and a creative disposition (Schwartz 1990). Creativity involves the ability to suspend judgments and leave all doors open as long as possible, together with shortcuts that become useful in absence of sufficient time, or under other difficult conditions. Similarly, individuals with creative personalities were found to be more likely to recognize entrepreneurial opportunities, make discoveries, create new ideas or any other activity related to innovation (Shane e Nicolaou 2015). In this perspective, creativity is one of the driving forces behind entrepreneurship. In this context, creativity is intended both as the ability to think *out-of-the-box* – in an unconventional way – and the ability to make *free associations* – recombining different pieces of knowledge stored in memory (Taura e Nagai 2017). Recalling the explanation of section *3.2*[7], the ability to connect the dots (even if remote) is typical of intuition. Put differently, intuition is a creative engine, capable of generating a great number of divergent ideas, later selected through a more deliberate cognitive process.

This explains why some people can recognize opportunities and make decisions that lead to successful innovation and others not (Shane e Venkataraman 2000). Consequently, entrepreneurs could have more chances to uncover new opportunities by investing less time in thinking about what could go wrong and focusing more on the action. An exceptional intuition can balance perceptions and imagination; it is quicker and sharper; it facilitates the synergy between experimentation and efficiency; and, finally, it is more successful in understanding ambiguous circumstances, and coming up with breakthrough ideas. Definitely, some methodical processes can be put in place to develop, refine and validate creative ideas, but the risk is to spend time overanalysing rather than acting (Gemmell, Boland e Kolb 2012). On the opposite, by thinking slow entrepreneurs can lead innovation in organizations (Legge e Hindle 1997), create something that did not exist before (Johnson 2001), and embody the vision of the entrepreneur as a change of state (Bygrave and Hofer in Legge e Hindle 1997).

[7] Recalling Kahneman's definition of System 1 as an '*associative machine*', it is the intuitive decision-making responsible for creating complex associations of ideas, by accessing the knowledge stored in memory with no waste of energy.

Individuals are usually tempted to trust their intuition – because they feel it is the result of experience and knowledge – but when intuition becomes too much imperative, trust becomes blind faith (Officer 2005). On the one hand, it is true that individuals are naturally prone to bring their backgrounds into any decision, but, on the other hand, this can be an obstacle to innovation. Knowledge pushes decision-makers to retrieve familiar schemas rather than exploring something new. There are several differences among individuals regarding the set of information they own and how they combine them into new ideas. Decisions based on intuition may sometimes be incorrect if the information were inaccurate or if people are biased. Having the possibility to make wrong decisions means that systematic errors may occur in the process (Shane e Venkataraman 2000). The sources of these errors are *cognitive biases* like overconfidence, a belief in the law of small numbers, the illusion of control, counterfactual reasoning, self-justification, and so on. Cognitive biases occur when entrepreneurs make decisions based on experience rather than on exact calculations, thus violating the rules of probability. The consequence is an overestimation of the reliability and validity of the information acquired which leads to incorrect conclusions (Simon e Houghton 2002). For the entrepreneur, this would mean recognizing an opportunity that, in reality, does not exist or developing an innovative strategy with a low probability of success.

On the other hand, under certain circumstances, engaging in an intuitive decision-making style helps entrepreneurs to reach conclusions more rapidly. Time matters also for entrepreneurs. It is the scarcest and most valuable resource, yet it represents as much an opportunity as a cost. When involved in time-sensitive processes, an entrepreneur may be forced to face trade-offs and sacrifice a more precise analysis to gain an advantageous position. When pioneering (i.e., entering a new market or the present one with a new product), intuition is vital for entrepreneurs who must make decisions before the window of opportunity closes or before they lose the advantage of being the first mover (Lévesque e Stephan 2020). In these situations, the entrepreneur must take initiative rather than passively receiving information. In presence of scarce resources (both in terms of time and data), more analytical decision-making would not allow entrepreneurs to seize the opportunity they strongly believe in, and it would also require more cognitive effort. In such cases, *heuristics* are shortcuts that help reducing uncertainty and complexity, thus considerably improving the decision-making speed (Simon e Houghton 2002). All things considered, these arguments suggest the following hypotheses:

Hypothesis 1a*:* *Intuition positively affects Innovation under time pressure.*

Hypothesis 1b: *Experience is an obstacle to innovation for the most intuitive decision-makers.*

Beyond creativity, the literature identified other dimensions of personality positively related to entrepreneurship (Shane e Nicolaou 2015). Personality traits represent different perceptions of reality which can make some opportunities more credible than others, thus incentivizing the entrepreneur to transform them into socio-economic value. Certainly, it depends also on the context. Under time pressure, being more optimistic or more pessimistic as well as being more or less confident of one's ideas can make a difference (Simon e Houghton 2002).

The Big Five Model has been used traditionally to measure personality traits. Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience have been linked separately to intuition and entrepreneurship. For instance, Bayram and Aydemir (2017) studied the relationship with decision-making styles, while Ciavarella, Buchholtz, Riordan, Gatewood, and Stokes (2004) focused more on their relation to entrepreneurship seen as the ability to develop a new and long-lasting firm. Building on their findings, the present thesis will verify if and how entrepreneurs' personality traits interfere in the relationship between cognitive processes and innovation. The expected outcome is the definition of a conceptual model which identifies some personality traits that can enhance or obstacle the entrepreneurial intuitive decision-making when developing innovative ideas.

For the purpose of the study, Openness to Experience, Conscientiousness, and Neuroticism have been taken into consideration. *Extraversion* and *Agreeableness* have been excluded because they are related to the view of the entrepreneur as a firm organizer more than an innovator. Extraversion is typically associated with managers and salespeople, but it can be important for an entrepreneur who has to ensure the survival of his/her business. Similarly, also agreeableness provides the entrepreneur with important skills like cooperation that can be particularly significant to establish a relationship with customers and shareholders to develop a new business. On the other hand, depression and anxiety – typical of *Neuroticism* – as well as organization, perseverance, and internal locus of control – typical of *Conscientiousness* – can positively influence the relation between intuition and innovation. Finally, *Openness to experience* is expected to positively influence innovation regardless of the cognitive processes. If this hypothesis is verified, nurturing decision-makers' creative and original spirit can be the key to overcome the negative relation between intuition and innovation caused by experience. Although it is difficult to isolate just a few personality traits, this discussion tentatively suggests the following:

Hypothesis 2a: *Conscientiousness, Neuroticism, and Openness to Experience play a moderator role in the relationship between Cognitive Processes and Innovation.*

Hypothesis 2b: *Openness to Experience helps entrepreneurs to overcome the obstacle represented by experience in their intuitive decision-making process.*

4. ANALYSIS

4.1 Research Design

In this paragraph, we will go more in detail describing the methods adopted to conduct the empirical study and the indicators used to test the hypotheses. To do so, data were provided by a total of 60 students and employees in an age range between 20 and 59. Participants volunteered in taking part in an experiment delivered in form of an online survey during summer 2021 (see *Appendix A*). The experiment took place in a controlled environment, minimizing the risk of errors.

Participants in the study

The sample size for the experiment was determined through a power analysis conducted in G*Power. To begin with, an a-prior power analysis was carried out setting the F family of tests and a One-Way ANOVA statistical test. A medium-size effect (f = 0.23) was estimated since the experiment took place in a relatively controlled environment. The alpha error probability was set to 0.05 and the beta error probability to 0.20 (thus, projecting to achieve 80% power). Finally, participants were divided into two groups according to the two decision-making styles being examined (i.e., intuition and analysis). According to G*Power, the minimum sample was set to n=152. Given the difficulty in reaching such a large sample in a small amount of time, a compromise power-analysis was also conducted setting the total sample size to 60, all else equal. The power reached with this sample size – thus, the probability to detect a true "effect" on the population – is 74%.

In the baseline sample, 40 participants were female (66,67%) and the remaining 20 participants (33,33%) were male. Of the participants who responded to the age question, 47 (78,33%) were in the age range 20-26, 8 (13,33%) in the age range 27-32, and 5 (8,33%) were over 33 years. Finally, of the participants who responded to the current employment status, 33 (55%) were students of bachelor's or master's Degrees, 26 (43,33%) were employed, and 1 (1,67%) selected "Other" being employed in civil service. To simplify the analysis, the only person selecting "other" has been included in the group of "employed". Employment positions varied from Data Analyst to Project Manager, Credit Administrator, Recruiter, Communication Manager, and Business Development both as internship and full-time employment. Similarly, courses of study ranged from Statistical Science to Communication, Arts Management, Cultural Heritage, Business, Economics, and Management. All respondents came from Italy, and currently, work or study in the same country. For this reason, no question about the geographical origin of the participants was added.

Variables and Measures

Variables and measures used to conduct the analysis are summarized in the following table.

Variables	Description	Measure
Group	Independent Variable	Intuition and Analysis randomly assigned to 1st and 2nd group respectively
Experience	Independent Variable	Questions about age and occupation
Innovation	Dependent Variable	Number of ideas * Time
Personality Traits	Moderator Variable	Big Five Personality Questionnaire

Table 2 - *Summarizing Table of Variables and Measures*

Before explaining the measures, a review of the variables' definitions is needed. Firstly, Intuition refers to Kahneman's *System 1,* the fast and automatic thinking that guides human decision-making, as opposed to *System 2*, the slower and more deliberate way of thinking (Kahneman 2011). Secondly, Innovation is a unique entrepreneurial characteristic. It is defined as the "*tendency to engage and support new ideas, novelty, and creative processes that may result in new products or services*"[8]. From this perspective, Innovation does not merely involve the creation of new businesses or ventures, rather it generally encompasses the act of bringing new ideas to life, whatever the form they take (products, services, businesses, strategies, and so on). Finally, personality traits have been defined as propensities to act or as predictors of entrepreneurial behaviour (Rauch e Frese 2007).

A questionnaire was developed to gather data (*Appendix A*). It has been divided into two main parts. The first was aimed at measuring the level of Openness to Experience, Conscientiousness, and Neuroticism in the sample. To minimize the risk of non-response bias, the assessment of personality traits was designed according to a reduced version of the NEO-PI-R taken from the International Personality Item Pool (http://ipip.ori.org/ipip/). Secondly, it was developed an *ad hoc* experiment in which participants were asked to put themselves in the shoes of a hotel owner struggling to gain a competitive advantage over a new entrant (Airbnb) and avoid bankruptcy. Participants were left free to think of any possible innovative strategy. Time represented the only limit. Finally, to incentivize participants' innovation, it was specified that shareholders would have evaluated the innovativeness of the strategy proposed in deciding whether to keep investing or not.

[8] Gabrielsson, Peter, e Mika Gabrielsson. 2013. «A dynamic model of growth phases and survival in international business-to-business new ventures: The moderating effect of decision-making logic» Industrial Marketing Management (ScienceDirect) 42, p. 1359.

To test the first hypothesis (H1a) which involved a time dimension, participants had a limit of 10 minutes to brainstorm as many ideas as possible. Time was measured simply by looking if participants took exactly, less, or more than 10 minutes to answer the question. Thus, no further measure of time was needed being it embedded in the experiment design. Knowledge and experience (Hypothesis 1b) were measured in the experiment through specific questions about participants' age (Age Range) and employment status (Occupation) which were combined with data on participants' cognitive processes to discuss the results of the analysis. Since it is difficult to engage either in intuitive or analytical decision-making – being the two processes not mutual-excluding – participants were divided into two random groups and unconsciously convinced that one mental process was more successful than the other in developing innovative ideas. Innovation, consequently, was measured by multiplying the number of ideas written in the brainstorm question for the time taken to develop them. The choice of this metric has not been an easy task.

Firstly, the concepts of innovation and creativity tend to overlap. The usual distinction made by literature considers creativity as the exploration and generation of ideas and innovation as the act of implementing and mastering those ideas (de Jong e den Hartog 2010). Since the present study looks upon the ability of entrepreneurs to find new innovative opportunities, only the first phase of the innovation process was taken into account. The experiment, indeed, provided participants with the chance of discovering new opportunities. The chosen source was a failure. The risk of going bankrupt was supposed to be the trigger for the hotel owner's exploration. Imagining new ways to use existing products combined with new ones would not only save but also innovate the business Idea generation was the next consequent step to find an innovative solution to the proposed problem.

Secondly, there is no generally accepted metric to measure innovation. Some even argued that innovation is just impossible to be measured. While it is wrong to consider the impossibility of quantifying innovation, it is true to think of innovation as a highly subjective measurement. Some companies value more the output of innovation, and so adopt metrics like the number of royalties coming from intellectual properties, the percentage of revenue coming from the new market versus the domestic one, the percentage of revenue coming from a new product or a new customer segment and so on. If, instead, the focus is on what fuels innovation, like in the case of Coca-Cola's Venturing & Emerging Brands (VEB) or Google, the metrics regard the company's culture of innovation. In both companies, employees are given money and extra time to explore new opportunities and develop new ideas. This is paying off with a higher number of innovative products and services sold in the market – Coca-Cola acquired very successful brands like FUZE juice drinks, while Google gave birth to brand new services like Gmail building upon employees' ideas (Kaplan 2014).

In the present study, Innovation has been considered a function of the number of ideas generated multiplied by the time spent to do so. This measure has been inspired by a metric used by companies to measure employees' innovation. The latter consists in counting the number of ideas presented in one month. This measurement is coherent with the first hypothesis which values time as an essential element. However, it doesn't take into account the quality of ideas. It was a personal choice of participants to spend more time on the quality or number of ideas.

Particular attention must also be paid to the personality traits measure's source. The IPIP – International Personality Item Pool – represents an open-source resource for the most common measures of personality traits. The IPIP inventory encloses sample self-report questionnaires widely accepted as valid descriptors of normal personality constructs (Jones 2014) including the Five-Factor Model (FFM). Self-report questionnaires are usually a convenient way to measure personality because they can be administered without the help of any professional figure. Usually, people own a lot of information about themselves and can easily access their thoughts and feelings, even if they might not always know or tell the truth. Alternatively, personality can be measured by observing participants' behaviours with the help of psychologists (Vazire 2014). Entrepreneurial research has mainly used self-reports (Form S) as demonstrated by several articles.

Given the popularity of this comprehensive Inventory of general personality traits, there are several derivatives used to operationalize the five broad categories and their sub-facets. One of the FFM-derived objective inventories is the NEO-PI-R (Neo Personality Inventory-Revised). It is a quite brief version of the original Neo Personality Inventory thought to be used when time is limited and addressed to individuals aged over 18. For instance, the NEO-PI-R consists of 240 items (Sleep, Lynam e Miller 2021), short phrases thought to assess the core of each trait and rated on a 5-point Likert scale with response options ranging from very inaccurate (1-2) to very accurate (4-5). Items are distinguished between positive and negative. Scores are computed per each personality trait by summing the points assigned to each item in the pool (Jones 2014). High scores indicate that the personality construct in question is highly owned by the respondent (Bayram e Aydemir 2017).

Shorter versions of the NEO-PI-R also exist, but usually, their validity is low – at least, for recruiting purposes. Considering the objective of this study, the 10-item IPIP scale has to be preferred to longer alternatives to moderate the probability of getting invalid responses in the questionnaire. Participants in the experiment answered to a positive item of one personality trait followed by a negative item of another personality trait, alternated until there have been answers to all the 10 items included in the pool for each of the personality traits (Jones 2014). The most important characteristic of a good personality measure is the consistency of the measure, also known as reliability. Reliability estimates (i.e., coefficient alpha) for the 10-item IPIP scales are the following:

10-Item IPIP Scales	Number of Items	Mean Item Intercorrelation	Coefficient Alpha	Correlation with NEO-PI-R
O: Openness	5+5=10	.33	.82	.79 [.91]
C: Conscientiousness	5+5=10	.31	.81	.79 [.92]
E: Extraversion	5+5=10	.38	.86	.77 [.88]
A: Agreeableness	5+5=10	.27	.77	.70 [.85]
N: Neuroticism	5+5=10	.37	.86	.82 [.92]
Mean	**5+5=10**	**.33**	**.82**	**.77 [.90]**

Table 3 - *A Comparison between the 5 Broad Domains in Costa and McCrae's NEO PI-R and the Corresponding Preliminary IPIP Scales Measuring Similar Construct*[9]

As shown in *Table 3*, the NEO-PI-R includes all the domains of the Five-Factor-Model. However, this study was conducted selecting only three specific traits matched to the entrepreneur's innovative task. According to Rauch and Frese (2007) traits matched to specific entrepreneurial tasks contribute to a more precise and reliable prediction of the entrepreneurial behaviours. The chosen factors are the following: Neuroticism (N) – the tendency to experience negative effects like sadness, anxiety, fear, embarrassment, and so on –, Openness to Experience (O) – the tendency to be open to new experiences, intellectually curious, and aesthetically imaginative – and Conscientiousness (C) – the tendency toward self-control, organization, and reliability (Detrick 2020).

As mentioned before, everyone owns different levels of personality traits. People high in neuroticism are usually more vigilant and aware of risks while people low in neuroticism are relatively calm, not easily stressed, and so on. People high in openness, instead, are more prone to try new things and play with different ideas, while people low in openness prefer the routine and are resistant to change. Finally, people high in conscientiousness strive to achieve optimal results, are tidy and punctual, while people low in conscientiousness are more disorganized, forgetful, and do just enough to get work done (Vazire 2014). These differences among individuals can be grasped by non-invasive and transparent questions, which can lead to a positive response bias. To avoid distorted answers, the administrator of the questionnaire has to gain the cooperation of the respondents. To comply with this requirement, respondents were provided with plenty of time to rate each of the items, with an explanation of the testing's purpose and assurance for privacy protection (Costa e McCrae, Chapter 6 - The NEO Inventories 2008). In the light of the NEO-PI-R 10-item scale, the following statements were used in the survey:

[9] https://ipip.ori.org/newNEO_DomainsTable.htm

NEUROTICISM

10-item scale (Alpha = .86)

+ keyed	I am often troubled by negative thoughts
	There are many things that I don't like about myself
	I often feel anxious about what could go wrong
	My moods change easily
	I often worry that I am not good enough
– keyed	I rarely get irritated.
	I seldom feel blue.
	I feel comfortable with myself.
	I am not easily bothered by things.
	I remain calm under pressure.

OPENESS TO EXPERIENCE

10-item scale (Alpha = .82)

+ keyed	I believe in the importance of art.
	I have a vivid imagination.
	I enjoy wild flights of fantasy.
	I am interested in the meaning of things
	I enjoy hearing new ideas.
– keyed	I am not interested in abstract ideas.
	I do not like poetry
	I avoid philosophical discussions.
	I do not enjoy going to art museums.
	I rarely look for a deeper meaning in things.

CONSCIENTIOUSNESS

10-item scale (Alpha = .81)

+ keyed	I am always prepared
	I pay attention to details
	I finish what I start
	I complete tasks successfully
	I make plans and stick to them
– keyed	I change my plans frequently
	I find it difficult to get to work
	I do just enough work to get by.
	I avoid taking a lot of responsibility
	I need a push to get started.

Table 4 - *Scoring Keys measuring personality constructs as in the NEO-PI-R* [10]

[10] https://ipip.ori.org/newNEODomainsKey.htm

Method of Analysis

The proper analysis will be conducted in the next chapter and will be structured as follow. First, some descriptive and frequency statistics will be shown to summarize the main characteristics of the data set and the categories used for the analysis. Descriptive statistics consist of *measures of central tendency* which analyse the middle value of a frequency distribution for the sample in question using mean, median, and mode, and *measures of variability* (or spread) which, instead, deals more with the dispersion of data through standard deviation, variance, and so on. Descriptive statistics are fundamental to represent data in a meaningful way, but they are not enough to reach conclusions about any hypothesis. On the contrary, inferential statistics are used to test statistical hypotheses. Indeed, the second step of the analysis will be to test both hypotheses using different tests.

To verify the first hypothesis (H1a-H1b), the analysis will investigate whether there are significant differences in innovation levels between the analytical and intuitive group of participants. Different statistical procedures can be applied to reach this goal. The most popular test is the *One-Way Analysis of Variance* (One-Way ANOVA) which organizes data into different groups according to one single variable (also called *factor*) for comparing means. It is usually applied to analyse the difference between the means of more than two groups. It is preferred to the multiple t-test to reduce the chances of making a Type I error (usually 5% but eventually multiplied for the number of t-tests conducted). Being a parametric test (whose validity depends on data distribution), data should be normally distributed and have equal standard deviations.

If the assumptions are not met, there are two alternatives. *Box-Cox transformation* is generally performed before any parametric test to provide a normal shape to non-normal variables. This transformation is based on an exponent, lambda (λ), which represents the best approximation of a normal distribution curve (also called the "*optimal value*") according to the data. A non-parametric alternative to ANOVA is the *Kruskal-Wallis H Test* (shortly, KWt). Differently from ANOVA, the KWt looks for differences in medians, regardless of the distribution of means. This is the reason why it can be applied also when the normality assumption is not met. Moreover, it can be employed both if the categorical variable has two or more levels. Notwithstanding, the logic behind the Kruskal Wallis test is the same as One-Way ANOVA. The *null hypothesis* assumes that the distribution of the dependent variable is the same in the populations compared. Conversely, the *alternative hypothesis* considers the distributions as not identical. Therefore, if the result of the test shows a statistically significant difference (the value of F is greater than the critical F-value and $p<0.05$), the alternative hypothesis is accepted. On the contrary, if the test has no significant difference (the value of F is less than the critical F-value and $p>0.05$), then the null hypothesis is accepted (Vargha e Delaney 1998).

Supposing that KWt shows a statistically significant difference in the distributions under examination – thus rejecting the null hypothesis, the next step of the analysis is to search in which way the two distributions are different. This can be achieved by performing a multiple pairwise comparison. Comparison techniques are usually employed so that if all the hypotheses are accepted, then the probability of rejecting at least one of them is no greater than a specific value, thus the *experiment-wise error rate* is controlled (Christensen 2020). The *Dunn's test* is usually the more appropriate procedure to be conducted following a Kruskal-Wallis Test. The Dunn's test consists in adjusting the α value – the probability of falsely rejecting the null hypothesis – through a Bonferroni adjustment. This adjustment simply divides α by the total number of tests. As a result, the α value remains the same and the *p-value* is multiplied. Thanks to this adjustment, the probability of rejecting the null hypothesis by error is completely excluded by the test performed (Dinno 2015).

Recalling the first paragraph of this chapter (*4.1. The Study's Hypothesis*), the second hypothesis was formulated to explore the moderating effect of personality traits on the relationship between cognitive processes and innovation. Generally, a moderator variable *Z* is defined as a variable capable of altering the strength of the relationship between the independent and dependent variables. The relation can be modified (multiplications of variables) or blocked (sum of variables). Heterogeneity between groups is also called *interaction*. According to Alin and Kurt (2006), "*Interaction between two factors is the phenomenon where the differences between mean values of one factor are not consistent across all levels of the other factor*"[11]. The identification and analysis of this effect in empirical research is particularly challenging and many different methodological procedures can be applied. The *two-way ANOVA* test is a valuable option. Most commonly, *Moderated Regression Analysis* is employed to verify whether moderator variables affect the main linear relation. The moderated regression model is suitable for both continuous and categorical variables. Even in this case, the moderating effect is defined by the presence of an interaction between variables. In moderated regression analysis, the moderator variable is connected to the dependent variable multiplicatively to assess whether their interaction helps to predict the independent one. The moderator relationship should be established a priori (Helm e Mark 2012). If then, the result of the test shows significant differences, the model can be further specified indicating how the relationship between the dependent and independent variables vary at the moderator variable's mean level, above the mean level (mean + standard deviation) or under the mean level (mean – standard deviation).

[11] Alin, Aylin, and S. Kurt. 2006. "Testing non-additivity (interaction) in two-way ANOVA tables with no replication." Statistical Methods in Medical Research, 15, p. 63.

4.2 Analysis and Results

Descriptive Statistics

Before proceeding with the proper analysis, it is necessary to summarize the basic features of the dataset. Firstly, variables should be distinguished between continuous and categorical. Categorical variables were used to divide the data set into groups and conduct the variance analysis for each of them. The variable "group" differentiated decision-makers randomly according to their cognitive processes; Gender and Occupation were simply given by the demographic questions included in the survey[12]. Finally, Age Range and Time were created later according to participants' answers and performance. Time categories were defined according to the design of the survey which expected participants to take maximum 10 minutes to brainstorm as many ideas as possible to solve the business problem. For what concerns the age range, groups were created in concordance more or less to the occupation of participants: people aged 20-26 are usually students, people aged 27-32 are usually in their first years of working experience while people over 33 years should have a more consolidated experience and knowledge. The following *frequency statistics* show the number of participants per category and associated percentages.

	Frequency	Percent
Analysis	31	51.7
Intuition	29	48.3
Total	**60**	**100**

	Frequency	Percent
Female	40	66.7
Male	20	33.3
Total	**60**	**100**

	Frequency	Percent
Student	33	55
Employed	27	45
Total	**60**	**100**

	Frequency	Percent
20-26	47	78.3
27-32	8	13.3
33+	5	8.3
Total	**60**	**100**

	Frequency	Percent
<10	39	65.0
10	14	23.3
>10	7	11.7
Total	**60**	**100**

Table 5 - *Frequency Statistics*

Table 5 shows that the sample population consists mainly of female (66.7%) students (55%) aged between 20-26 (78.3%). 51.7% (31) of total participants was assigned randomly to the group of people using *System 2* – the analytical and more deliberate cognitive process –, while 48.3% (29) was assigned to the group of intuitive decision-makers. Most participants respected the maximum time set at 10 minutes (23.3% worked exactly on time, while 65% finished even earlier than the deadline), but some outliers exceeded it (11.7%).

[12] For simplification, the only participant who selected "other" in the question about the employment status was included in the group of "employed" being a volunteer.

Having clear the distribution of participants according to the different groups, it is possible to proceed with *descriptive statistics* which will, instead, summarize the characteristics of the dataset.

	Analysis (N = 31)						*Intuition (N = 29)*					
	mean	sd	median	skew	kurtosis	se	mean	sd	median	skew	kurtosis	se
Innovation	34.00	28.88	27.00	1.14	0.35	5.19	24.28	21.93	15.0	1.41	1.36	4.07
Openness	81.42	12.70	82.00	-0.26	-1.03	2.28	81.17	15.51	86.0	-1.33	1.85	2.88
Conscientiousness	75.61	12.34	74.00	0.34	-1.08	2.22	72.28	12.02	72.0	-0.66	0.56	2.23
Neuroticism	62.45	11.22	62.00	0.04	-0.98	2.01	61.72	13.52	60.0	0.00	-0.86	2.51

Table 6 - *Descriptive Statistics by Cognitive Processes*

Firstly, Skewness' coefficient is used to measure the degree of symmetry in a probability distribution. Data reveal that Innovation is skewed to the right in both the random groups (Analysis: *Skew* = 1.14 and Intuition: *Skew* = 1.41). Openness, instead, is significantly skewed to the left in the intuitive group (*Skew* = -1.33), while for the analytical group it is quite symmetric. Conscientiousness and Neuroticism have in both groups a skew value around zero, meaning that the distribution follows, almost perfectly, a normal distribution. Secondly, the Kurtosis coefficient provides information about the existence of possible outliers. In the analytical group, data of personality traits are light-tailed meaning that there is a lack of outliers and so an almost normal distribution. On the other hand, in the intuitive group, only Neuroticism shows a small presence of outliers. Kurtosis for Innovation and Openness indicates the presence of thick and heavy tails, thus of significant outliers, while for Conscientiousness is around zero. Finally, descriptive statistics include measures of central tendency (mean) and variability of spread (standard deviation) for each group. On average, analytical decision-makers (M = 34, SD = 28.88) resulted to be more innovative than intuitive ones (M = 24.28, SD = 21.93) under time-constraints. *Figure 6* summarizes visually the results obtained.

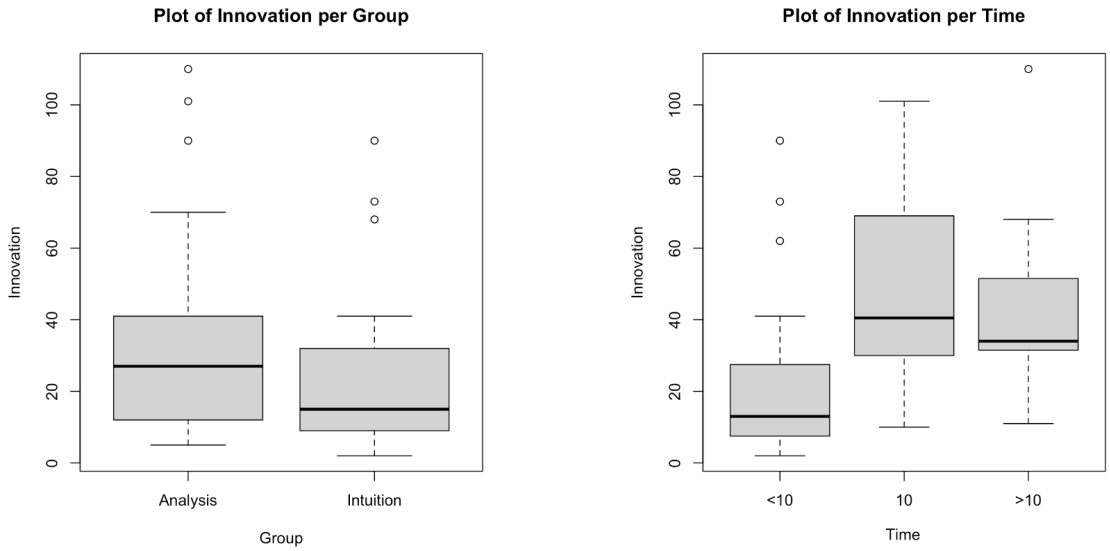


Figure 6 - *Levels of Innovation reached according to Cognitive Processes and Time*

Comparing the medians of the first graph, the analytical group shows a slightly higher level of innovation if compared to the intuitive group, but the median line of the first group is still inside the other box meaning that the difference is not significant. In the second graph, instead, the median line of the group taking exactly 10 minutes to answer the question is outside the box plots of the other two groups, meaning that there is a significant difference between the groups. The size of the whiskers suggests that data of the analytical group and the group taking 10 minutes are more dispersed in comparison to their respective other groups. Some outliers are present in all groups but one (the one of people taking 10 minutes to answer the brainstorming question). Finally, skewness levels are consistent with the ones of the descriptive statistics. These results provide an initial understanding of data distribution which will be fundamental to conduct the analysis of variance since normality distribution is the first assumption of this statistical procedure.

Figure 7 follows the same reasoning applied to personality traits' distribution. Looking at the median line of each box plot, levels of Conscientiousness and Neuroticism appear to be slightly more in the group of analytical decision-makers (Conscientiousness: *Median* = 74 and Neuroticism: *Median* = 62) while Openness to Experience results typical of intuitive decision-makers (*Median* = 86). However, differences are not significant – in fact, the median line is also within the other box plot per each personality trait, and mean levels are very similar (*Analytical group*: *M* = 81.42, *SD* = 12.70 and *Intuitive group*: *M* = 81.17, *SD* = 15.51). In the graphs plotting Openness and Conscientiousness, there are also outliers but are far less than the ones present in *Figure 6*. Finally, also here skewness levels are consistent with the ones of the descriptive statistics, and data are more dispersed only in the case of Neuroticism for the group of intuitive decision-makers.

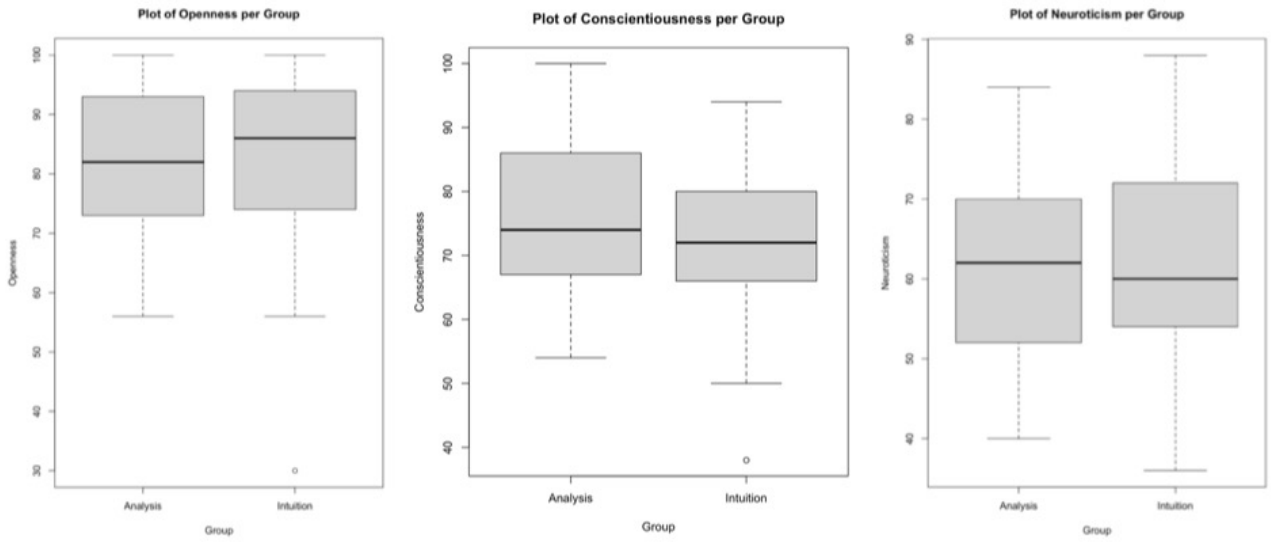


Figure 7 - *Different levels of personality traits according to Group*

Major differences arise when data on cognitive processes and personality traits are combined with demographic data. In particular, intuitive male participants show signs of being more open to experience compared to the corresponding group of analytical ones. Moreover, regardless of their cognitive processes, female participants registered generally higher scores of Openness and Neuroticism. For what concerns Occupation, in both the groups of analytical and intuitive decision-makers, employees showed, on average, higher levels of Conscientiousness while students of Neuroticism. Differences in the level of Openness were highly affected by the cognitive processes: analytical students and intuitive employed demonstrated to be more open. Finally, in the analytical group, people aged 20-26 resulted as the most open and conscientious (for almost the same level of people aged 33+), while Neuroticism was found a typical trait of the age range 27-32. In the intuitive group, instead, it is the opposite: Neuroticism level is significant for the age range 20-26 while the other two personality traits for the range 27-32 (*Appendix B*).

Figure 8 plots data about innovation according to demographic data.

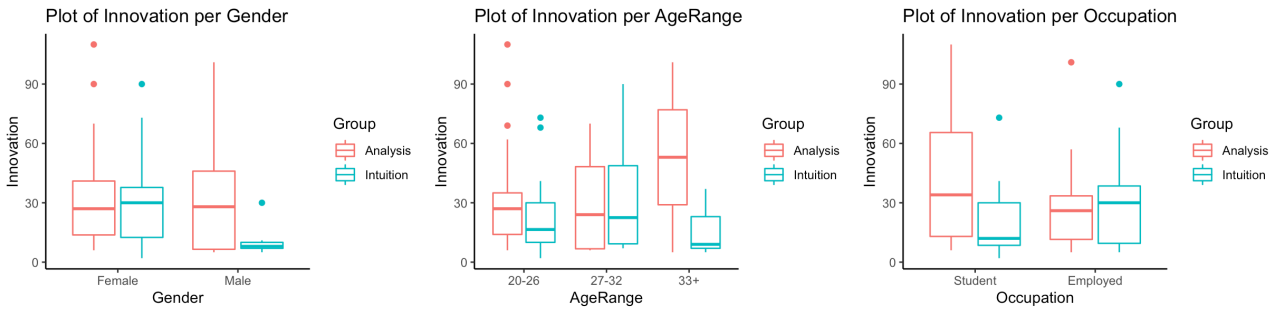


Figure 8 – *Box Plots combining Groups and Demographic Data*

At first glance, male participants have reached a wider range of innovation levels, but females were on average the most innovative participants. In particular, the difference between the two genders in the analytical group is very small (around 1.40 points), while in the intuitive group female ($M = 30.45$, $SD = 23.57$) achieved three times the innovation realized by men ($M = 10.56$, $SD = 7.55$). Considering the age range, instead, analytical participants over 33 years old were more innovative than the rest of the sample with data spread out over a wider range of values ($M = 53$, $SD = 67.88$). However, on average, participants belonging to the group 27-32 registered a wider range of innovation levels with a slightly higher mean for the intuitive group (*Analytical group:* $M = 31$, $SD = 30.67$ and *Intuitive group*: $M = 35.50$, $SD = 38.44$). This result is also confirmed by the combination with occupation data. Looking at the third and last box plot (*Figure 8*), in fact, intuitive employees ($M = 31.55$, $SD = 27.14$) were, on average, more innovative than analytical ones ($M = 27.94$, $SD = 24.43$). Finally, the group which obtained the highest score on innovation was the one of the analytical students ($M = 40.47$, $SD = 32.58$).

Analysis' Results

The descriptive statistics already provided some insights on data, describing the sample's characteristics in the light of the study's hypotheses and combining them with demographic data. To verify such insights, the first part of the analysis was focused on examining mean differences in the level of innovation achieved by the different groups. The second part, instead, was aimed at investigating the moderator role played by personality traits in the relations that emerged from the first part. It is evident that the structure of the analysis reflects the two main hypotheses of the study.

As mentioned in the subsection *"Method of Analysis"*, before conducting any statistical test, it is necessary to check that the assumptions of *Independence*, *Homoskedasticity,* and *Normality* are met. The first assumption requires observations between two groups to be independent. In other words, no participant can appear twice in two different groups. This assumption cannot be tested, but the experiment design already implied that participants could belong to one and only one group given that questions required one and only one answer. For this reason, it was assumed to be met.

Homoskedasticity, instead, refers to a condition in which variance is homogeneous, thus the error term (or *residual*) in the model is constant. The opposite is Heteroskedasticity (the error term is not constant). If the variance of error varies too much around the regression line, the regression model may be not well-defined (Kenton 2021). To check homoskedasticity both *Bartlett's* and *Levene's tests* could be applied. The choice between the two depended on the data's distribution. The Bartlett test is more suitable for data with normal distribution, while the Levene's one for data not normally distributed.

Finally, normal distribution, also known as *Gaussian Distribution*, is a probability distribution that is symmetric about the mean. Data closer to the mean occurs more frequently than data far from the mean. Looking graphically at the data's probability distribution, the normal distribution is bell-shaped (Chen 2021). The *Skewness* and *Kurtosis* coefficients showed in the descriptive statistics already measured how different data distribution is from a normal one. Notwithstanding, the *Shapiro-Wilk Normality test* was also performed. This method is based on the correlation between the data set and the corresponding normal levels. The null hypothesis assumes that the distribution is normal. If the test shows significant differences ($p\text{-value} < 0.05$) it means that the null hypothesis is rejected, and data are not normally distributed. Given the small size of the sample, the test's results were combined also with a visual inspection of data distribution (STHDA s.d.).

The starting point of the analysis was the test of the first hypotheses which assumed a positive relation between Intuition and Innovation under time pressure (H1a) and a negative relation for higher levels of experience (H1b) which could have represented an obstacle to innovation.

To begin with, the assumptions were verified on Innovation as a function of cognitive processes, occupation, age range, and time. As said before, independence was already assumed to be met. Data about innovation also reported a homogeneous variance, checked using *Levene's test* which is less sensitive to departures from a normal distribution. Finally, data about Innovation appeared to be normally distributed for groups determined by age range (especially people between 27 and 32 years old) and time (equal or higher than ten), but not for groups determined by cognitive processes and occupation (*Appendix B*). Given that the normality assumption was not met for all groups, the *One-Way ANOVA* couldn't be performed. Thus, it was substituted by the *Kruskal Wallis Test*.

The test recorded no statistically significant difference in innovation's mean levels between the analytical and intuitive groups (*p-value* = 0.1877). However, this doesn't imply that the two groups are identical. The insights of the descriptive statistics demonstrated that, on average, analytical decision-makers (M = 34) were more innovative than intuitive ones (M = 24.28). The same result was achieved also for Occupation (*p-value* = 0.8467) and AgeRange (*p-value* = 0.7702). Students and employed didn't report any difference neither in the descriptive statistics (contradicting H1b). Only participants aged 27-32 showed an average innovation level slightly higher than the other groups (*Appendix B*). Given that the variable "AgeRange" consisted of three levels (20-26, 27-32, 33+), a *One-Way Analysis of Variance* was conducted using *Box-Cox Transformation* to verify the result. After having multiplied values for lambda (λ) – the optimal value –, the *p-value* was still greater than 0.05 confirming the absence of a statistically significant difference.

The groups which, conversely, registered a statistically significant result in KWt were the ones determined by the Time spent to answer the brainstorming question (*p-value* = 0.0005436). Also in this case, a *One-Way ANOVA* after *Box-Cox Transformation* was conducted to verify the *result* (*Table 7*). As the *p-value* obtained through ANOVA was less than significance level 0.05 (*p-value* = 0.000272897), the mean differences were statistically significant in the three groups (<10, 10, >10).

data: Innovation by Time	
Kruskal-Wallis rank sum test	
Kruskal-Wallis chi-squared =	15.035
df =	2
p-value =	0.0005436
One-Way Analysis of Variance (alpha = 0.05)	
Statistic =	9.509.971
Num df =	2
Denom df =	57
p.value =	0.0002728969
Result:	Difference is statistically significant.

Table 7 - *Kruskal-Wallis Test and One-Way ANOVA for Innovation by Time*

A multiple pairwise comparison was performed to assess in which specific group's mean difference was statistically significant. Looking at the *p-value* adjusted by *Dunn's test* for multiple pairwise comparison, it resulted that the group taking less than 10 minutes to brainstorm as many innovative ideas as possible to solve the business problem had a significant mean difference with respect to the other two groups (*Table 8*). This result provided new evidence to answer H1a. Most of the participants in the experiment took even less than the given time and still chose analysis.

data: Innovation by Time

Dunn's post-hoc test

.y.	group1	group2	n1	n2	statistic	p	p.adj	p.adj.signif
Innovation	<10	>10	39	7	2.54	0.0111	0.0333	*
Innovation	<10	10	39	14	3.38	0.000726	0.00218	**
Innovation	>10	10	7	14	0.0221	0.982	1	ns

Table 8 - *Dunn's post-hoc test for Innovation by Time*

Figure 9 shows graphically the significant results of this first analysis including mean and standard error. Firstly, it is evident that the average Innovation's level in the analytical group was higher than in the intuitive one (with almost the same standard error). Secondly, the group taking less than 10 minutes to brainstorm innovative ideas was less innovative than the other groups (explaining the statistically significant difference of the *Dunn's post-hoc test*). However, the standard error for these groups is higher given their smaller size. It is possible to conclude that the innovation reached the level <10 is representative of the sample population. Consequently, under time pressure, analytical decision-makers were more innovative than intuitive ones (contradicting H1a).

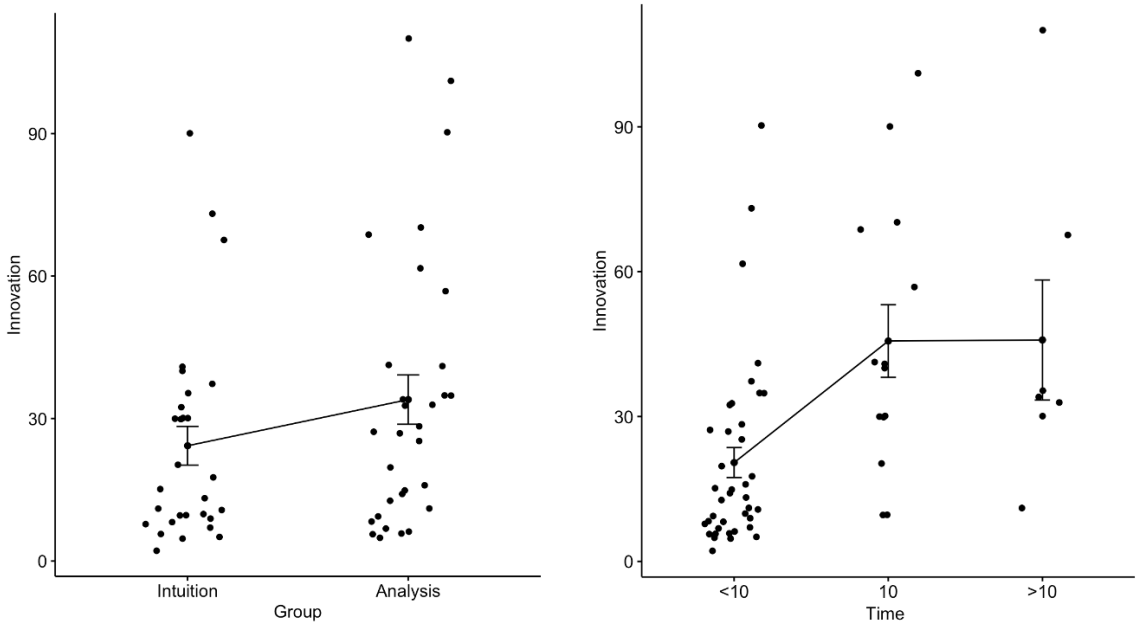


Figure 9 - *Graphical representation of the first analysis' results*

Given that the first part of the analysis showed a higher tendency towards innovation in the analytical group under time pressure, it was then assumed that some personality traits could have affected the relationship. The second step of the analysis consisted in elaborating a *Moderated Regression Model* (Zhang e Wang 2020) which would have first assessed whether personality traits could eventually modify the relations resulted from the *Kruskal-Wallis Test*, and then which traits among Conscientiousness, Neuroticism or Openness to Experience were responsible for such alteration (Hypothesis 2a). Note that both the outcome variable (Innovation) and the potential moderators (each personality trait) are continuous variables, while groups' variables were transformed in numeric to perform the moderated regression.

Firstly, the moderated regression analysis was applied to Innovation as a function of the cognitive processes (0 for *Intuition and* 1 for *Analysis*). Contrary to the expectations of hypothesis 2a, the regression coefficient estimates of the interaction terms *Group*Openness* (-0.5) and *Group*Neuroticism* (-0.1) reported a *p-value* > 0.05 (95% confidence level). This result suggested that Openness and Neuroticism didn't modify the main relation with innovation (*Appendix B).*

For what concerns Conscientiousness, instead, the result was different. The moderated regression model still didn't recognize any statistically significant difference in the mean (*Appendix B*). However, the *Simple Slopes Analysis* showed that for Conscientiousness' levels above the mean, the *p-value* was, indeed, significant (*Table 9*). That is, as long as Conscientiousness was inside the interval [83.70, 88.78] – the *Johnson-Neyman* interval which helps understanding where simple slopes are significant for interactions in multiple linear regression – the relation between innovation and cognitive processes reached its highest level (19.35 > 9.67 > -0.01).

Simple Slopes Analysis

Slope of Group when Conscientiousness = 61.79831 (-1 SD)

Est.	S.E.	t val.	p
-0.01	9.48	-0.00	1.00

Slope of Group when Conscientiousness = 74.00000 (Mean)

Est.	S.E.	t val.	p
9.67	6.72	1.44	0.16

Slope of Group when Conscientiousness = 86.20169 (+1 SD)

Est.	S.E.	t val.	p
19.35	9.61	2.01	0.05

Table 9 - *Interaction between cognitive processes and Conscientiousness in predicting Innovation*

Figure 10 shows graphically the slopes representing the relation between Innovation and Cognitive Processes at three different levels of each personality trait: at the mean, one standard deviation above the mean, and one standard deviation below the mean. The parallel lines for both Openness and Neuroticism show graphically the absence of a significant moderator effect. Note that when the two personality traits are above their mean levels, the Innovation level is the lowest. When, instead, Conscientiousness is at the mean or 1SD above, the Innovation levels are the highest (for Group 1, analytical decision-makers). If, on the contrary, Conscientiousness levels fall below the mean, the innovation obtained by both groups is almost the same. In sum, the moderating effect of Conscientiousness on the relation between Innovation and Cognitive Processes does not consist in an alteration of such relation (which remains positive), but in the shift of the gravity centre from the intuitive to the analytical group.

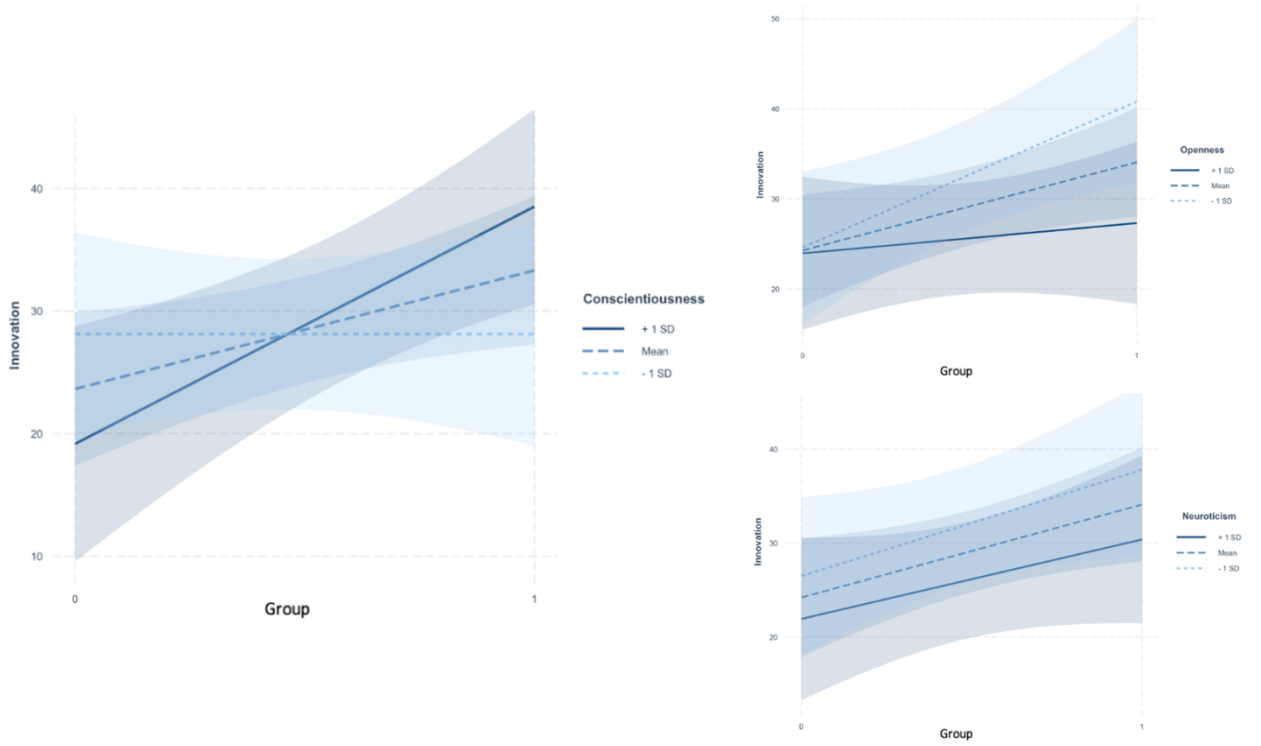


Figure 10 - *Personality traits' effect on the relation between Innovation and Cognitive processes*

The *Moderated Regression Model* adds a fourth assumption to the three of the *One-Way ANOVA* – normality, homogeneity of variance, and independence. The relationship between the predictor and the outcome must be linear (*Linearity*). Note that for linear regression, assumptions should be checked on residuals of the model.

Figure 11 summarizes the check of assumptions on residuals. Firstly, the plot of *Residuals vs Fitted* was used to check linearity. The presence of a horizontal line without distinct patterns was an indication of a linear relationship. Secondly, the *Normal Q-Q plot* showed that also the normality assumption was met since residuals' distribution followed the straight dashed line. However, the residuals deviate from the diagonal line in the upper tail meaning that tails are heavier (larger values). Finally, the last two graphs were used, respectively, to check the homogeneity of variance and to identify possible extreme values which might have influenced the results of the analysis. The *Scale-Location* plot showed a horizontal line with points equally distributed, meaning that variance was indeed homogeneous. The graph showing *Residuals vs Leverage*, instead, identified the top three most extreme points. None of these points was found outside Cook's distance lines, meaning that there are no significant influential cases.

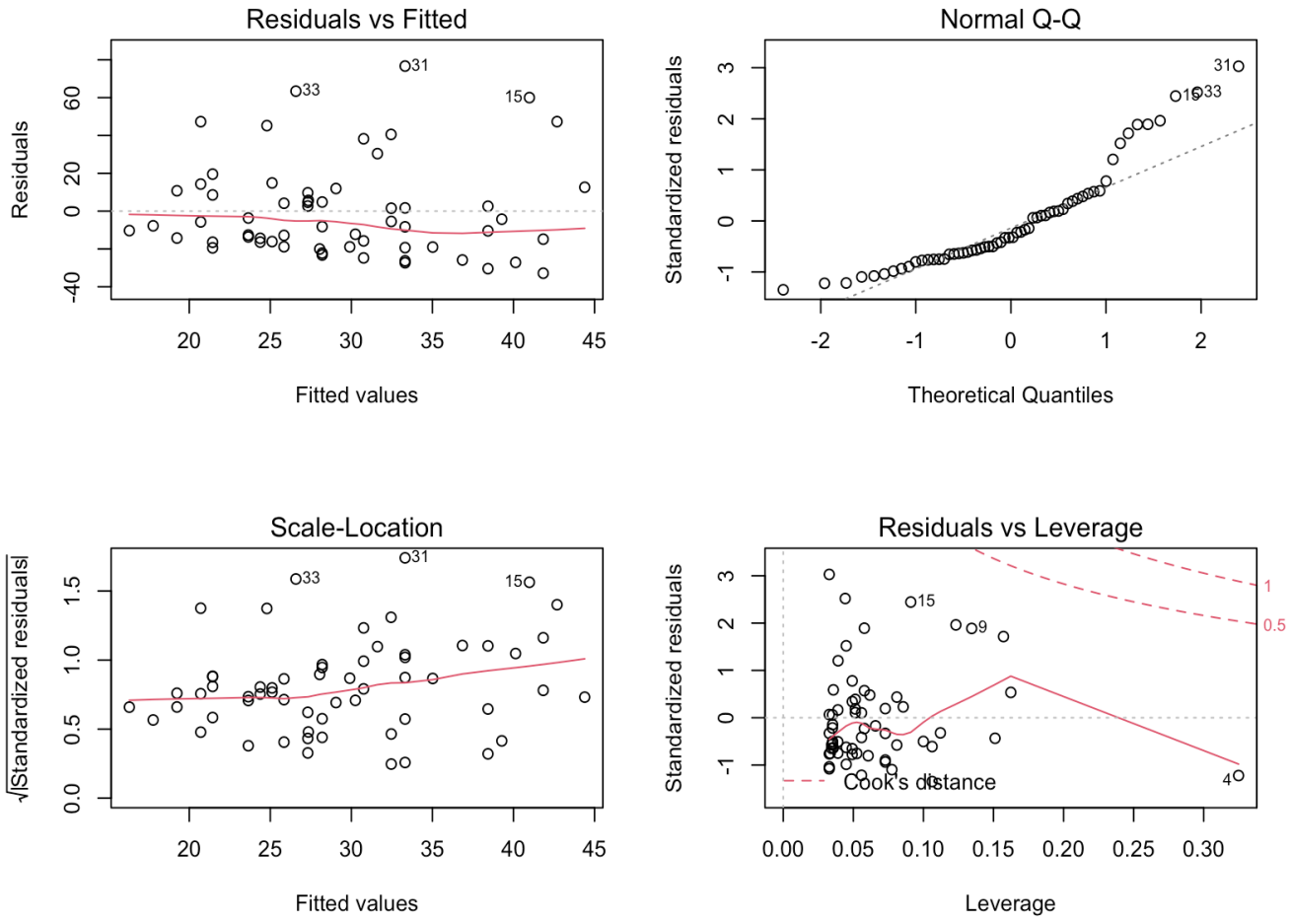


Figure 11 - *Assumptions' check for the regression model (Group*Conscientiousness)*

Hypothesis 2b assumed that Openness to Experience could have eventually modified the relation between Innovation and Experience (expressed as a result of both age and occupation), regardless of the cognitive processes used in the decision-making. Recalling the results of the *Kruskal-Wallis Test*, there were no statistically significant differences between the group of students and one of the employees, as well as among the three different age ranges. Thus, the *Moderated Regression Analysis* was applied to verify whether personality traits could have changed this result.

For what concerns Age Range, the interaction with any of the personality traits never reported a significant *p-value*, meaning that the relation between Innovation and Age is not moderated, thus neither altered, by any of the three traits belonging to the Big Five Personality Model. Even in the case of Occupation, the interaction with Conscientiousness or Neuroticism didn't reveal any statistically significant difference in the innovation levels reached by the two groups of students and employees. Neuroticism, on the other hand, reported a significant regression coefficient *estimate* (61.07) at the intercept level with a *p-value* = 0.0163 (*Appendix B*). The intercept usually describes the expected mean value of the dependent variable (Innovation) when all independent variables (Occupation and Neuroticism) are equal to zero. Given that one of the two independent variables is dichotomous, the condition that equals such variable to zero represents exactly the case in which innovation is measured for students. Given these results, it was concluded that in absence of neurotic attitudes, students can reach higher levels of innovation (Estimate = 61).

A significant regression coefficient estimate (1.00) was found for the interaction between Occupation and Openness with a *p-value* = 0.04. The *Moderated Regression Model* (*Table 10*) showed that when Occupation is equal to zero (thus participants are Students) or Openness tends to zero, the relation with Innovation is negative. However, when the two terms interact, the relation becomes positive, meaning that a moderation effect does exist.

data: Innovation by Occupation*Openness

Moderated Regression Model

Residuals:

Min	1Q	Median	3Q	Max
-32.612	-16.771	-6.571	9.612	83.101

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	83.1386	26.5004	3.137	0.00272	**
Occupation	-80.0161	39.4491	-2.028	0.04729	*
Openness	-0.6695	0.3243	-2.064	0.04364	*
Occupation:Openness	0.9892	0.4774	2.072	0.04289	*
Signif. Codes	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' ' 1

Residual standard error:	25.56 on 56 degrees of freedom
Multiple R-squared	0.08339
Adjusted R-squared	0.03428
F-statistic	1.698 on 3 and 56 DF
p-value	0.1778

Simple Slopes Analysis

Slope of Occupation when Openness = 67.29359 (-1 SD)

Est.	S.E.	t val.	p
-13.45	9.48	-1.42	0.16

Slope of Occupation when Openness = 81.30000 (Mean)

Est.	S.E.	t val.	p
0.41	6.65	0.06	0.95

Slope of Occupation when Openness = 95.30641 (+1 SD)

Est.	S.E.	t val.	p
14.26	9.38	1.52	0.13

Table 10 - *Openness' moderator effect of the relation between Innovation and Occupation*

Recalling the results of the Kruskal-Wallis Test on the relation between Innovation and Occupation, no statistically significant difference was found between the group of students and the group of employees in terms of innovation. The *Simple Slopes Analysis* confirmed that even adding an interaction with personality traits, the result didn't change. Notwithstanding, the combination of the Simple Slopes Analysis with the interaction plot results in a graphical representation of how the relation between Innovation and Occupation changes according to different levels of Openness to Experience (the trait object of hypothesis 2b). *Figure 12* represents the outcome of the combination. It becomes evident that for Openness' levels 1 standard deviation above the mean, the estimate relation between Occupation and Innovation reaches its highest level for employed decision-makers (Occupation = 1).

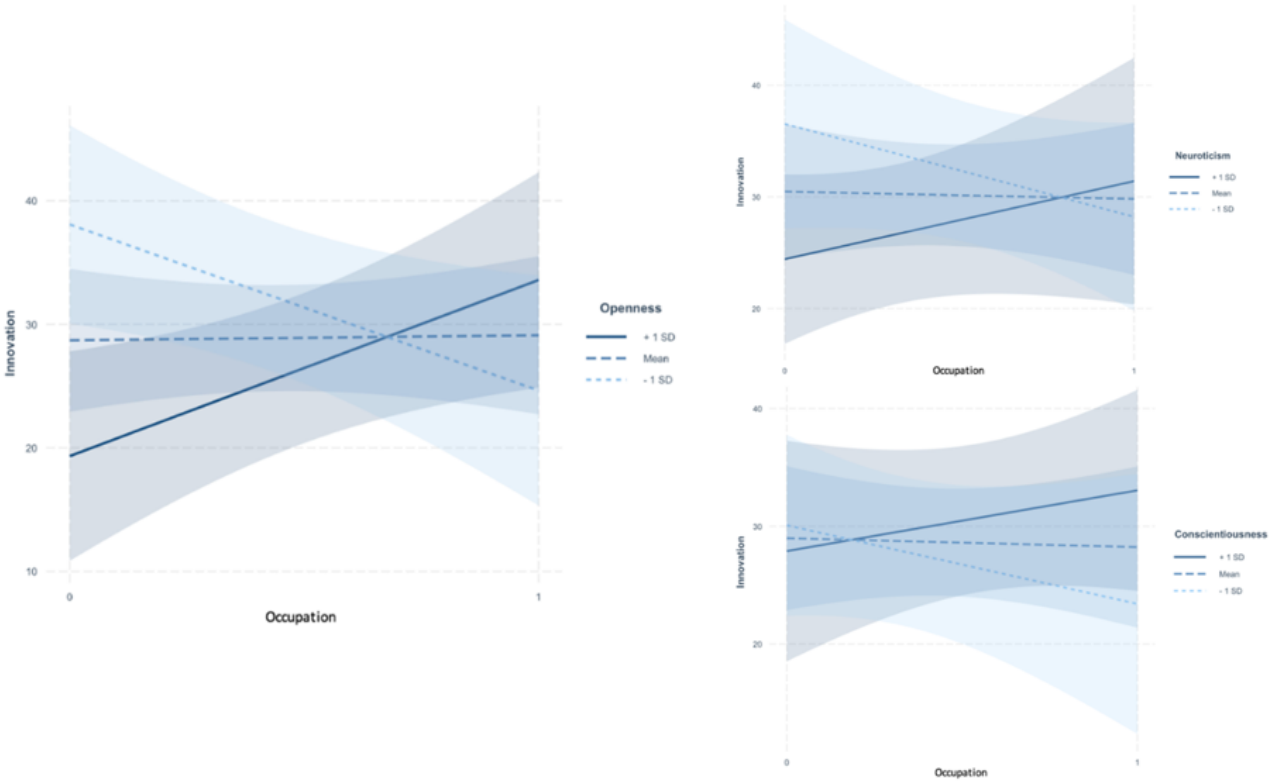


Figure 12 - *Personality traits' effect on the relation between Innovation and Occupation*

As done with the previous *Moderated Regression Model*, the analysis was concluded with a check of the assumptions on residuals. The diagnostic graphs in *Figure 13* indicate that this model only meets the assumption of normal distribution (represented in the *Normal Q-Q* plot). On the contrary, there is no linearity (*Residuals vs Fitted*), variances are not homogeneous (*Scale-Location*), and the extreme values are outside Cook's distance (*Residuals vs Leverage).*

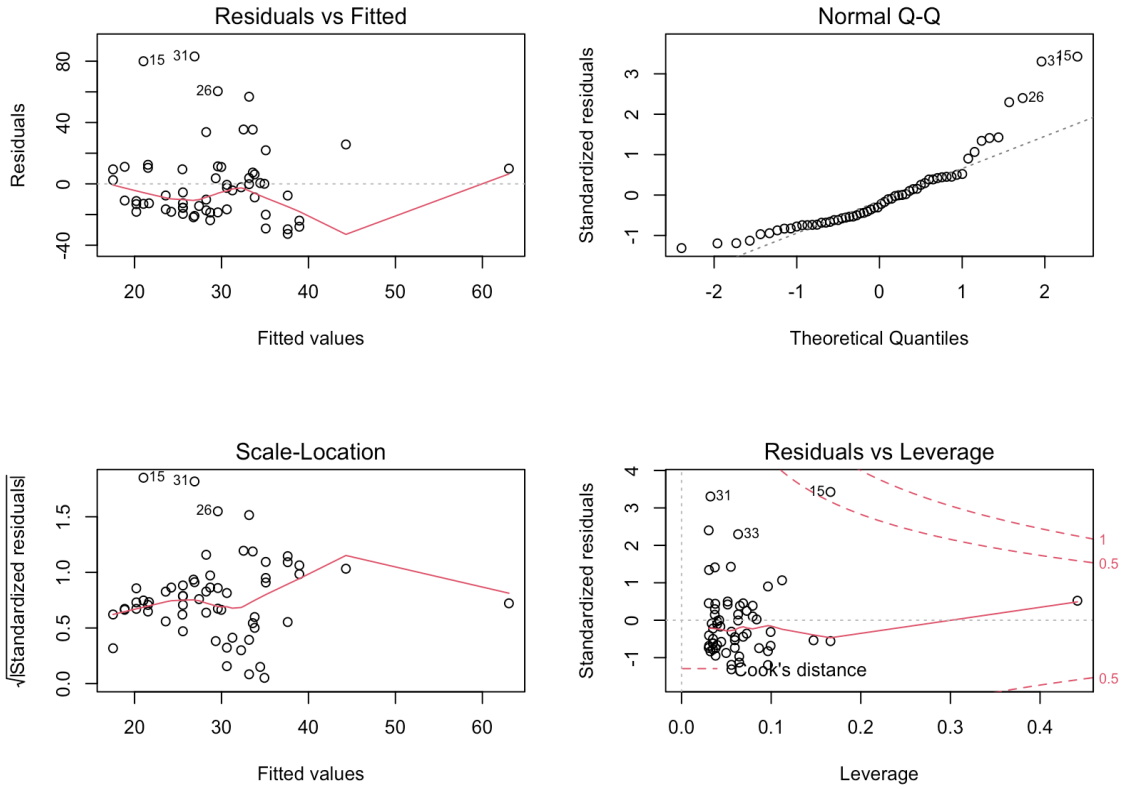


Figure 13 - *Assumptions' check for the regression model (Occupation*Openness)*

As a consequence, a logarithmic transformation of the outcome variable was applied to solve the problems of non-linearity, heteroskedasticity, and extremes outside the Cook's distance lines. The new diagnostic plots after the transformation are summarized in *Figure 14*.

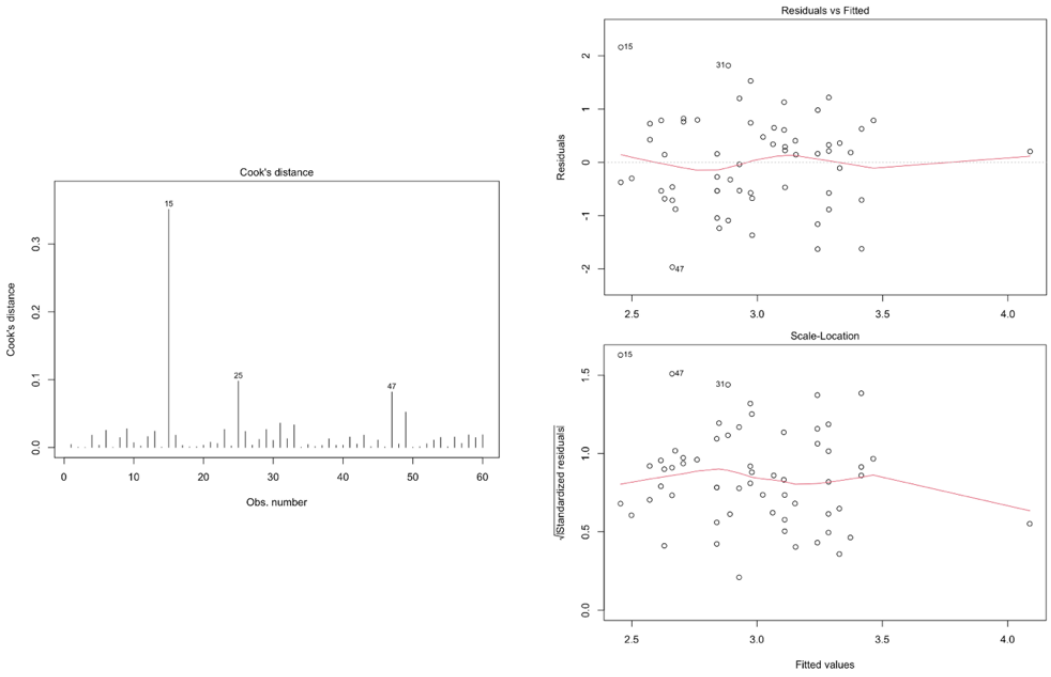


Figure 14 – *Diagnostic Plots after logarithmic transformation (Occupation*Openness)*

Figures 15 and 16 show the most significant results of the *Moderated Regression Analysis*. In particular, *Figure 15* provides a possible explanation of the result achieved in the first part of the analysis. Analytical decision-makers were more innovative than intuitive ones – could have been explained by the interaction with Conscientiousness. As Conscientiousness levels increase, the innovation achieved by the Group 1 (the analytical one) is considerably higher than Group 0 (the intuitive one). When Conscientiousness is low, instead, the opposite occurs.

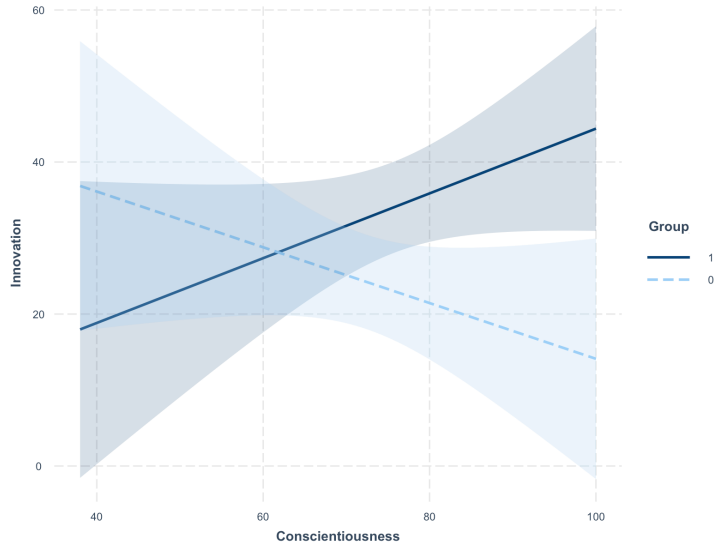


Figure 15 - *Relation between Innovation and Conscientiousness according to Group*

The same occurs with Openness in the relation between Innovation and Occupation (*Figure 16*). The presence of a more open personality overturns the result of the first part of the analysis. The level of innovation reached by students (Group 0) and employees (Group 1) is not the same. More open employees can outperform their student peers.

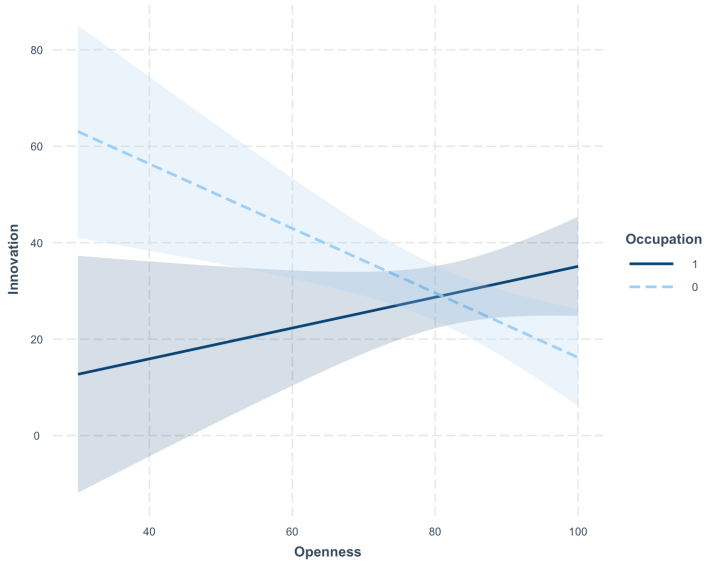


Figure 16 - *Relation between Innovation and Neuroticism according to Occupation*

4.3 Discussion

The study was designed to cover one of the themes related to Entrepreneurship Theory which didn't receive much attention from the academic world: the entrepreneurial decision-making process. The difference with non-entrepreneurial decision-making lies in the creation and identification of previously unconnected means to reach innovation. In this perspective, the entrepreneurial decision is expected to create a disequilibrium – something new and unexpected – when it is not possible to rely on well-established routine procedures. This represents the core of entrepreneurial activities in Schumpeter's view. The success of such an entrepreneurial decision rest on the nature of the individual itself, its personality, brain, and gut feeling – how it is usually recognized intuition (Grieco 2007). The current research findings identified three neural systems involved in human decision-making: head, heart, and gut. They all coexist but are differently used according to individual competencies and preferences. It is, then, not surprising to see that they are also differently used according to external conditions or habits. Different is also the degree to which individuals are aware of the different use they make of such neural systems (Soosalu, Henwood e Deo 2019).

The main intention of the analysis was to provide a comprehensive analysis on the topic discussing the role of "internal determinants" like personality traits, cognitive processes, and experience. Specifically, the first part of the analysis was aimed at finding empirical evidence about a positive relation between Intuition and Innovation (one of the most distinguishing features of entrepreneurial activity) in conditions of time pressure. Particular attention was paid also to experience. In some cases, it forces decision-makers to sacrifice exploration for the replication of well-established routines. The second part was supposed to determine whether the Big Five personality attributes – in particular, Openness to Experience, Conscientiousness, and Neuroticism – could have played a moderator role in such relations.

Initial insights on the sample's basic features obtained through frequency and descriptive statistics suggested the following. Most of the sample's participants were female students between 20 and 26 years old. When asked to brainstorm as many innovative ideas as possible to solve a business problem, those who engaged in an analytical decision-making style reached higher levels of Innovation – with respect to those who preferred to follow their intuition – in even less than the given time (10 minutes). Even if the difference was found to be not statistically significant by the *Kruskal-Wallis Test*, the experiment's results confuted the first hypothesis (H1 a) of the study which assumed a positive relation between Intuition and Innovation in lack of time. The alternative hypothesis according to which, instead, more analytical decision-makers can come up with more innovative ideas even under time pressure, proved to be true.

Hypothesis 1b, instead, assumed that experience creates an obstacle to innovation for entrepreneurs engaging in an intuitive decision-making style. By definition, intuitive thinking relies on experience which is, then, replicated in familiar situations. Inevitably, the more experience an individual accumulates, the less he/she is keen to explore new alternatives. At first glance, the *Kruskal-Wallis Test's* results confuted this hypothesis because, on average, all groups determined by age and occupation reached the same level of innovation. However, the combination with cognitive processes was needed to verify that the hypothesis was wrong. Participants aged between 20 and 26 engaging in more analytical decision-making reached higher innovation levels than intuitive ones. In the age range 27-32, the results of both the intuitive and analytical groups were the same. Finally, the group of people aged over 33 was too small to be a good representation of the entire population. For what concerns occupation, analytical students confirmed to be the most innovative, in absolute terms. However, intuitive employees were able to surpass both intuitive students and analytical employees. All in all, also hypothesis 1b proved to be wrong since experience didn't negatively affect the relation between intuition and innovation. On the contrary, more experienced participants leveraging intuition reached a good level of innovation.

These new findings demonstrated that neither cognitive processes nor demographic data, alone, were sufficient to predict how innovative entrepreneurs can be in their decision-making process. As a matter of fact, descriptive statistics didn't show particular differences in innovation levels reached by analytical vs intuitive entrepreneurs, students vs employees, or among all age ranges. On the contrary, the combination of the two already provided more significant results. Regardless, this was considered still not enough to grasp the complexity of the phenomenon under examination. That is, the study also included a second analysis on the moderator role of personality.

Hypothesis 2a assumed that three of the Big Five Personality Traits – Conscientiousness, Neuroticism, and Openness to Experience – could have influenced the relationship between intuition and innovation, both positively or negatively. More specifically, the presence of a positive effect of Openness on the relation between intuition and innovation would have helped entrepreneurs to overcome the obstacle represented by experience. According to Kahneman, one of the drawbacks of engaging in intuitive decision-making is to rely on heuristics and biases to simplify the process which could lead to systematic errors. Experience represents one of the most dangerous biases for an intuitive decision-maker that is too much confident of its intuition, perceived to be the result of well-consolidated routines already proved successful. The result is a preference for the exploitation of existing mechanisms and schemas rather than the exploration of new alternatives.

The analysis was conducted developing different *Moderated Regression Models* which included an interaction term with the different personality traits. Firstly, the focus was on the relation between Innovation and Cognitive processes (H2a). It resulted that there was no statistically significant difference in the relation when Openness, Conscientiousness, or Neuroticism were added as interaction terms. That is, the personality traits did not change the relationship that resulted between an analytical decision-making style and innovation. However, the *Simple Slopes Analysis* provided a possible explanation of this relation. It was found that as Conscientiousness' level increased – reaching one standard deviation above the mean – analytical decision-makers were more innovative than their intuitive counterparts. On the contrary, when Conscientiousness was low, there was no difference between the groups – this was the case also for the other traits. Recalling the purpose of the study, the result of this analysis proves that personality traits can be predictors of entrepreneurs' behaviours. Conscientiousness was, indeed, particularly high in the group of analytical decision-makers. A conscientious individual is very organized, committed, and self-disciplined; prefers to optimize time and avoid stress to be fully focused on what's important. Intuitively, the presence of these characteristics can predict the choice of an analytical decision-making style. Similarly, an analytical entrepreneur willing to reach the best results in terms of innovation should work on its Conscientiousness.

Even if Openness to Experience and Neuroticism didn't change the relationship between innovation and cognitive processes, the analysis demonstrated that they were able to moderate respectively the relation with Occupation and Age. To begin with, the *Moderated Regression Analysis* recorded a statistically significant difference for the interaction term Occupation*Openness to Experience. In particular, when participants were students (Group 0), the relation with Innovation was negative for each level of Openness. However, for the group of employees, it was the opposite. The relation with Innovation became positive when Occupation interacted with Openness. That is, when Openness reached one standard deviation above the mean, employees reached the highest level of innovation. This finding can be a possible explanation of the first analysis' result in which employees engaging in intuitive decision-making were more innovative than students. Even in this case the result of the regression is noteworthy. Openness to Experience showed a moderating effect on the relation between Innovation and Occupation which, in the previous analysis, was more inclined towards analytical students. This suggests that, regardless of the obstacle that their experience may represent, more open-minded employees, with their intuition, can outperform calculator students.

Finally, the Moderated Regression Analysis found a statistically significant difference in the intercept of the relation between innovation and the interacting term Age Range*Neuroticism. The intercept usually shows the level of the outcome variable (Innovation) when all the other variables equal zero. In our analysis, this finding suggests that for younger participants, Neuroticism is an obstacle to innovation. Low Neuroticism is usually associated with *overconfidence* and *overoptimism*. These two facets of personality aren't always negative for innovative entrepreneurs. More likely, they again reflect the dichotomy between *exploration* and *exploitation*. Entrepreneurs are more inclined to exploration when they overestimate their chances for success. This occurs because, having more trust in their abilities, they also accept to take on more risks without fearing possible failures. This behaviour is particularly evident in young individuals who have great ambition but little experience in the field – which could lead them to fear risk if in the past it has not led to success. At the same, too much overconfidence leads individuals to overestimate the precision of the information at their disposal. As a consequence, if the information is highly valued, entrepreneurs may prefer to exploit what is currently available rather than exploring something new and unknown. This is very common in well-established companies which prefer to rely on routines because they already proved to be efficient and effective. Recent studies demonstrated, indeed, that there is a positive link between innovative activities and overoptimism, but a negative link with the so-called *judgmental overconfidence* (Herz, Schunk e Zehnder 2014). The choice between overoptimism or overconfidence depends on the individual, the experience accumulated as well as individual attitudes. Experience, cognitive processes, and personality are again involved together in individuals' decisions.

This was the most important result of this study. It changed the previous understanding of the entrepreneurial phenomenon because it demonstrated that these elements do not act independently but are rather intertwined in the decision-making process. The outcome of the analysis demonstrated that probably it was too obvious to assume a relation between intuition and innovation because creativity is commonly related to both or because, in lack of time, more deliberate decision-making can't be easily applied. The research, instead, proved that reality is not as simple as that. Many factors are involved in the relationship and this changes depending on the individuals considered.

Firstly, more conscientious people proved to be more innovative when choosing an analytical decision-making style. Since conscientious people master self-regulation and impulse control, more deliberate thinking is usually associated with this personality trait. Conscientious people do not postpone decisions but are rather proactive. Their decisions are less impulsive, resulting from precise work of planning, setting timelines, and paying particular attention to details. Conscientiousness is also often associated with success.

Self-disciplined entrepreneurs and individuals, in general, will always work diligently toward achieving their goals. Not even failure or absence of time create an obstacle to the execution of their task. The study expected to see people engaging in the fastest thinking to develop as many innovative ideas as possible in the given time (H1a). However, considering the main characteristics of a conscientious person, it is not surprising to see that a higher percentage of conscientious entrepreneurs was present in the analytical group of participants (H2a).

In the same way, it was assumed that experience (in the form of age and employment status) would have negatively influenced the relation between intuition and innovation leading entrepreneurs to sacrifice exploitation (H1b). The theory usually associates negative innovative outcomes to intuitive decisions because when individuals trust too much their intuition they think less at the future rewards, the risk of failing and the changing environment. In the end, this also depended on the personality of entrepreneurs. Regardless of their experience, when employees are more opened, intuition still brings more innovative results (H2b). Openness to Experience can be the key to promote exploration, consequently facilitating the entrepreneurs' job (Simon e Houghton 2002). Probably, if employees stop relying too much on well-established routines and open themselves more to change, the combination between intuition and experience can lead to even more innovative results.

In sum, the research advanced previous knowledge by stating that the relation between intuition and innovation can't be established *a priori*. It varies significantly according to individual features, preferences, and experience. The new findings of this study should have made entrepreneurs more aware of their cognitive and judgemental biases, together with their individual preferences. Some humans are more sensitive to their gut feelings, while some others leave to their head the hard task of consciously and deliberately make the right decision. Still others may have realized that it is difficult to separate the two systems when making decisions. In sum, entrepreneurs should have understood that the combination between analytical decision-making and a conscientious personality allows them to perform better their innovative tasks. The analytical decision-making allows them to reach a more deliberate decision after having balanced costs and benefits. However, it is the laziest side of our brain. Thus, it needs a very strong conscientious personality to be adequately motivated to operate by precision and hard-working. Similarly, students and organizations should be aware of the limits that Neuroticism and a closed working environment bring to their respective innovative activities. Openness to Experience allows employees to overcome represented by experience in their intuitive decision-making to reach more innovative results. Neuroticism, instead, helps young students to have more confidence in their abilities and, consequently, to accept the risks associated with an innovative decision.

5. CONCLUSIONS

5.1 Summary

The study suggests that a relation between cognitive processes and innovation exists and is influenced by personality traits. To achieve higher levels of Innovation, entrepreneurs have to be more aware of the mental processes they apply when making decisions on innovative opportunities. In the same way, they must understand which personality traits to improve and which to keep stable. Even the modern literature can't develop a consistent theory explaining the phenomenon of entrepreneurship if it does not consider personality traits and cognitive processes.

The research has been motivated by the double need to follow the new academic interest aroused around the phenomenon of entrepreneurship for its socio-economic value and, consequently, to contribute to filling the gaps left in the reference literature. To do so, the study was intended to explore the relationship existing between intuition and innovation (considering time pressure and experience) and assess whether personality traits influence it. The analysis has been divided into two parts. Firstly, the *One-Way ANOVA* (or the non-parametric alternative *Kruskal-Wallis Test*) was applied to examine possible mean differences existing between the groups of participants determined by cognitive processes, occupation, and age range. The *Moderated Regression Analysis*, instead, added an interaction term to verify if it explained or modified the relations estimated in the first analysis.

In absence of a generally accepted definition, the research was based on Schumpeter's view of the entrepreneur as a *creative destroyer*. Specifically, while traditionally the literature studied entrepreneurship as the activity of creating a new business quickly able to grow, this study focused more on the entrepreneurial task of capturing unforeseen and significant opportunities. The introduction of novelty following the entrepreneurial activity is beneficial for the entire society and helps the economic system to grow (Schumpeter 1936). Creativity is at the core of this process. Since new technologies represent a risk for human jobs, different theories for creativity enhancement have been discussed (Schwartz 1990). Some studies attributed to the so-called "*gut feeling*" an important role in decision-making. Indeed, more recent studies focus on understanding *System 1* – the faster, autonomous, and unconscious response – and how it can influence entrepreneurs in the judgment process (Brown, Packard e Bylund 2018). When referring to personality, this research refers to the personality traits modelled by the Five-Factor Theory. Most studies have tested whether the study of personality traits may help to predict who is more likely to become an entrepreneur (Gartner 1988). While it might be true that some characteristics mark out the entrepreneur's uniqueness compared to non-entrepreneurs, this view can be too simplistic.

The first hypothesis assumed that a meaningful connection did exist between intuition and innovation, but it was positive or negative according to the situation. Adding a temporal dimension helped to reveal the cause-effect relation between intuition and innovation. The intuitive mode can help entrepreneurs to gather effortlessly a large amount of information and re-elaborate them through pattern recognition, all in a very short amount of time. Experience also plays a role. Learned routines and past experiences are progressively stored in memory (Simon e Houghton 2002) and, when proved successful, automatically recalled by the human brain. The associative machine works well in both familiar and uncertain situations. In sum, given that Entrepreneurs deal mostly with the unknown and uncertain (H. Simon 1987), mastering intuition may help them to make a rapid decision before the window of opportunities disappears. On the other hand, relying too much on past experiences may force them to sacrifice exploration in favour of exploitation.

This mode is extremely efficient, but sometimes it fails to expand the individual's understanding of a given situation and rather reinforces existing knowledge. The intuitive decision-making style is characterized by a tendency to rely on premonitions and feelings rather than on a systematic search for information (Bayram e Aydemir 2017). It is the more controlled and calculator mode that should intervene at this point, but it is very demanding. This can be one reason why the present research found analytical decision-makers to be more innovative than intuitive ones when individuals present higher levels of Conscientiousness, the personality trait usually associated with hard-working, precision, and self-discipline. This conclusion suggests that, even if analysis and not intuition resulted to be positively related to innovation, probably the explanation must be found in the role played by personality.

The second hypothesis, indeed, was formulated to investigate whether personality traits play a moderator role in the relation between intuition and innovation. As proof that personality deserves further investigation given its ability to influence entrepreneurs' behaviour, consider, for example, the analysis carried out on innovation as a function of Occupation. The analysis of variance didn't report any statistically significant difference in Innovation between students and employees. However, the moderated regression analysis demonstrated that more open employees are more innovative than the students' counterparts.

In sum, underestimation of the personality traits' role and imperfect knowledge of entrepreneurs' mental processes were the main gaps left in the literature. The exchange between different disciplines was particularly valuable to fill them by identifying the differences existing within the group of entrepreneurs and explaining their innovative decisions. This study opened the black box existing between the personal dimension of entrepreneurship and its outcomes providing a fresh outlook on the literature.

5.2 Implications and Contribution to knowledge

In formulating the study's research questions, it was assumed that a strong relationship between intuition and innovation did exist. Usually, the fast and sharp intuitive decision-makers are more likely to understand ambiguous circumstances and make breakthrough discoveries – through a divergent process – which are later tested and sorted through a rational convergent process (Hogarth 2001). Regardless, the findings suggested that the opposite is true. Even in situations of time pressure, individuals struggle to rule out analytical reasoning. More interestingly, students with less experience resulted to be more innovative when engaging in analytical decision-making. On the opposite, intuition was rather prominent for employed participants struggling to reach higher levels of innovation. This finding suggested that experience was not an obstacle to innovation, but rather a discriminant to choose the cognitive process applied in the innovative decision-making.

The basic assumption underneath the second hypothesis proved to be true. Personality traits are, indeed, involved in the decision-making process leading to innovation. Conscientiousness gave the impression of being responsible for the denial of hypothesis 1a because it demonstrated to play a strengthening role in the relation between Analysis and Innovation. In the same way, Openness to Experience did play a role because it allowed employees to be more innovative than students. When data were analysed without the interaction with personality traits, there was, instead, no difference between students and employees.

These findings confirmed that Entrepreneurship Theory, alone, is not sufficient to depict a more comprehensive picture of such a complex phenomenon. Entrepreneurship and Innovation are closely intertwined but their relationship does not preclude the presence of other factors – both internal and external to the individuals' dimension – that can influence it. The combination with Cognitive Theory turned out to be particularly efficient in showing which are the mental processes applied by entrepreneurs when facing an opportunity for innovation and how decision-makers engage in one or the other according to the circumstances. The Psychological Theory, instead, was useful to investigate the more intimate dimension of entrepreneurship, that of entrepreneurs' personality. The present study contributes to the new stream of research demonstrating that differences within the same group of entrepreneurs do exist and affect their behaviours. Being more hard-working, goal-oriented, and organized helps entrepreneurs to avoid the biases of intuitive decision-making and to concentrate all strengths on more deliberate and objective reasoning. On the other hand, experienced decision-makers can be more prone to trust their intuition because they feel it is fuelled by their know-how. All things considered, the study demonstrated that, by combining theories outside the scope of entrepreneurship, researchers can enrich the new-born entrepreneurial literature.

In addition, this study contributes to the other works of literature that informed the study's theorizing. *Cognitive Theory* relies on Kahneman's study on how cognitive processes coexist and collaborate in decision-making. According to Kahneman, intuition is the fastest mental process, that decision-makers unconsciously use to elaborate innovative solutions to unforeseen problems. System 2 represents the laziest cognitive process, too demanding to be applied when time is lacking. However, it also allows thinking about future rewards, balancing costs and benefits, and evaluating risks and opportunities. These are all fundamental features for an entrepreneur. Differently from all other individuals, entrepreneurs refuse to risk systematic errors and are rather inclined to put more effort into gathering information for data-driven decisions, unless they are very confident of the knowledge and experience accumulated. These new results suggest that the generalization carried out by Cognitive Theory is not always valid regardless of the cluster of individuals or circumstances. The research also expands the scope of the behavioural approach in the *Psychological Theory*. Every individual owns a continuum of personality traits and each of them may influence differently the result of entrepreneurial activities. The integration with Entrepreneurship Theory was aimed at providing valuable insights for psychological research related to how to cope with uncertainty or time pressure, or current trends in the working environment to foster creativity and innovation.

With this new understanding of entrepreneurs' judgmental processes, and the personality traits influencing their behaviour, the study's findings represent a powerful tool for improving entrepreneurial decision-making. Practically, entrepreneurs are now aware of what should be done to be innovative – where to put more effort, which personality trait to nurture and which to keep stable. Considering that entrepreneurs' activities are also an exemplification of the current trends in the world of work, organizations should have acquired new evidence of the fact that an open and tolerant (to change) working environment may facilitate the creative process of their intuitive employees. In the same way, students and educators could grasp new insights on the skills that need to be developed to be more innovative as well as the traits of the personality that need to be educated. In particular, this study stressed the need to be more organized, precise, self-disciplined, and emotionally stable, especially at a young age. This, combined with the younger generation willing to make an impact, can lead to a greater advance for the entire society. Nowadays it is already evident that the world is moving towards more data-driven decisions. Great amounts of data are almost freely available (Big Data), and they already proved to be efficient for marketing automation, replacing repetitive works, healthcare, managing traffic, etc., just to name a few. Moreover, new jobs have been created to respond to the need of analysing and fully exploiting such data. Analytical decision-making integrated with a conscientious personality and an open working or studying environment may allow new generations of entrepreneurs to be more innovative.

5.3 Limits and Further research

Diagnostic functions and plots were used to check the *One-Way ANOVA's* and *Linearity Regression's* assumptions of Independence, Normality, Homogeneity, and Linearity (added only for the second part of the analysis) to demonstrate the validity of the results. Regardless, the study presents some limitations, both in the design and results, that deserve further attention.

Starting from the design of the experiment, as already highlighted, one limitation regards the measure of Innovation. The choice of such measure was limited by the design of the experiment and the need to keep it short to avoid non-response biases. Other measures of Innovation can be applied to a new study taking into consideration also the quality of ideas to assess which factors can lead entrepreneurs not only to more innovation but to innovative success.

Another limitation to the research has been the absence of a control group which could have also enriched the analysis showing what happens when individuals are left free to select the decision-making style. For this reason, a third (random) group shouldn't have been influenced to think analytically or intuitively. The choice not to include a control group was suggested by some theoretical findings according to which people are not well-aware of their cognitive processes. Relying on a self-assessment would have eventually altered the results of the research. The same can be said for the assessment of the Big Five Personality Traits which is highly subjective. Individuals do not usually have direct knowledge of their thoughts, feelings, and desires. They discover about them through actions and experience. On the contrary, those who seem to have such knowledge often do not share it with external observers. They choose what to show and what not, thinking about what the "stranger" should know about them and what not (Costa e McCrae 1999).

The survey included one last question for participants regarding the mental processes they thought they have applied while experimenting. Some participants affirmed that they "*couldn't remember the cognitive process used given the lack of time, but they were quite sure to have used intuition*". Others, instead, admitted having been "*influenced by the historical data showed in the question text for gathering a clearer picture of the actual situation and to have applied intuition only later to develop innovative ideas*". Finally, some participants explicitly reported having "*drew on their personal experience of study or work*". These answers confirmed that *Systems 1 and 2* are not independent. In reality, it can be difficult to find entrepreneurs who rely exclusively on intuition or exclusively on analysis. Analysis somehow always precedes intuition. Previous analytical processes are stored in memory and replicated by intuition in similar situations. Moreover, it is difficult for *System 1* to perform effectively under uncertainty, thus *System 2* must intervene. This is a further limitation of the study which strove to analyse the two mental processes separately.

Finally, being students between 20 and 26 years old most of the sample population, the final result is more likely to be representative of this group rather than the others. Indeed, analytical students proved to be more innovative, but other findings suggested that also intuitive workers are no less. To generalize such results, additional investigation is needed with samples from diverse populations to determine if the opposite of these findings is true. Future research can focus on the relation between Innovation and Cognitive Processes using Experience (external to the individual dimension) as a possible moderator variable. Experience fuels intuition, which is associated with creativity and, consequently, with Innovation. But it can also create biases that do not allow entrepreneurs to experiment and discover new ways of doing better what is now part of their routine.

Moreover, Organizations are usually characterized by more deliberate decision-making. Thus, if it is true that more intuitive employees are also more innovative, the design of the workplace should be adapted to foster individuals' creativity. When the environment provides scarce inputs, too demanding challenges, or no challenges at all, bad intuition can bring to poor outcomes (Hogarth 2001). The presence of rigid positions and resistance to change are symptoms of a wicked environment. On the contrary, as demonstrated also by the present study, when the environment welcomes innovation and promotes openness, individuals feel safer in discussing new ideas and experimenting with those that seem to be successful. More open employees are also more innovative. Can the working environment lay the foundations for this condition to be realized?

Given that mostly the results of this study refer to students, another stream of future research can focus on the methodologies used by universities to enhance students' innovative capabilities. Can a different background influence the degree of innovativeness students can achieve? Which are the skills related to the intuition that allows employees to be more innovative? Can they be thought? More interestingly, can innovation be thought, nurtured, and educated? On one hand, it can be obvious that as knowledge grows through study and practical experience also the range of stored memories augment. That is, the possibilities to come up with more innovative ideas connecting remote concepts are higher. On the other hand, students can have a personal attitude towards innovation that, despite having the tools at their disposal, does not allow them to achieve the desired innovative outcome. The present study already demonstrated that personality traits can somehow influence the level of innovation achieved. In some cases, it is likely that focusing on eliminating the inhibitory traits of personality leads to achieving better results than working merely on creativity.

6. BIBLIOGRAPHY

Alin, Aylin, and S. Kurt. 2006. "Testing non-additivity (interaction) in two-way ANOVA tables with no replication." *Statistical Methods in Medical Research* 15: 63-85.

Amabile, Teresa M., Jennifer S. Mueller, William B. Simpson, Constance N. Hadley, Steven J. Kramer, and Lee Fleming. 2002. "Time Pressure and Creativity in Organizations: A Longitudinal Field Study." *Harvard Business School Division of Research* 1-27.

Autio, Erkko, Martin Kenney, Philippe Mustar, Don Siegel, and Mike Wright. 2014. "Entrepreneurial innovation: The importance of context." *Research Policy* 43: 1097-1108.

Baregheh, Anahita, Jennifer Rowley, and Sally Sambrook. 2009. "Towards a multidisciplinary definition of innovation." *Management Decision* (Emerald Group Publishing Limited) 47 (8): 1323-1339.

Barnes, James H. Jr. 1984. "Cognitive Biases and Their Impact on Strategic Planning." *Strategic Management Journal* 5 (2): 129-137.

Baron, Robert A. 2006. "Opportunity recognition as pattern recognition: How entrepreneurs «connect the dots» to identify new business opportunities." *Academy of Management Perspectives* 20: 104-119.

Baumol, William J. 1993. "Formal entrepreneurship theory in econom- ics: Existence and bounds. J." *Journal of Business Venturing* 8: 197-210.

Bayram, Nuran, and Mine Aydemir. 2017. "Decision-Making Styles and Personality Traits." *International Journal of Recent Advances in Organizational Behaviour and Decision Sciences (IJRAOB)* 3 (1): 905-915.

Brown, Lincoln, Mark Packard, and Per Bylund. 2018. "Judgment, fast and slow: Toward a judgment view of entrepreneurs' impulsivity." *Journal of Business Venturing Insights* .

Bull, Ivan, and Gary E. Willard. 1993. "Towards a Theory of Entrepreneurship." *Journal of Business Venturing* (Elsevier Science Publishing Co. Inc.) 8: 183-195.

Busenitz, Lowell W. , and Jay B. Barney . 1997. "Differences between entrepreneurs and managers in large organizations: biases and heuristics in strategic decision-making." *Journal of Business Venturing* 12: 9-30.

Busenitz, Lowell W., Page G. West, Dean Shepherd, Teresa Nelson, Gaylen N. Chandler, and Andrew Zacharakis. 2003. "Entrepreneurship research in emergence: Past trends and future directions." *Journal of Management* 29 (3): 285-308.

Caprara, Gian Vittorio, and Daniel Cervone. 2000. *Personality: Determinants, dynamics, and potentials.* New York: Cambridge University Press.

Chen, James. 2021. *Investopedia.* 31 March. Accessed August 31, 2021. https://www.investopedia.com/terms/n/normaldistribution.asp.

Christensen, Ronald. 2020. *Plane Answers to Complex Questions.* Fifth Edition. Springer.

Ciavarella, Mark A., Ann K. Buchholtz, Christine M. Riordan, Robert D. Gatewood, and Garnett S. Stokes. 2004. "The Big Five and venture survival: Is there a linkage?" *Journal of Business Venturing* 19: 465-483.

Costa, Paul T., Jr, and Robert R. McCrae. 1999. "Chapter 5 - A Five-Factor Theory of Personality." In *Handbook of personality: Theory and research (2nd ed.)*, by L. A. Pervin and O. P. John, 139-153. New York: Guilford.

Costa, Paul T., Jr, and Robert R. McCrae. 2008. "Chapter 6 - The NEO Inventories." In *Personality Assessment*, by Robert P. Archer and Steven R. Smith, 223-256. New York: Routledge.

Costa, Paul T., Jr, and Robert R. McCrae. 2012. "The Five-Factor Model, Five-Factor Theory, and Interpersonal Psychology." *National Institute on Aging, NIH, DHHS* 2-25.

Croitoru, Alin. 2012. "A review to a book that is 100 years old." *Journal of Comparative Research in Anthropology and Sociology* 3 (2): 137-148.

de Jong, Jeroen, and Deanne den Hartog. 2010. "Measuring Innovative Work Behaviour." *Creativity and Innovation Management* 19 (1): 23-36.

Detrick, Paul. 2020. "NEO Personality Inventory-Revised (NEO PI-R)." *Post.ca.gov.* Accessed Agosto 04, 2021. https://post.ca.gov/portals/0/post_docs/publications/psychological-screening-manual/NEO_PI-R.pdf.

Dinno, Alexis. 2015. "Nonparametric pairwise multiple comparisons in independent groups using Dunn's test." *The Stata Journal* 15 (1): 292-300.

Gabrielsson, Peter, and Mika Gabrielsson. 2013. "A dynamic model of growth phases and survival in internationalbusiness-to-businessnew ventures: The moderating effect ofdecision-making logic." *Industrial Marketing Management* (ScienceDirect) 42: 1357-1373.

Gartner, William B. 1988. "Who Is an Entrepreneur? Is the Wrong Question." *Entrepreneurship Theory and Practice* (Wiley) 12 (4): 11-32.

Gemmell, Robert M., Richard J. Boland, and David A. Kolb. 2012. "The Socio-Cognitive Dynamics of Entrepreneurial Ideation." *Entrepreneurship Theory and Practice* 1053-1073.

Gorgievski, Marian J., and Ute Stephan. 2016. "Advancing the Psychology of Entrepreneurship: A Review of the Psychological Literature and an Introduction." *International Association of Applied Psychology* 65 (3): 437-468.

Grieco, Daniela. 2007. "The entrepreneurial decision: theories, determinants and constraints." *Liuc Papers* (207): 1-28.

Helm, Roland, and Antje Mark. 2012. “Analysis and evaluation of moderator effects in regression models: state of art, alternatives and empirical example.” *Review of Managerial Science* 6 (4): 307 - 332.

Herz, Holger, Daniel Schunk, and Christian Zehnder. 2014. “How do judgmental overconfidence and overoptimism shape innovative activity?” *Games and Economic Behavior* 83: 1-23.

Hisrich, Robert D., Janice Langan-Fox, and Sharon Grant. 2007. “Entrepreneurship Research and Practice: A Call to Action for Psychology.” *American Psychologist* 62 (6): 575-589.

Hogarth, Robin M. 2001. *Educating intuition.* Chicago: University of Chicago Press.

Ireland, Duane R., Michael A. Hitt, and David G. Sirmon. 2003. “A Model of Strategic Entrepreneurship: The Construct and its Dimensions.” *Journal of Management* 29 (6): 963-989.

Jarrett, Christian. 2016. *BBC Future.* 12 October. Accessed August 31, 2021. https://www.bbc.com/future/article/20161011-do-men-and-women-really-have-different-personalities.

Johnson, David. 2001. “What is innovation and entrepreneurship? Lessons for larger organisations.” *Industrial and Commercial Training* 33 (4): 135-140.

Jones, Paul W. 2014. “Enhancing a Short Measure of Big Five Personality Traits With Bayesian Scaling.” *Educational and Psychological Measurement* 74 (6): 1049-1066.

Judge, Timothy A., Jessica B. Rodell, Ryan L. Klinger, Lauren S. Simon, and Eean R. Crawford. 2013. “Hierarchical Representations of the Five-Factor Model of Personality in Predicting Job Performance: Integrating Three Organizing Frameworks With Two Theoretical Perspectives.” *Journal of Applied Psychology* 98 (6): 875-925.

Kahneman, Daniel. 2011. *Thinking, Fast and Slow.* New York: Farrar, Straus and Giroux.

Kaplan, Soren. 2014. “How to measure Innovation (to get real results).” *Fast Company.* 16 06. Accessed 08 28, 2021. https://www.fastcompany.com/3031788/how-to-measure-innovation-to-get-real-results.

Kenton, Will. 2021. *Investopedia.* 25 January. Accessed August 31, 2021. https://www.investopedia.com/terms/h/homoskedastic.asp.

Klotz, Anthony C., and Donald O. Neubaum. 2016. “Research on the Dark Side of Personality Traits in Entrepreneurship: Observations from an Organizational Behavior Perspective.” *Entrepreneurship Theory and Practice* 7-17.

Kuratko, Donald F. 2003. “Entrepreneurship education: Emerging trends and challenges for the 21st century.” *Coleman Foundation White Paper Series.*

Legge, John, and Kevin Hindle. 1997. *Entrepreneurship: How Innovators Create the Future.* Melbourne: Macmillan Publishers.

Leonelli, Simona, Federica Ceci, and Francesca Masciarelli. 2016. "The importance of entrepreneurs' traits in explaining start-ups' innovativeness." *Sinergie - Italian Journal of management* 34 (101): 71-85.

Lévesque, Moren, and Ute Stephan. 2020. "It's Time We Talk About Time in Entrepreneurship." *Entrepreneurship Theory and Practice* 44 (2): 163-184.

McCrae, Robert R., and Paul T. Jr. Costa. 1990. *Personality in Audulthood: A Five-Factor Theory Perspective.* New York: Guilford Press.

Mitchell, Ronald K., Lowell Bousenitz, Theresa Lant, Patricia P. McDougall, Eric A. Morse, and J. Brock Smith. 2002. "Toward a Theory of Entrepreneurial Cognition: Rethinking the People Side of Entrepreneurship Research." *Entrepreneurship Theory and Practice* 27 (2): 93-104.

Officer, Donald R. 2005. "The Unexplored Relationship between Intuition and Innovation." *The Innovation Journal: The Public Sector Innovation Journal* 10 (3): 2-11.

Quirk, Thomas J., and Julie Palmer-Schuyler. 2020. *Excel 2019 for Human Resource Management Statistics.* Second Edition. Springer.

Rauch, Andreas, and Michael Frese. 2007. "Let's put the person back into entrepreneurship research: A meta-analysis of the relationship between business owners' personality characteristics and business creation and success." *European Journal of Work and Organizational Psychology* 16 (4): 353-385.

Riaz Naveed, Muhammad, Muhammad Riaz Akram, and Naila Batool. 2012. "Personality Types as Predictors of Decision Making Styles." *Journal of Behavioural Sciences* 22 (2).

Sánchez, José C. 2011. "Entrepreneurship as a legitimate field of knowledge." *Psicothema* 23 (3): 427-432.

Schumpeter, Joseph A. 1936. *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle.* Cambridge: Harvard University press.

Schwartz, Stephan A. 1990. "Creativity, Intuition, and Innovation." *Subtle Energies* 1 (2): i - x.

Shane, Scott, and Nicos Nicolaou. 2015. "Creative personality, opportunity recognition and the tendency to start businesses: A study of their genetic predispositions." *Journal of Business Venturing* 30: 407-419.

Shane, Scott, and S. Venkataraman. 2000. "The Promise of Entrepreneurship as a Field of Research." *The Academy of Management Review* 25 (1): 217-26.

Simon, Herbert A. 1987. "Making Management Decisions: the Role of Intuition and Emotion." *The Academy of Management Executive* 1 (1): 57-64.

Simon, Mark, and Susan M. Houghton. 2002. “The Relationship Among Biases, Misperceptions, and the Introduction of Pioneering Products: Examining Differences in Venture Decision Contexts.” *Entrepreneurship Theory and Practice* 105-124.

Sleep, Chelsea E., Donald R. Lynam, and Joshua D. Miller. 2021. “A Comparison of the Validity of Very Brief Measures of the Big Five/Five-Factor Model of Personality.” *Assessment* 28 (3): 739-758.

Soosalu, Grant, Suzanne Henwood, and Arun Deo. 2019. “Head, Heart, and Gut in Decision Making: Development of a Multiple Brain Preference Questionnaire.” *SAGE Open* 1-17.

STHDA. n.d. *Statistical tools for high-throughput data anlysis.* Accessed August 31, 2021. http://www.sthda.com/english/.

Taura, Toshiharu, and Yukari Nagai. 2017. “Creativity in Innovation Design: the roles of intuition, synthesis, and hypothesis.” *International Journal of Design Creativity and Innovation* 5 (3-4): 131-148.

Tversky, Amos, and Daniel Kahneman. 1974. “Judgment under Uncertainty: Heuristics and Biases.” *Science* 185 (4157): 1124-1131.

Vargha, András, and Harold D. Delaney. 1998. “The Kruskal-Wallis Test and Stochastic Homogeneity.” *Journal of Educational and Behavioral Statistics* 23 (2): 170-192.

Vazire, Simine. 2014. *PERSONALITY: A Six-Day Unit Lesson Plan for High School Psychology Teachers.* American Psychological Association, Teachers of Psychology in Secondary Schools (TOPSS) .

Wood, Matthew S., Alexander McKelvie, and Michael J. Hayne. 2014. “Making it personal: Opportunity individuation and the shaping of opportunity beliefs.” *Journal of Business Venturing* 29: 252-272.

Wu, J., and S. Shang. 2020. “Managing Uncertainty in AI-Enabled Decision Making and Achieving Sustainability.” *Sustainability* 12 (21): 8758.

Zacharakis, Andrew L., and Dale G. Meyer. 1998. “A lack of insight: do venture capitalists really understand their own decision process?” *Journal of Business Venturing* 13: 57-76.

Zhang, Zhiyong, and Lijuan Wang. 2020. *Advanced Statistics using R.* Accessed August 31, 2021. https://advstats.psychstat.org/book/moderation/index.php.

Zhao, Fang. 2005. “Exploring the synergy between entrepreneurship and innovation.” *International Journal of Entrepreneurial Behaviour & Research* 11 (1): 25-41.

Zhao, Hao, and Scott E. Seibert. 2006. “The Big Five Personality Dimensions and Entrepreneurial Status: A Meta-Analytical Review.” *Journal of Applied Psychology* 91 (2): 259-271.

7. APPENDIX A

Section A: General Instructions

You are about to participate in a decision-making game as an hotel owner struggling to keep its business alive.

The experiment is designed in a way that the anonymity of all the participants is protected.

A1.

A2. **The experiment consists of 2 phases:**

1) First, before to make any decision, you will respond to a short survey about your personality.

2) Second, you will start the proper experiment as the owner of Hotel Tonight. You should develop as many innovative ideas as possible and decide which one to present to shareholders to save your business.

Please bear in mind that people engaging in an INTUITIVE DECISION-MAKING STYLE have the highest probability to develop and chose the most innovative ideas.

This experiment takes 15-20 minutes to complete.

Do you confirm that you understand the rules of the game?

Yes ☐

No ☐

A3. The experiment consists of <u>2 phases</u>:

1) First, before to make any decision, you will respond to a short survey about your personality.

2) Second, you will start the proper experiment as the owner of Hotel Tonight. You should develop as many innovative ideas as possible and decide which one to present to shareholders to save your business.

Please bear in mind that people engaging in an ANALYTICAL DECISION-MAKING STYLE have the highest probability to develop and chose the most innovative ideas.

This experiment takes 15-20 minutes to complete.

Do you confirm that you understand the rules of the game?

Yes ☐

No ☐

Section B: Personality Traits

This part of the survey is inspired to the Big Five Personality Traits Model developed by Costa and McCrae (1992). You will be asked to rate from 1 (inaccurate) to 5 (very accurate) to define how accurately the following statements describe yourself.

B1. How much do the following sentences accurately describe yourself?

(1= "not at all" to 5= "very accurately")

	1	2	3	4	5
I am often troubled by negative thoughts	☐	☐	☐	☐	☐
I rarely get irritated	☐	☐	☐	☐	☐
I believe in the importance of art	☐	☐	☐	☐	☐
I am not interested in abstract ideas.	☐	☐	☐	☐	☐
I am always prepared	☐	☐	☐	☐	☐
I change my plans frequently	☐	☐	☐	☐	☐
There are many things I don't like about myself	☐	☐	☐	☐	☐
I find it difficult to get to work	☐	☐	☐	☐	☐
I do not like poetry	☐	☐	☐	☐	☐
I have a vivid imagination	☐	☐	☐	☐	☐
I seldom feel blue	☐	☐	☐	☐	☐
I pay attention to details	☐	☐	☐	☐	☐
My moods change easily	☐	☐	☐	☐	☐
I enjoy hearing new ideas	☐	☐	☐	☐	☐
I finish what I start	☐	☐	☐	☐	☐

B2. How much do the following sentences accurately describe yourself?

(1= "not at all" to 5= "very accurately")

	1	2	3	4	5
I need a push to get started	☐	☐	☐	☐	☐
I do not enjoy going to art museums	☐	☐	☐	☐	☐
I am interested in the meaning of things	☐	☐	☐	☐	☐
I complete tasks successfully	☐	☐	☐	☐	☐
I remain calm under pressure.	☐	☐	☐	☐	☐
I avoid philosophical discussions	☐	☐	☐	☐	☐
I do just enough work to get by	☐	☐	☐	☐	☐
I often feel anxious about what could go wrong	☐	☐	☐	☐	☐
I enjoy wild flights of fantasy	☐	☐	☐	☐	☐
I make plans and stick to them	☐	☐	☐	☐	☐
I am not easily bothered by things	☐	☐	☐	☐	☐
I rarely look for a deeper meaning in things	☐	☐	☐	☐	☐
I avoid taking a lot of responsibility	☐	☐	☐	☐	☐
I feel comfortable with myself	☐	☐	☐	☐	☐
I often worry that I am not good enough	☐	☐	☐	☐	☐

Section C: Hotel Tonight Experiment

Now you can proceed with the second part of the experiment.

C1. General Information

Hotel Tonight is located in Monti, a suburb near the center of Rome. The hotel is almost bankrupt after the entry of Airbnb in the market.

Your role (as the hotel owner)

Your aim as the hotel owner is to develop an innovative strategy that will allow your hotel to gain competitive advantage.

Unfortunately, you don't have much time to brainstorm ideas and make the final choice. In 20 minutes you will have a first meeting with the shareholders who have to decide if to keep investing or not.

What should you do?

Before meeting the shareholders you have 10 minutes to brainstorm as many innovative ideas as possible (ex. a new possible pricing strategy, a new combination of amenities to offer, the introduction of new technologies to improve the guests' journey or eventual side businesses that can increase *your* profits immediately).

When you feel confident with the strategies you have developed, you have additional 3 minutes to choose which one you to present to the shareholders and convince them to keep investing.

In making your decision, consider that:

Choosing a particular decision-making style will increase your probability to develop more innovative and successful ideas.

Shareholders will evaluate how innovative your proposal is.

There is no COVID-effect.

Some historical data (if you need them)

Your hotel, so far, has an average review score of 76%, an average price of 147€ and an anverage number of amenities offered of about 3.7.

Below you may find your apartment's data for the last month (per day). Please consider today as the "Day 0".

Day	Price (in €)	No of Amenities	Booked	Review Score
-1	135	4	Yes	80
-2	171	4	No	
-3	160	1	Yes	30
-4	128	5	Yes	80
-5	118	6	No	
-6	183	5	No	
-7	142	2	No	
-8	156	2	No	
-9	145	5	Yes	80
-10	170	2	No	
-11	194	4	Yes	50
-12	170	4	No	
-13	155	4	Yes	70
-14	108	5	Yes	100
-15	115	5	Yes	100
-16	137	3	No	
-17	128	4	Yes	80
-18	181	7	No	
-19	108	1	No	
-20	196	7	No	
-21	159	1	No	
-22	109	6	Yes	100
-23	171	2	Yes	50
-24	200	3	No	
-25	141	3	Yes	60
-26	197	3	No	
-27	170	3	Yes	60
-28	118	1	Yes	60
-29	142	5	Yes	90
-30	150	5	Yes	80

C2. Now that you have developed a sufficient number of ideas, it is time to choose which one to present to the shareholders' meeting.

Remember the ideas you have developed are

Choose the one you judge as the most innovative.

Section D: Conclusive Questions

Thank you for participating in the experiment. Please answer the following questions and submit the survey.

D1. Please indicate the gender you identify as

Female ☐

Male ☐

D2. Please indicate your age (*in years*)

☐☐☐☐☐☐☐☐☐☐

D3. Plase indicate your current employment status

Please specify in the comment box what is your job position (if employed) or the course you are attending / you just graduated from (if student).

Employed ☐

Comment

Student ☐

Comment

Other ☐

Other

D4. If you would like to help this research, please leave some comments about the way you conducted the second part of the experiment. In particular,

Which decision making style did you used? Did you used the historical data or you followed your intuition? Are you satisfied with the innovativeness of your ideas?

Thank you for participating to the experiment

8. APPENDIX B

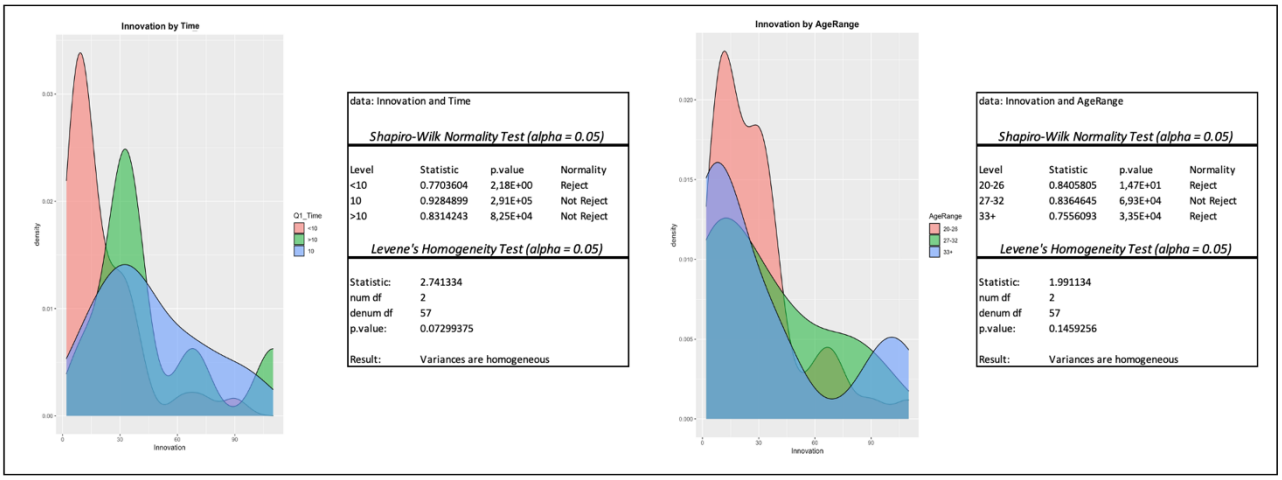
Descriptive Statistics combining Cognitive processes and Demographic Data

	Analysis (N = 31)						*Intuition (N = 29)*						
	mean	sd	median	skew	kurtosis	se		mean	sd	median	skew	kurtosis	se
Female (N = 20)							*Female (N = 20)*						
Innovation	34.50	28.32	27	1.25	0.62	6.33	*Innovation*	30.45	23.57	30	1.02	0.18	5.27
Openness	84.80	10.63	84	-0.83	0.21	2.38	*Openness*	83.10	16.83	86	-1.63	2.43	3.76
Conscientiou	75.10	12.34	74	0.24	-1.15	2.76	*Conscientiou*	72.40	9.46	73	-0.61	-0.44	2.12
Neuroticism	66.00	10.28	67	-0.02	-1.07	2.30	*Neuroticism*	64.20	13.59	62	-0.13	-0.97	3.04
Male (N = 11)							*Male (N = 9)*						
Innovation	33.09	31.26	28	0.86	-0.57	9.42	*Innovation*	10.56	7.55	8	1.81	1.94	2.52
Openness	75.27	14.32	72	0.65	-0.99	4.32	*Openness*	76.89	11.79	80	-0.31	-1.22	3.93
Conscientiou	76.55	12.90	74	0.46	-1.39	3.89	*Conscientiou*	72.00	17.12	72	-0.48	-0.76	5.71
Neuroticism	56.00	10.28	54	0.27	-1.27	3.10	*Neuroticism*	56.22	12.31	56	0.11	-0.90	4.10

	Analysis (N = 31)						*Intuition (N = 29)*						
	mean	sd	median	skew	kurtosis	se		mean	sd	median	skew	kurtosis	se
20-26 (N = 22)							*20-26 (N = 22)*						
Innovation	32.96	26.47	27	1.34	1.16	5.29	*Innovation*	23.23	19.20	16.5	1.20	0.67	4.09
Openness	83.52	10.85	84	-0.19	-1.16	2.17	*Openness*	79.82	16.00	86.0	-1.34	1.84	3.41
Conscientiou	77.20	11.89	74	0.33	-1.21	2.38	*Conscientiou*	71.36	12.53	73.0	-0.75	0.45	2.67
Neuroticism	62.96	9.20	64	-0.13	-1.27	1.84	*Neuroticism*	64.73	12.52	62.0	-0.10	-0.62	2.67
27-32 (N = 4)							*27-32 (N = 4)*						
Innovation	31.00	30.67	24.0	0.27	-2.14	15.34	*Innovation*	35.50	38.44	22.5	0.54	-1.87	19.22
Openness	76.50	19.21	74.0	0.18	-2.17	9.60	*Openness*	91.50	7.90	94.0	-0.62	-1.75	3.95
Conscientiou	65.00	8.41	66.0	-0.24	-1.93	4.20	*Conscientiou*	76.50	11.47	75.0	0.14	-2.26	5.74
Neuroticism	66.00	19.66	66.0	0.00	-2.43	9.83	*Neuroticism*	50.50	17.54	45.0	0.61	-1.76	8.77
33+ (N = 3)							*33+ (N = 3)*						
Innovation	53.0	67.88	53.0	0	-2.75	48.0	*Innovation*	17.00	17.44	9	0.36	-2.33	10.07
Openness	65.0	12.73	65.0	0	-2.75	9.0	*Openness*	77.33	18.15	80	-0.14	-2.33	10.48
Conscientiou	77.0	21.21	77.0	0	-2.75	15.0	*Conscientiou*	73.33	11.37	70	0.27	-2.33	6.57
Neuroticism	49.0	12.73	49.0	0	-2.75	9.0	*Neuroticism*	54.67	5.03	54	0.13	-2.33	2.91

	Analysis (N = 31)						*Intuition (N = 29)*						
	mean	sd	median	skew	kurtosis	se		mean	sd	median	skew	kurtosis	se
Employed (N = 16)							*Employed (N = 16)*						
Innovation	27.94	24.43	26.0	1.57	2.32	6.11	*Innovation*	31.55	27.14	30	0.87	-0.52	8.18
Openness	80.38	13.76	83.0	-0.13	-1.35	3.44	*Openness*	84.91	15.32	92	-0.88	-0.79	4.62
Conscientiou	76.75	13.30	74.0	0.23	-1.52	3.33	*Conscientiou*	77.27	9.05	82	-0.12	-1.74	2.73
Neuroticism	61.38	11.61	62.0	-0.10	-1.14	2.90	*Neuroticism*	55.45	11.17	54	0.32	-0.63	3.37
Student (N = 15)							*Student (N = 15)*						
Innovation	40.47	32.58	34	0.69	-0.87	8.41	*Innovation*	19.83	17.43	12	1.53	2.12	4.11
Openness	82.53	11.84	82	-0.36	-0.87	3.06	*Openness*	78.89	15.60	84	-1.57	2.64	3.68
Conscientiou	74.40	11.57	72	0.39	-0.74	2.99	*Conscientiou*	69.22	12.80	70	-0.53	0.22	3.02
Neuroticism	63.60	11.06	64	0.23	-1.26	2.86	*Neuroticism*	65.56	13.66	66	-0.35	-0.70	3.22

First Analysis – Assumptions check for One-Way ANOVA



data: Innovation and Time

Shapiro-Wilk Normality Test (alpha = 0.05)

Level	Statistic	p.value	Normality
<10	0.7703604	2,18E+00	Reject
10	0.9284899	2,91E+05	Not Reject
>10	0.8314243	8,25E+04	Not Reject

Levene's Homogeneity Test (alpha = 0.05)

Statistic:	2.741334
num df	2
denum df	57
p.value:	0.07299375
Result:	Variances are homogeneous

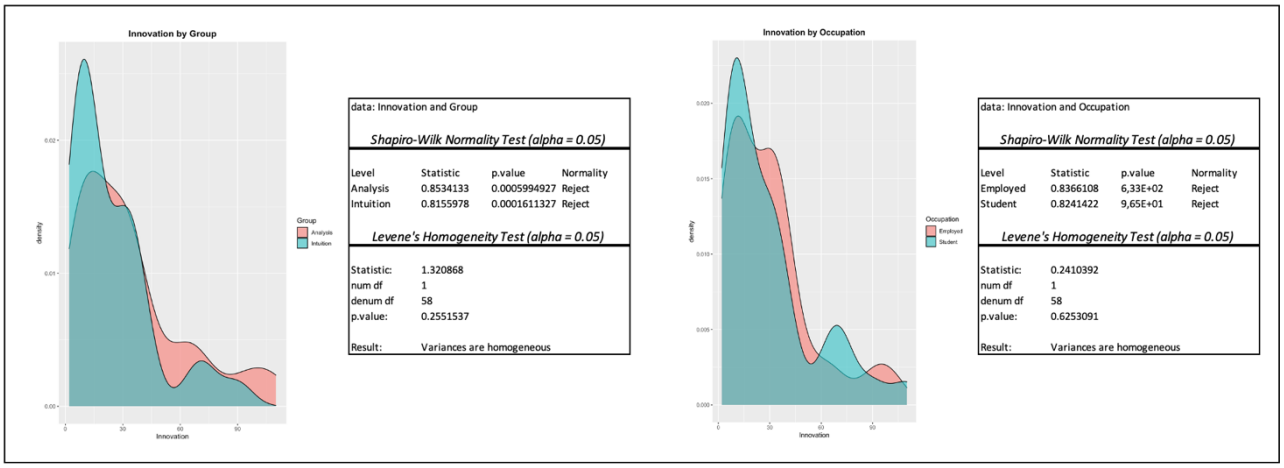
data: Innovation and AgeRange

Shapiro-Wilk Normality Test (alpha = 0.05)

Level	Statistic	p.value	Normality
20-26	0.8405805	1,47E+01	Reject
27-32	0.8364645	6,93E+04	Not Reject
33+	0.7556093	3,35E+04	Reject

Levene's Homogeneity Test (alpha = 0.05)

Statistic:	1.991134
num df	2
denum df	57
p.value:	0.1459256
Result:	Variances are homogeneous



data: Innovation and Group

Shapiro-Wilk Normality Test (alpha = 0.05)

Level	Statistic	p.value	Normality
Analysis	0.8534133	0.0005994927	Reject
Intuition	0.8155978	0.0001611327	Reject

Levene's Homogeneity Test (alpha = 0.05)

Statistic:	1.320868
num df	1
denum df	58
p.value:	0.2551537
Result:	Variances are homogeneous

data: Innovation and Occupation

Shapiro-Wilk Normality Test (alpha = 0.05)

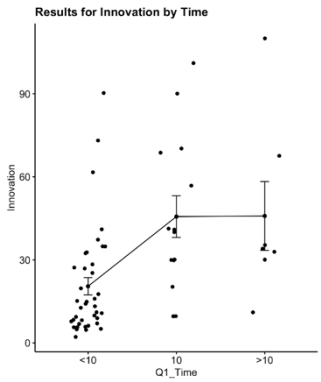
Level	Statistic	p.value	Normality
Employed	0.8366108	6,33E+02	Reject
Student	0.8241422	9,65E+01	Reject

Levene's Homogeneity Test (alpha = 0.05)

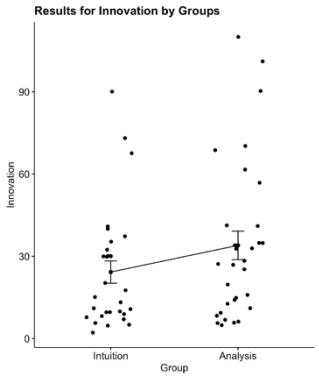
Statistic:	0.2410392
num df	1
denum df	58
p.value:	0.6253091
Result:	Variances are homogeneous

First Analysis – Kruskal-Wallis Test and One-Way Analysis of Variance

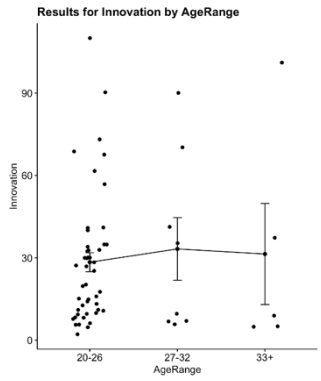
data: Innovation by Time	
Kruskal-Wallis rank sum test	
Kruskal-Wallis chi-squared =	15.035
df =	2
p-value =	0.0005436
One-Way Analysis of Variance (alpha = 0.05)	
Statistic =	9.509.971
Num df =	2
Denom df =	57
p.value =	0.0002728969
Result:	Difference is statistically significant.



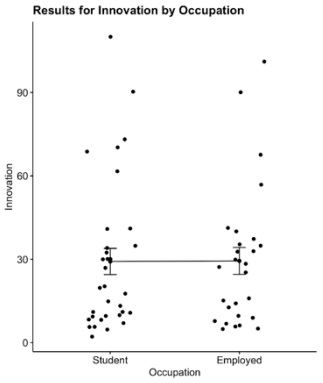
data: Innovation by Group	
Kruskal-Wallis rank sum test	
Kruskal-Wallis chi-squared =	1.7358
df =	1
p-value =	0.1877



data: Innovation by AgeRange	
Kruskal-Wallis rank sum test	
Kruskal-Wallis chi-squared =	0.52225
df =	2
p-value =	0.7702
One-Way Analysis of Variance (alpha = 0.05)	
Statistic =	0.1952553
Num df =	2
Denom df =	57
p.value =	0.8231725
Result:	Difference is not statistically significant.



data: Innovation by Occupation	
Kruskal-Wallis rank sum test	
Kruskal-Wallis chi-squared =	0.037367
df =	1
p-value =	0.8467



Second Analysis – Moderated Regression Model by Group

data: Innovation by Group*Openness

Moderated Regression Model

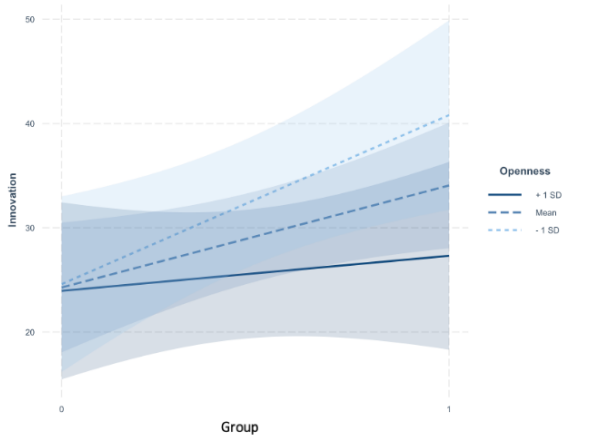
Residuals:

Min	1Q	Median	3Q	Max
-35.427	-17.886	-4.332	8.041	77.243

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	26.14934	26.00233	1.006	0.319	
Group	47.06744	40.14134	1.173	0.246	
Openness	-0.02308	0.31484	-0.073	0.942	
Group:Openness	-0.45858	0.48678	-0.942	0.350	
Signif. Codes	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' ' 1

Residual standard error:	25.83 on 56 degrees of freedom
Multiple R-squared	0.06373
Adjusted R-squared	0.01357
F-statistic	1.271 on 3 and 56 DF
p-value	0.2933



data: Innovation by Group*Conscientiousness

Moderated Regression Model

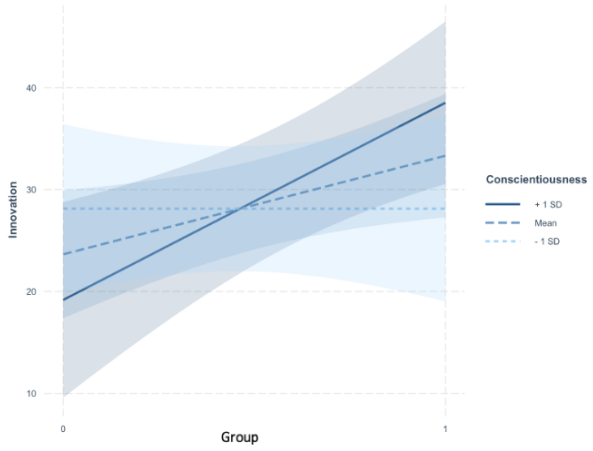
Residuals:

Min	1Q	Median	3Q	Max
-32.835	-17.043	-7.986	9.956	76.687

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	50.7904	29.6436	1.713	0.0922	.
Group	-49.0115	41.5834	-1.179	0.2435	
Conscientiousness	-0.3669	0.4048	-0.906	0.3687	
Group:Conscientiousness	0.7930	0.5557	1.427	0.1592	
Signif. Codes	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' ' 1

Residual standard error:	25.75 on 56 degrees of freedom
Multiple R-squared	0.06994
Adjusted R-squared	0.02011
F-statistic	1.404 on 3 and 56 DF
p-value	0.2513



data: Innovation by Group*Neuroticism

Moderated Regression Model

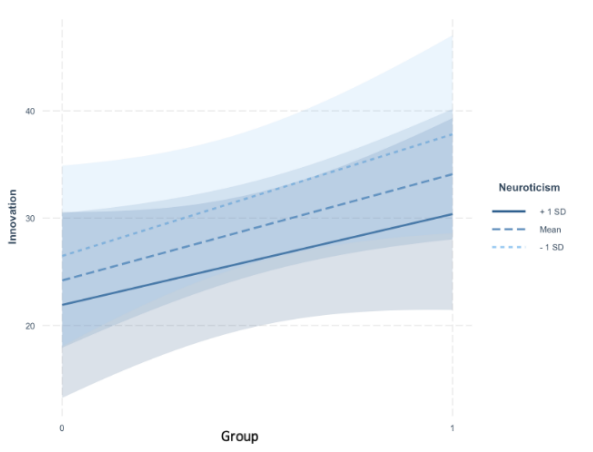
Residuals:

Min	1Q	Median	3Q	Max
-32.373	-18.281	-6.495	10.561	75.863

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	35.7310	22.9824	1.555	0.126	
Group	17.1682	35.3681	0.485	0.629	
Neuroticism	-0.1856	0.3640	-0.510	0.612	
Group:Neuroticism	-0.1170	0.5587	-0.209	0.835	
Signif. Codes	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' ' 1

Residual standard error:	26.04 on 56 degrees of freedom
Multiple R-squared	0.04857
Adjusted R-squared	-0.002396
F-statistic	0.953 on 3 and 56 DF
p-value	0.4214



Second Analysis – Moderated Regression Model by Occupation

data: Innovation by Occupation*Openness

Moderated Regression Model

Residuals:

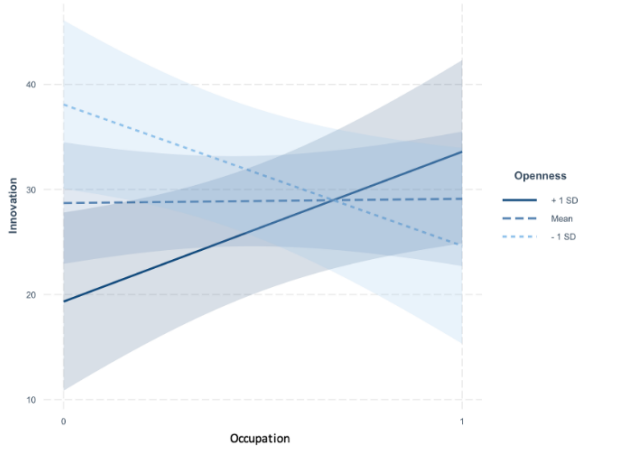
Min	1Q	Median	3Q	Max
-32.612	-16.771	-6.571	9.612	83.101

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	83.1386	26.5004	3.137	0.00272	**
Occupation	-80.0161	39.4491	-2.028	0.04729	*
Openness	-0.6695	0.3243	-2.064	0.04364	*
Occupation:Openness	0.9892	0.4774	2.072	0.04289	*

Signif. Codes 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error:	25.56 on 56 degrees of freedom
Multiple R-squared	0.08339
Adjusted R-squared	0.03428
F-statistic	1.698 on 3 and 56 DF
p-value	0.1778



data: Innovation by Occupation*Conscientiousness

Moderated Regression Model

Residuals:

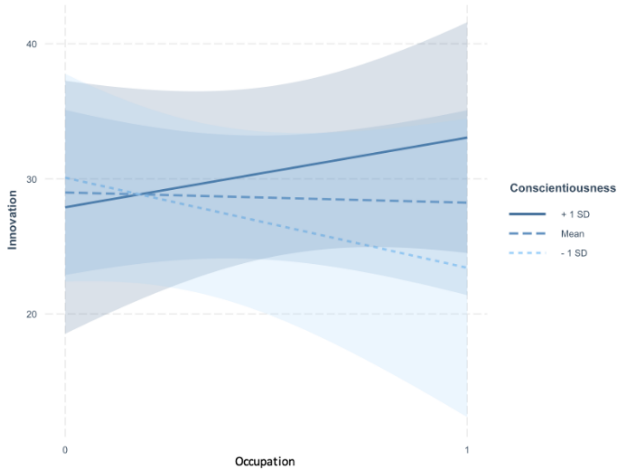
Min	1Q	Median	3Q	Max
-27.974	-19.040	-9.063	10.851	81.005

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	35.62466	27.54839	1.293	0.201
Occupation	-36.59098	44.52111	-0.822	0.415
Conscientiousness	-0.08959	0.37945	-0.236	0.814
Occupation:Conscientiousness	0.48424	0.58830	0.823	0.414

Signif. Codes 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error:	26.5 on 56 degrees of freedom
Multiple R-squared	0.01456
Adjusted R-squared	-0.03824
F-statistic	0.2757 on 3 and 56 DF
p-value	0.8427



data: Innovation by Occupation*Neuroticism

Moderated Regression Model

Residuals:

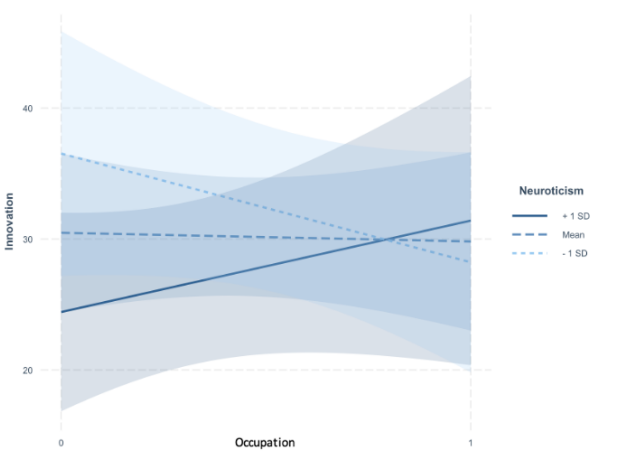
Min	1Q	Median	3Q	Max
-32.467	-18.024	-6.470	8.644	79.474

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	61.0720	24.6578	2.477	0.0163	*
Occupation	-39.3052	36.3252	-1.082	0.2839	
Neuroticism	-0.4927	0.3747	-1.315	0.1939	
Occupation:Neuroticism	0.6223	0.5811	1.071	0.2888	

Signif. Codes 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error:	26.27 on 56 degrees of freedom
Multiple R-squared	0.03139
Adjusted R-squared	-0.0205
F-statistic	0.605 on 3 and 56 DF
p-value	0.6145



Second Analysis – Moderated Regression Model by Age Range

data: Innovation by AgeRange*Openness

Moderated Regression Model

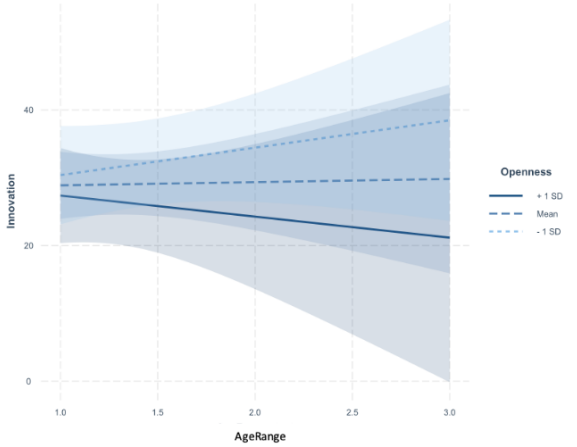
Residuals:

Min	1Q	Median	3Q	Max
-35.206	-18.401	-4.682	11.435	81.418

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	16.4226	45.6862	0.359	0.721	
AgeRange	21.2044	29.1743	0.727	0.470	
Openness	0.1474	0.5697	0.259	0.797	
AgeRange:Openness	-0.2550	0.3749	-0.680	0.499	
Signif. Codes	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' ' 1

Residual standard error:	26.39 on 56 degrees of freedom
Multiple R-squared	0.02274
Adjusted R-squared	-0.02961
F-statistic	0.4344 on 3 and 56 DF
p-value	0.7292



data: Innovation by AgeRange*Conscientiousness

Moderated Regression Model

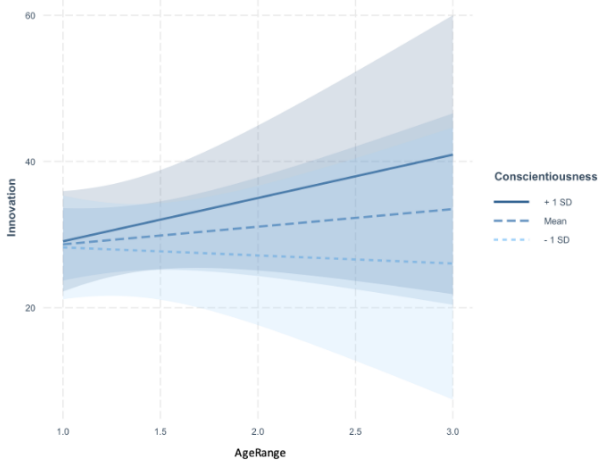
Residuals:

Min	1Q	Median	3Q	Max
-35.809	-20.276	-5.958	7.156	81.338

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	45.0451	49.8599	0.903	0.370	
AgeRange	-18.8995	35.1561	-0.538	0.593	
Conscientiousness	-0.2540	0.6615	-0.384	0.702	
AgeRange:Conscientiousness	0.2880	0.4690	0.614	0.542	
Signif. Codes	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' ' 1

Residual standard error:	26.53 on 56 degrees of freedom
Multiple R-squared	0.01253
Adjusted R-squared	-0.04037
F-statistic	0.2368 on 3 and 56 DF
p-value	0.8703



data: Innovation by AgeRange*Neuroticism

Moderated Regression Model

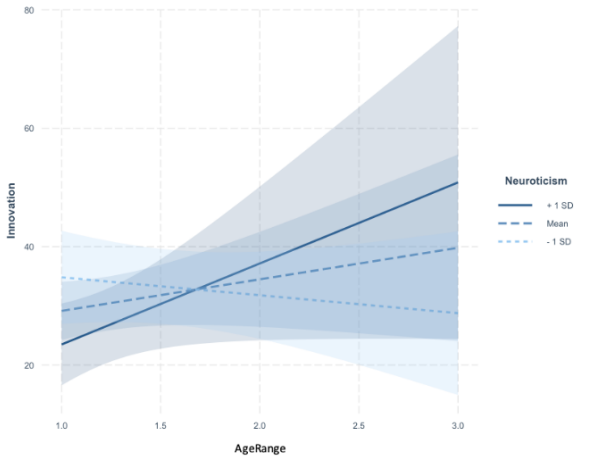
Residuals:

Min	1Q	Median	3Q	Max
-31.12	-18.46	-5.50	8.29	81.06

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	94.7785	46.1046	2.056	0.0445	*
AgeRange	-36.9326	29.2257	-1.264	0.2116	
Neuroticism	-11.426	0.7613	-1.501	0.1390	
AgeRange:Neuroticism	0.6805	0.5120	1.329	0.1892	
Signif. Codes	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' ' 1

Residual standard error:	26.13 on 56 degrees of freedom
Multiple R-squared	0.04203
Adjusted R-squared	-0.009294
F-statistic	0.8189 on 3 and 56 DF
p-value	0.4889



Second Analysis – Moderated Regression Model by Time

data: Innovation by Q1_Time*Openness

Moderated Regression Model

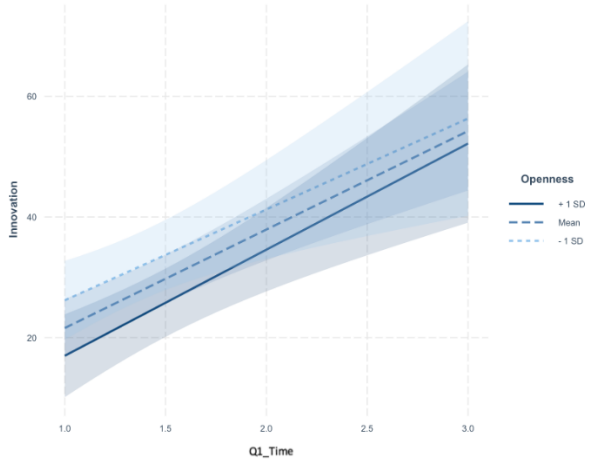
Residuals:

Min	1Q	Median	3Q	Max
-45.506	-16.776	-7.742	10.485	67.977

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	39.2660	43.5673	0.901	0.371	
Q1_Time	9.0047	29.0248	0.310	0.758	
Openness	-0.4181	0.5241	-0.798	0.428	
Q1_Time:Openness	0.0900	0.3442	0.261	0.795	
Signif. Codes	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' ' 1

Residual standard error:	23.74 on 56 degrees of freedom
Multiple R-squared	0.2095
Adjusted R-squared	0.1671
F-statistic	4.947 on 3 and 56 DF
p-value	0.004072



data: Innovation by Q1_Time*Conscientiousness

Moderated Regression Model

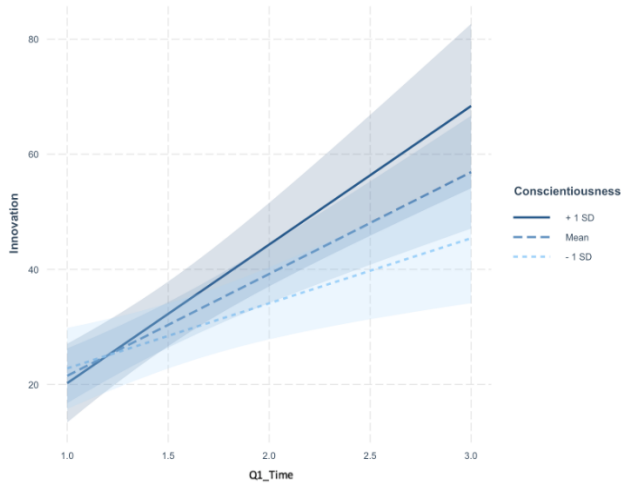
Residuals:

Min	1Q	Median	3Q	Max
-35.897	-14.580	-7.330	7.624	70.793

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	50.3015	43.2929	1.162	0.250	
Q1_Time	-21.0213	23.9691	-0.877	0.384	
Conscientiousness	-0.6281	0.5850	-1.074	0.288	
Q1_Time:Conscientiousness	0.5231	0.3302	1.584	0.119	
Signif. Codes	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' ' 1

Residual standard error:	23.46 on 56 degrees of freedom
Multiple R-squared	0.2278
Adjusted R-squared	0.1864
F-statistic	5.506 on 3 and 56 DF
p-value	0.002193



data: Innovation by Q1_Time*Neuroticism

Moderated Regression Model

Residuals:

Min	1Q	Median	3Q	Max
-38.36	-15.45	-6.03	10.11	65.65

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	15.7525	38.5580	0.409	0.684	
Q1_Time	23.1587	22.3756	1.035	0.305	
Neuroticism	-0.1791	0.6040	-0.297	0.768	
Q1_Time:Neuroticism	-0.1009	0.3407	-0.296	0.768	
Signif. Codes	0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' ' 1

Residual standard error:	23.72 on 56 degrees of freedom
Multiple R-squared	0.2105
Adjusted R-squared	0.1683
F-statistic	4.978 on 3 and 56 DF
p-value	0.00393