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THE ROLE OF CREATIVITY AND ETHICS IN RESPONSIBLE INNOVATION BEHAVIOR

THESIS REPORT

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Executive Summary

As innovations became the source of competitive advantage for many companies, creativity became an incredibly valued trait, sought in individuals during recruitment processes for example. Creativity can be defined as the ability to generate novel and useful idea. However, as the world saw many creative inventions resulting in harmful innovations, as well as creative endeavors resulting in deceptive and even criminal behavior, many researchers started questioning the relationship between creativity and ethics.

One research area of emerging necessity, which has been getting continually more attention, is the area of Responsible Research and Innovation, which analyses how the process of creating something new, on the basis of research and innovation, can be done in a more responsible way, reflecting the need and values of society (Owen, Macnaghten, & Stilgoe, 2012). In that way, it is possible to see efforts towards making the creative achievements of certain individuals or groups more ethical, which refers to the discussion between ethics and creativity.

For being a considerably new area of research, there is still much left to be done. While most studies currently employ a macro perspective, focusing on how to systematize the development of a Responsible Research and Innovation concept, this work intends to identify individual characteristics of responsible innovators, thus looking at the micro level. This adds a new perspective to the scientific efforts in this area, showing a different way of approaching the same topic. Recognizing how the responsible innovative behavior happens should make it possible to better understand its motivations and how to reinforce them. By incentivizing those behaviors, society will benefit from more ethical efforts in innovation, reducing both intended and unintended harmful consequences for innovation.

The behaviors leading to Responsible Innovation are considered rooted in two constructs, ethics (responsible) and creativity (innovation). An extensive literature review was conducted on those topics in order to understand how they relate to the object of study. Based on that, a Responsible Innovation Scale, RIS, was developed, being the aim of this work to analyze its validity in terms of content and predictive power. This scale was administered to 147 respondents, together with additional scales and scenarios, and the responses were analyzed for their statistical significance and relationship. The questionnaire contained a majority of Likert-scale questions and two open ended questions, which were coded and rated before being analyzed.

Two supportive scales were chosen, one for each construct. For creativity, the scale used was the Runco Ideational Behavior Scale, which focus more on the generation of new ideas, but has been widely used in the literature for general creativity measure. It is a simple way to measure creativity

and allows for the online administration of questionnaire. For ethics, the scale used was the Perceived Role of Ethics and Social Responsibility, PRESOR, which is concerned about the dilemma in corporations between profitability and doing the right thing for society. Since this was a very fitting theme, this scale was selected as the measure for ethics in this study.

Several scenarios were presented to respondents, which were given the opportunity to select how likely they would follow a course of action, or to openly describes ways of dealing with the situation. These scenarios simulate real life situations where subjects are encountered with ethical dilemmas and must decide to which direction they will focus their creative efforts. The results of this part were compared to those obtained with the scales, and was analyzed whether the RIS had predictive validity.

The results obtained showed no relationship between the ethics measure (PRESOR) and the creativity measure (RIBS). However, both the regression analysis, and the moderating effect investigation shown in the supplementary analysis, showed that these two constructs, ethics and creativity, are participating in the scores for RIS, providing evidence for its content validity. Regarding the predictive validity of the scales on the real-life scenarios presented to participants, there were different performances. The creativity scale, RIBS, roughly did not predict any different behavior between low and high scorers, having just one significant unexpectedly negative relationship with the measure for creativity in one of the scenarios. The PRESOR, scale measuring social responsibility, reliably predicted a more ethical behavior for most of the scenarios, being a good predictor of ethical responses. Finally, the results obtained for RIS showed that, out of the 5 scenarios investigated, the RIS reliably predicted ethical behavior in 4 of them. However, there was no significant distinction between low and high scorers on RIS in the creativity score, showing that the scale did not predict reliably this construct.

The main contribution of this study is the development of a reliable scale to measure Responsible Innovation Behavior. The RIS can be used to understand the differences between groups of people when it comes to responsible innovation, providing a simple way to gather information from a large group of subjects. This was not available in the literature yet, and the RIS closes this gap. It can also be used to understand the underlying motivations for these behaviors, helping educational institutions and policy makers to direct their efforts into more efficient solutions.

Although RIS has proven to predict the ethical and responsible side of respondents' behavior, a more thorough analysis should be conducted on the link with creativity. Since the supporting scale proved to be unstable, and the scenarios were designed with a stronger focus on the ethical side, this link was not sufficiently validated. For future work, it is recommended to test RIS against different creativity measures, and design the data gathering in such a way that allows participants to show their true creative potential.

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1. Introduction

We live in a world where creative achievements are not only praised, but many times seen as the way forward. The fast pace of technological innovation makes it feel as if every day there is a new, original and useful product, ready to make everyone's lives easier, more comfortable or more adventurous. At the same time that companies admittedly look for creative individuals while recruiting, learning online platforms such as edX, Udemy or Coursera, are offering different types of courses on creativity and how to unlock creative potential. The desirability of creativity is ubiquitous and undeniable.

On the other hand, it is not hard to identify situations in which creative efforts resulted in harmful consequences for society. Ranging from the atomic bomb, that killed hundreds of thousands, to the more recent misuse of personal data by Cambridge Analytica and Facebook, it is possible to think of many situations where creative outcomes were directed at harmful and unethical goals. Upon this reflection, one realizes that some criteria are needed in order to identify when innovations are positive for society, and when they are potentially disastrous. To understand whether there is any pattern or relationship between creativity and the social responsibility of these efforts, many researchers developed their own hypothesis and methodologies, and these can be found in the recent literature.

Gino & Ariely (2012), for instance, found a correlation between creativity and dishonest behavior, yet they were not the only ones to analyze the dark side of creativity (Jonason, Richardson, & Potter, 2015; Mai, Ellis, & Welsh, 2015; Wang & Murnighan, 2011). On the other hand, researchers also found positive correlations between creative and ethical behavior (Bierly, Kolodinsky, & Charette, 2009; A. M. Grant & Berry, n.d.; Martin, 2006; Mumford et al., 2010). This has created a big debate in the academic community whether creativity can lead to ethical or unethical behavior, or if it depends on the accompanying values the creative individual already possesses.

More specifically on the power of innovations of changing society, one research area emerged, attempting to define how could innovations became more socially responsible. That is the area of Responsible Research and Innovation, that focused not on the intrinsic relationship between creativity and ethics, but on how the outputs of the many innovation systems can be made better for society. Researchers on this field attempt at defining how the need and values of society can be accommodated in the innovation process, and steer it to a positive impact later on (Owen et al., 2012). A lot of effort has been put in defining what a responsible innovation is, but a clear and unambiguous definition is yet to be constructed. Von Schomberg (2011) defined it as a process in which innovators and society both take responsibility for steering the innovations in a more ethical, socially desirable direction, in order to include those advancements in society in a more inclusive and responsible way.

Although much attention has been dedicated to Responsible Innovation in the recent years, it has mostly been focused on the macro perspective of it. For instance, clearer and more specific definitions for what exactly is Responsible Innovation have been sought after (Gurzawska, Mäkinen, & Brey, 2017; Owen et al., 2012; von Schomberg, 2011). Other works are more focused on the governance of these new innovations, on how policy and regulations can be developed to remain relevant for this fast changing reality, and ensure citizens' rights are being preserved (Callon, 1987; Hajer, 2003; Hajer, 2009). Whilst there is this trend of looking at the system as a whole, understanding how innovations happen and what can be done to be them more responsible, there is not enough literature on understanding Responsible Innovation from an individual's perspective. Understanding from where the individual behavior stems allows researchers to not only focus on how the system should work, but also on how we can steer the behavior to a more responsible one every step of the way. This work intends on closing a part of this knowledge gap, by identifying responsible innovation behavior on individuals, thus looking at the micro level and developing a reliable way of measuring it. The goal is to finally answer the question is: How can we measure responsible innovation at the individual level, i.e. how can we measure Responsible Innovation Behavior? It will not provide ways to steer individual behavior to a more responsibly innovative one, yet it might open up the discussion and offer a tool to start moving on that direction.

This work will contribute to the scientific community by shedding light to a different facet of responsible innovation, which is the individual characteristics of the people involved with it. The scale to be developed will serve as a tool for not only identifying personal characteristics, but at a later stage to also allow for further behavioral research. Once these characteristics can be reliably measured, further investigations such as how they can be enhanced by learning, how the environment can prime this behavior, whether they change over time, among others, can be conducted. Looking at responsible innovation at the individual level might contribute to further developing and spreading this new, but extremely necessary, concept. In that way, society will benefit from the progress of responsible innovation, which might help solve societal problems with technological innovations, whilst mitigating or reducing unwanted consequences.

The scale to be studied here will be based in the Responsible Creativity and Innovation Scale (RCIS), which was developed by Laurens Rook, Robert Verburg, Udo Pesch and MOT 2017 laureate Hakim Agung. It was already tested and is statistically stable, which means it is controlled for random errors and the results obtained with it are interpretable (Rohatgi & Saleh, 2015). The proposed research is focused on further validating the scale, by having the subjects answering to other established scales, as well as reacting to different scenarios which involve creative and ethical thinking. The focus here is to check the content validity of the scale, which is how well a certain measure can represent all facets

of the construct it intends on measuring (Rohatgi & Saleh, 2015). In order to do so, the main research question was subdivided into the following questions.

RQ1. How can Responsible Innovation be understood at the individual level?

RQ2. Which constructs can be used to understand Responsible Innovation Behavior?

RQ3. Is there any relationship between creative behavior and ethical behavior?

RQ4. Can Responsible Innovation Behavior be measured in a valid and reliable way using the RIS scale?

In the following chapters, all these questions will be answered, in order to build up to the main research question, on how to measure responsible innovation behavior.

Chapter 2 will cover the Literature Review, showing what has been done in the main domains of interest here. The split into subchapters is necessary to understand each of these domains in the necessary depth, starting by clarifying what in Responsible Innovation in the first section. Even though the concept is still ill-defined (Owen et al., 2012), many authors have attempted at finding a less ambiguous definition for it, and create a framework for developing a responsible innovation. All these contributions to the literature are necessary to understand what can still be done, here on the individual level of behavior.

The subsequent section concerns the relationship between creativity and ethics. There is an intense debate in the literature on whether there is a positive relationship between these constructs, a negative one, or none at all. Different types of methodologies have been used in the pursuit of an answer to this, yet the debate is still alive. The relevance of reviewing the literature on this is justified in the premise of being creativity and ethical behavior both important for understanding responsible innovation. Thus, whether these two characteristics are independent of each other, or interrelated, can play a role in analyzing the results.

Finally, the last section of Chapter 2 will review the current methods of measuring these constructs, both creative potential and ethical behavior, to be able to design this work's methodology. After gathering the knowledge on the relevant areas and defining how to interpret responsible innovation behavior, it is time to understand how to make this a measurable construct. This will finalize the literature review part of the work.

The research methods chosen for this work are survey with real-life scenarios. This was done through Likert-scaled questions combined with open-ended questions, that are coded and rated to allow for quantitative analysis as well. The questions concern both scales to measure specific constructs, and

scenarios that simulate real life situations that respondents might be challenged with, and measures their chosen path of action. Chapter 3 will come to describe the methodology used to attain the goal of this research. Starting with the conceptual model used, this chapter explains how the constructs of interests were measured, and how this was organized in the questionnaire administered to respondents. Information on the demographics of respondents will also be available, as well as the rating criteria used to analyze the open-ended responses. Also in Chapter 3, some pre-analyses on the scales used are done, showing their reliability and stability, which will be relevant for further discussions. By the end of this chapter, it should be clear how all the evidence later discussed was gathered.

The results of all statistical analysis run on the data will be presented in Chapter 4, and their relevance will already be addressed as they are presented. The relationships sought after are not only concerning the scales and the scenarios posed, but also between the scales. Pearson's correlations and regression analyses were conducted for all combinations described in the conceptual model, available in Chapter 3, and their statistical significance was always analyzed. The relevant results are all presented in Chapter 4 and are discussed more in depth in Chapter 5. The discussion will not only focus on what was proven by this research, but also the impact that this research can have on the scientific realm, the business community and in society in general, as well as areas in which further study should be conducted. Finally, concluding remarks can be found in Chapter 6.

2. Literature review

It is not an easy task to define a concept like Responsible Innovation. As Owen et al. (2012, p. 753) said, “few would argue for irresponsible research and innovation”, yet it is still difficult to define exactly what this entails and how to achieve it. This Chapter aims at reviewing what has been said in the literature so far in terms of Responsible Innovation and the characteristics that are involved in it at an individual level. Only after doing so, the hypothesis from this study can be drawn and further tested, which will be described in full in this report.

2.1 Responsible research and innovation

It is not hard to look at technology as a tool we have at our disposal to make every day life easier. However, even the earliest tools we had, stones and sticks that our primates ancestors used, have shaped our anatomy, to the extent that human hands became suitable for the use of tools (Young, 2003). The same is true for technology, it constantly shapes us, even if we don’t realize it. The more advancements were seen in technology, the more debate there was on the balance between its potentials and risks, benefits and side effects, and on how to control it and assign responsibility over it (Grunwald, 2014).

After acknowledging that technology has a tremendous impact in shaping society, the next step is defining a way to balance these effects out: keep the development and benefits obtained via technological innovations, at the same time as reducing its risks and negative impacts. The need for a better understanding of how it is possible to do so, and who is responsible for ensuring this happens, is what gave rise to the concept of Responsible Innovation (van den Hoven, 2014; von Schomberg, 2011). Even though technology has been present for centuries and it has been debated in different instances (Stilgoe, Owen, & Macnaghten, 2013), it was only in the past two decades that the idea of innovating responsibly became a topic of concern, with discussions arising in the policy and academic environment since early 2000s (Owen et al., 2012). The more our society has become technology driven, the more concerns have arisen on unforeseen impacts of innovation in society, which led to the understanding that the debate on how research is conducted should be brought close to society.

The concept of Responsible Innovation, even though recent, has fueled many debates, policy developments and academic publications (Guston et al., 2014; von Schomberg, 2014). The idea of including the societal impact in the innovation process is a positive and necessary notion. However, what exactly is Responsible Innovation? One of the most widely used definitions was given by René von Schomberg (2011, p. 9), and it states:

> *"Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view on the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)"*

At a first read, this definition seems like several beautiful words put together, nevertheless providing little practical meaning. It lacks clarity in terms of what it is, what it entails, and what needs to be done. According to Koops (2015), "it is by no means clear what exactly the term refers to, nor how Responsible Innovation, once we know what is meant by this, can or should be approached" (p. 2). Since the definition is still work in progress, there is ongoing experimentation and development on how to approach and operationalize responsible innovation (Ribeiro, Smith, & Millar, 2017). Such a concept, if remains ill defined, might eventually become a void concept, just another buzzword or "manager's language" (De Jong, Kupper, Roelofsen, & Broerse, 2015), considering that no one would argue for "irresponsible innovation" (Owen et al., 2012).

To better understand what is meant by Responsible Innovation, we can start by breaking down the definition presented by Schomberg (2011). First, Responsible Innovation relates to the process, and not the outcome of it. This allows for the interpretation that RI will provide guidance on how to innovate, and not on what to innovate. This already gives the first scope. Under this concept, innovation is seen as an interactive and transparent process, so it is two-way and not confined to a certain environment only. Information is flowing in and out, differently than the more "traditional" view of innovation, that could picture it as a scientist, confined in the laboratory, creating something completely new without the participation of different actors. Here, innovators and society are *mutually responsible to each other*, which highlights again the importance of this being a two-way street. Innovators must think about society and how their creations will impact the different stakeholders, yet society also plays a role and shares the responsibility of making sure the desired process will be in place (Lubberink, Blok, Van Ophem, & Omta, 2017; Owen et al., 2012).

Continuing with the interpretation, the second part of it is even more difficult to properly define. According to Davies & Horst (2015), finding a consensus on what is ethically acceptable, sustainable and socially desirable, by the multiple actors involved is "at best difficult and at worst impossible" (p. 47). The debate on finding out what is the "right thing" is as old as philosophy itself. As soon as humans could think, they started contemplating how to create rules to guide human behavior, how to be moral and ethical, in summary, how to be good. This is why the concept is describing a interactive process, and not a set of rules, because only through continuous interaction and communication that

stakeholders can find a good trade-off between values, which will then result in a socially desirable outcome (Grinbaum & Groves, 2013; Owen et al., 2012; Schomberg, 2007). Further on the definition, we see that the end goal is to have a socially desirable process, yet that will guarantee a socially desirable marketable products, thus focusing on the process to ensure a compliant outcome.

Finally, the sentence between parenthesis talks about the final aspiration: *a proper embedding of scientific and technological advances in society*. The idea of debating about the negative impacts of technology in society does not aim at demonizing technology. Including societal actors in the discussions in early stages of the innovation process does not aim at hampering its progress. On the contrary, the notion of Responsible Innovation comes to create a more harmonic interaction between society and scientific advancements, incorporating technology and its benefits for society in a constructive way (von Schomberg, 2014).

Another definition that later came to complement the one given by Schomberg (2011) is the one from Stilgoe et al. (2013, p. 1570), that says: "*Responsible innovation means taking care of the future through collective stewardship of science and innovation in the present*". The collective stewardship connects back to the multiple actors being mutually responsible for each other and collectively responsible for steering innovation in the right direction. The reframing of responsibility to this more collective view aims at tackling the problem that, while actors in the innovation process might not be individually irresponsible, the lack of proper accountability might create an organized irresponsibility of the whole system (Owen et al., 2012; Stilgoe et al., 2013). Responsible Innovation is not something that should be done in isolation, or only depending on your profession or role. It is a collective effort, and it needs to be in place throughout the entire process of innovation. By doing that, we will be taking care of the future, solving societal problems with the help of science and innovation (Lubberink et al., 2017).

Over the years, even though some variants of definitions and frameworks have been developed, Responsible Innovation has been defined as containing four main dimensions: anticipation, reflexivity, inclusion and responsiveness (Lubberink et al., 2017; Stilgoe et al., 2013). These help break down the Responsible Innovation concept even further, allowing for a deeper understanding of what they entail and how it can be operationalized. Each of them will be explained in the subsections below.

2.1.1 Anticipation

Sometimes after an innovation is marketed, it takes a turn and ends up being used for a different purpose than that aspired by the innovator. This might cause them to not feel responsible or accountable for the consequences of their innovations, and even when they do, the harm has already been done (Grinbaum & Groves, 2013). One very famous invention that ended up being used for a

different purpose was the dynamite, invented by Alfred Nobel in 1866. His intention was to invent a safer and better to handle explosive for construction purposes. However, the dynamite was also used for warfare, which caused a great sense of guilt in him, leading eventually to the creation of the Nobel Prize (Rogers, 2006). Thus, it is important that innovators take an active role in anticipating the impacts of the innovation, be that positive and aspired, be that negative or distorted.

More often than not, the risks associated to a new technology cannot be properly quantified, being difficult to establish an acceptable baseline for an unknown risk (von Schomberg, 2014). Regardless of that, being aware of the existence of the risk might help mitigate its effects or prevent them from happening, or even to help be prepared to act on them once they happen. For that reason, systematic thinking about all possible implications that the new technology implies must take place during the innovation process, requiring the innovators to have a deep understanding not only of the object of their study, but also the dynamics surrounding its introduction in society (Lubberink et al., 2017).

Anticipation involves not only the discussion on possible and desirable futures, including the reflection on the paths that would lead us there, but also on the undesirable potential impacts of the innovation, here including ways of mitigating the risks associated (Lubberink et al., 2017; Owen et al., 2012; Stilgoe et al., 2013). Multiple methods have been developed and can be used, such as: Constructive Technology Assessment (Grunwald, 2014; Schot & Rip, 1997), which not only attempts at identify the effects of a given technology, but also influence the design and implementation phases through inclusion of diverse stakeholders in them; Scenario planning (Amer, Daim, & Jetter, 2013; Schoemaker, 1995), which uses trends and uncertainties to predict possible scenarios as outcomes; or Future-oriented Technology Analysis (Cagnin, Havas, & Saritas, 2013; Koivisto et al., 2009), which is an iterative process of reflection and discussion to foresee the impacts of a certain technology. All these techniques take different approaches in anticipating outcomes and evaluating how likely they are, at the same time as providing frameworks for understanding the pathways to get or not there. Nevertheless, it is always useful to include the other stakeholders in these anticipatory exercises, since they might bring different views and concerns, and together can assess available alternatives to go around the anticipated issues (Lubberink et al., 2017).

2.1.2 Reflexivity

This pillar of Responsible Innovation regards the careful consideration of one's own motivations and actions. Reflexivity is about critically scrutinizing assumptions and values currently held, to ensure they are not biased or one-sided (Chilvers, 2012; Lubberink et al., 2017), and also to engage in a deeper reflection on how these value systems and beliefs are impacting the development of the innovation process. Stilgoe et al. (2013) define reflexivity as ''*holding a mirror up to one's activities commitments*

and assumptions, being aware of the limits of knowledge and being mindful that a particular framing of an issue may not be universally held'' (p. 1571).

To do so, innovators need to step out of their role, and actively take up on wider moral responsibilities (Owen et al., 2012; Ribeiro et al., 2017). This can be facilitated and enhanced by including stakeholders and the general public in these reflections and debates (von Schomberg, 2014). The assumption of scientific amorality should be taken down by the concept of reflexivity (Stilgoe et al., 2013), since it brings the responsibility of actively contemplating what is being done and how it is being done throughout the innovation process.

One activity to facilitate reflexivity is to integrate social scientists and engineering ethicists on the laboratory work, to engage natural scientists and engineers in reflecting about the social and ethical implications of their research and development process (Schuurbiers, 2011; Stilgoe et al., 2013). This collaborations enhance the quality and breadth of the reflections, since it brings a different view on the socio-ethical context of scientific work (Schuurbiers, 2011). Another aspect of reflexivity, which was approached by the study of Schippers, Den Hartog, Koopman, & Van Knippenberg (2008), is how having a strong leadership and a shared vision positively affects team reflexivity and performance. Thus, reflexivity does not only have the power to transform the outcomes of the innovation process, but also improves how this process is undertaken, improving team performance by reflecting and understanding why they are working on that.

In summary, Lubberink et al. (2017) define reflexivity as: "*critically thinking about one's own actions and responsibilities (1), values and motivations (2) knowledge and perceived realities (3), and how each of these have an effect on the management of the innovation process for the desired outcome*" (p. 12). Therefore, reflexivity comes to question the motivations and operationalization of the innovation process, and help steer it to a more socially responsible one.

2.1.3 Inclusion

In the previous sections, it was mentioned that both Anticipation and Reflexivity can be enhanced by including stakeholders and the public in those processes. The pillar of Inclusion refers exactly to the invitation of the different stakeholders in these deliberations from an early stage of the innovation process (Owen et al., 2012; Stilgoe et al., 2013). While some firms already tend to engage with end-users and customers to understand their needs and wants for a new product, the practice of involving the general public, or even stakeholders that might be against it to hear their concerns, is still under development (Owen & Williamson, 2014). Ideally, it should be involved all stakeholders that could provide different resources and viewpoints necessary for the responsible governance of the

innovation process, not only listening to them, but also creating and maintaining relationships (Lubberink et al., 2017).

The rationale behind the Inclusion practice is well explained by Bozeman, Rimes, & Youtie (2015). The first reason is that, by to the public values, it is more likely that those will be considered during the design of the new product, and increases the chances of the marketable outcomes of the innovation process being socially desirable (Bos-Brouwers, 2009). Secondly, whenever a research project is funded by public institutions, it is ultimately funded by the general public money translated in taxes, which should give them a right to an opinion. Finally, an important reason for having a systematic inclusion of public values in the innovation process is that, without it, these values might be easily forgotten. Having a framework in place ensures that all stakeholders will be included, and not only those of interest, with one-sided views.

The idea of inclusion is to shift from a traditional "downstream" decision making, where innovators and regulators guide the innovation process and then implement the outcome, to a more "upstream" approach, in which the public can engage in the innovation process to articulate their vision and expectations at an earlier stage (Chilvers, 2009). This stems from the fact that Responsible Innovation is a collective effort, thus the responsibility of interacting and participating in this process is shared by the whole society. As von Schomberg (2007) pointed out, "*upon everyone's shoulders rests a particular moral obligation to engage in the collective debate that shapes the context for collective decision making*" (p. 12).

The operationalization of this concept includes conferences, deliberative mapping, focus groups, polling, among other systematic approaches of obtaining the public's inputs (Chilvers, 2009). However, these approaches do not come without setbacks. The first issue to be balanced out is the uneven power relationships (Stilgoe et al., 2013). If the dialogue is intentionally framed by one of more parties in the discussion, the benefits of that interaction might be arguable, and the understanding of the general public about the innovation might be hampered (de Saille, 2015). Another issue is in identifying who to be included in order to have a representative sample, which will bring different relevant opinions and viewpoints to the discussion (Lubberink et al., 2017). For that reason, Callon, Lascoumes, & Barthe (2009) have proposed three points to keep in mind when organizing an Inclusion opportunity: intensity, or how early the public should be consulted and how much attention will be devoted to these events; openness, meaning the diversity of the group; and quality of these encounters. The need to involve the public in the process and think about how to steer technology into a more positive outcome for society, together with the other pillars reviewed so far, give rise to the first hypothesis of this work:

- *Hypothesis 1: Responsible Innovation is positively correlated to ethical behavior.*

2.1.4 Responsiveness

The purpose of Anticipation has been established in section 2.1.1 as the reflection about the possible paths and outcomes from the innovation, contemplating the likelihood of them happening in the future. However, this exercise would not be helpful unless the innovation systems and organizations are ready to adjust to these possible changes and scenarios. It is important to consider how these innovation systems can become as responsive as possible to this volatile reality (Stilgoe et al., 2013).

Responsiveness, as a dimension of Responsible Innovation, exists to ensure the adaptability of the innovation process to the external changes in the environment, or other circumstances that can impact the effect of the innovation in society (Lubberink et al., 2017). The desired outcomes will not be achieved without this flexibility, since the dynamics of society might be different from the moment the innovation process started until the marketable outcome is actually implemented.

The different stakeholders are responsible for recalibrating their roles when confronted to changing circumstances or values (Lubberink et al., 2017), sharing the responsibility of paying attention to the environment and adjusting accordingly. In order to exist Responsible Innovation, it is necessary that the process is flexible enough to change its shape or direction, through recognizing that the knowledge in the beginning or during the innovation process is insufficient, so they might need to adjust the course of action as more information becomes available (Owen et al., 2012; Stilgoe et al., 2013).

It is also important that innovators are also responsive to societal challenges, possibly directing the efforts of research and development towards solving those (Schomberg, 2013). However, the political and regulatory environment in which the innovation process is situated must be compliant with a culture of responsiveness, considering not only the final product, but also the purpose of it, and incentivizing the organizations to remain responsive (Stilgoe et al., 2013). To summarize, Pellizzoni (2004) defines responsiveness as "*a situation where there is neither presumption of sufficient knowledge and control nor reliance on ex-post accounts and adjustment of self-established courses of action, but rather a receptive attitude to external inputs to help in deciding what to do*" (p. 557).

2.2 Ethics and creativity

2.2.1 Creativity and innovation

In the previous section, it was described what Responsible Innovation stands for. However, before we can fully comprehend how to make an innovation more socially responsible, we first need to understand what exactly defines an innovation. One simple way to look at is to view creativity as the process of generating useful and original ideas, and innovation as the implementation of those ideas

(Amabile, 1988; Gurteen, 1998). While creativity refers to ideas produced by an individual, innovation is about putting the new ideas into action and successfully realizing them (Oldham & Cummings, 1996). Thus, innovation stems from creativity.

For decades already it has been realized the power of creativity and innovation in the success of an organization. Innovation can foster growth, increases in productivity and by consequence in profits, and ultimately can define how successful the firm is (Gurteen, 1998; Heunks, 1998; Hyvärinen, 1990). To foster creativity in an organizational context, Amabile (1988) argues that three aspects must be present: the innovator's skillset and techniques; organizational resources available; and motivation, both from the individual and the organization, be that intrinsic or extrinsic. In a different model, yet with a similar direction, Terblanche & Martins (2003) claims that some factors are determinant to achieving innovative outcomes, such as strategy that encourages creativity, structure and support mechanisms offered by the organization, and open communication. However, besides the qualities of the organization in which the individual is inserted in, the creative individual's characteristics are also important. Oldham & Cummings (1996), for instance, found a set of personal traits that were reliably correlated with creative measures, such as broad interests, attraction to complexity, aesthetic sensitivity, toleration of ambiguity and self-confidence.

Creativity is crucial for not only technological advance, but also for the social and behavioral sciences. Although being undeniably important for problem-solving (Weisberg, 2006), creativity is also about being adaptable and flexible. One way of looking at creativity is through a Darwinist lens (Campbell, 1960), on which the ideas are generated through a blind-variation process, and later submitted to cognitive and sociocultural selection, and the ideas that are deemed worthy by a criteria of usefulness, truth or beauty get retained (Simonton, 1999). Therefore, creativity allows society to remain adaptable to changing environments, responding to evolutionary changes with original and flexible ways of adjusting (Runco, 1994; Simonton, 1999). In addition, creative outcomes also impact on society, therefore being at the same time a reaction and a fuel to change (Runco, 2004). Thus, responsible innovation needs creativity to also find new ways of implementing a certain innovation in a desirable way for society. From this, stems our second hypothesis:

- *Hypothesis 2: Responsible Innovation behavior is positively correlated to Creative behavior.*

Although every person can be creative, the level of creativity may vary from person to person, and also from situation to situation (B. Nijstad, De Dreu, Rietzschel, & Baas, 2010). At the same time, one can be creative in multiple areas, such as in science, mathematics, arts, interpersonal relationships, athletics, and even in politics (Kaufman, 2012; Runco, 2004). The flexibility and adaptability factors give the creative individual the ability to cope with change and opportunities in different areas, and

change is necessary for advancements and ultimately, innovation (Paulus & Nijstad, 2003). Researchers of creativity also might have different views on how to interpret their findings. For that reason, Runco (2004) suggests, after reviewing decades of literature on creativity, that to understand creativity, one must remain also a flexible approach and avoid relying on only one perspective.

One model for understanding creativity was posed by Nijstad et al. (2010), and it is called "The Dual Pathway to Creativity". In their work, they assume two different processes that happen in order to achieve a creative outcome: the flexibility pathway and the persistence pathway. The first relates to generating ideas, insights and solutions through processes of divergent thinking, of flexible switching among different categories and approaches, and of remote associations. The second pathway relates to how hard work and systematically exploring possibilities can result in creative outcomes. The in-depth analysis of a few perspectives might result in not only something original, but also highly useful. The logic is that more original ideas would be generated later in a systematic ideation procedure, such as brainstorming, since in the beginning people rely more on easily accessible thoughts (Nijstad, Diehl, & Stroebe, 2003; Perkins, 1981), so the persistence pathway would lead to more creative ideas (B. Nijstad et al., 2010).

2.2.2 Dark side of creativity

Although creativity is related to personal and organizational success, as mentioned in the previous section, and it allows individuals to be flexible, adaptive and come up with problem solutions, the consequences of creative outcomes might not always be positive. Examples range from terrorist attacks such as 9/11, to bank robberies or Ponzi schemes. The concept of malevolent creativity describes the situation where there is deliberate intention of causing harm, such as when creating weapons of mass destruction (McLaren, 1993). There is also the possibility of negative consequences unintentionally arising from creative outcomes, either as caused by an accidental set of circumstances or being a by-product of other activities, which would then be described as a failed benevolent (Cropley, Cropley, Kaufman, & Runco, 2010). In any case, these negative outcomes have brought attention from the academic community to what was called the dark side of creativity.

The application of creativity in intentionally harmful activities was hardly discussed in the early studies of creativity, possibly due to the positive connotation usually associated with it (Cropley & Cropley, 2011). However, as it was pointed out by Gino & Wiltermuth (2014), even though breaking rules has a negative meaning when talking about morality and ethics, thinking "outside of the box" has a positive connotation in the field of creativity. Some lawbreaking involves highly effective creative processes and plans, and some lawbreakers display personality traits that are typically associated with creative individuals (Cropley & Cropley, 2011).

Several influential studies have shown these "dark" sides of creativity. Walczyk, Runco, Tripp, & Smith (2008) have studied creative lying through the administration of social dilemmas in which lying would be advantageous to the subjects. The responses were coded for novelty, effectiveness in solving the dilemmas, and the possible long-term damage of the lie, and subjects were also measured in terms of divergent thinking ability, and a correlation was found between highly creative lies and high ideational behavior. Beaussart, Andrews, & Kaufman (2013) tested measures of creativity against both self-reported and behavioral measures of integrity, and found a negative correlation for both cases, suggesting that creative individuals demonstrate less integrity. Relationships were also found between dark traits of personality and creativity. Jonason et al. (2015) found that participants high in narcissism were self-reporting to be more creative than most people, which might be due to their exaggerated expectation of being better than average. In addition, scores on humor were also correlated with narcissism and psychopathy traits.

Baucus, Norton, Baucus, & Human (2008) have reviewed the creativity literature in search of recommendations for fostering creativity. They have found some prescriptions that raise ethical issues when looked at without the positive connotation of creativity. These are: "(*1) breaking the rules or avoiding standard approaches to problems; (2) challenging authority and avoiding traditions; (3) creating conflict, competition and stress; and (4) taking risks*" (Baucus et al., 2008). These recommendations could seem to normalize unethical behavior once creativity is on the spotlight.

Gino & Ariely (2012) tested participants on creativity and subsequently in dishonest behavior, in which subjects were tempted at cheating on a test. They found that subjects with a more creative personality cheated more than others, and also groups that were first primed with creative activities subsequently cheated more. The reverse was tested in a different study (Gino & Wiltermuth, 2014), in which they found that participants who cheated more were subsequently more creative in their activities. This might be explained by their shared feature of breaking the norm (Gino & Wiltermuth, 2014). In addition, when an individual is confronted with an ethical dilemma, choosing to act unethically in order to maximize their self interest will cause a negative impact in their moral self-image (Mead, Baumeister, Gino, Schweitzer, & Ariely, 2009). Creative individuals, Gino & Ariely (2012) claim, are able to creatively justify it to themselves that their behavior is morally appropriate. By convincing themselves, they are able to do the morally wrong act without suffering the consequences to their self-image, thus explaining the correlation between creativity and dishonest behavior.

2.2.3 Moral creativity

In 1993, Howard E. Gruber published his paper "Creativity in the Moral Domain: Ought Implies Can Implies Create". He claimed that, once something ought to be done and can be done, one must act on

it. However, then the issue at hand is new and difficult, the only way to solve it is by being creative. For instance, Stein (1993) maintained that, given the technological advances of recent times, many of our societal and scientific challenges can only be tackled with creativity, and that we would need specific guidelines on how to solve the moral dilemmas attached to these challenges.

The reason why this association was and still is seen as contradictory or at least unexpected is the associations commonly made to both morality and creativity. While the first is mainly regarded as a traditional set of rules which ought to be conformed to, the second is often associated with originality, rebelliousness and breaking the rules (Gruber, 1993). Nevertheless, Runco (2004) argued that rules and procedures are also important for many artistic and scientific domains, making creativity not entirely unconventional. Besides, creativity may be achieved not by breaking the rules, but through insightful integration, modification or restructuring of the current scenario (Shen, Yuan, Yi, Liu, & Zhan, 2017). For scientific creativity, it happens, by nature, within a rule-bound system of methodologies and procedures (Mumford et al., 2010). At the same time, morality must adapt to the new ethical dilemmas caused by the changing environment (Gruber, 1993; Stein, 1993).

Although some might consider these two concepts oxymoronic, solving a complex ethical problem without being creative might not be possible (Sternberg, 2014). For instance, when trying to find possible solutions to an ethical problem, creative thinking might lead to a larger range of possibilities, eventually leading to a more effective problem solving and more ethical decision making (Mumford et al., 2010). Given their ability to solve complex problems and come up with new courses of action, it is actually likely that creative workers would help an organization find an ethical solution to its challenges (Bierly et al., 2009). Therefore, creativity may help ethical behavior by employing divergent thinking in order to find multiple solutions, and sorting them out to make the right decisions (Bierly et al., 2009; Mumford et al., 2010). Our third hypothesis is, then:

- *Hypothesis 3a: Responsible Innovation is positively correlated to moral responses to ethical dilemmas.*
- *Hypothesis 3b: Responsible Innovation is positively correlated to creative responses to ethical dilemmas.*

In science and engineering, morality is part of the values when creating an innovation, since much of it is driven by a desire to improve something or solve a problem (Martin, 2006), thus, the intentionality behind the scientific work should make it moral. In fact, the motivations are an important factor in much of the moral creativity literature. Haste (1993), for instance, defined moral creativity in terms of: vision, how serious the individual views the moral implications of the problem; efficacy, the ability to follow through with the planned course of action; and responsibility, or how the individual

perceives its own personal responsibility to act. Thus, moral creativity is not only about the intentions, but also the responsibility and accountability the individual is willing to take (Haste, 1993). In the case of creative work motivated by a moral responsibility, Gruber & Wallace (1999) defined these individuals as "creative altruists", since they dedicate their time and efforts into pursuing solutions for a problem and are intrinsically motivated by this ethical drive.

In their study, Bierly et al. (2009) studied the relationship between creativity and ethical ideologies, both moral relativism and moral idealism. Even though they had hypothesized that there would only be a positive relationship between creativity and relativism, they found that both ideologies were positively related to creativity, contradicting the stereotype that creative individuals are more socially insensitive (Bierly et al., 2009). This stereotype was perpetuated by some psychology literature, such as the Gough's Creative Personality Scale (Gough, 1979), in which adjectives such as "honest" and "sincere" would decrease a person's score in creativity.

Another evidence was found in the study by Grant & Berry (2011), in which pro social motivation and exercises of perspective taking enhanced the development of creative ideas. One possible explanation for it is because pro social motivation would strengthen intrinsic motivation, which would then enhance the creative output. In addition, perspective taking would allow for participants to think differently than usual and identify new strategies, also increasing their creative performance. In a different study, it was found that creative individuals have better moral reasoning abilities, which leads to making more ethical decisions (Paul & Elder, 2009).

Even though there is a lot of debate on whether creativity is related to ethical or unethical behavior on a psychological level, we still need creative individuals to come up with new solutions for our societal problems. Ultimately, as Gruber (1993) indicated, when two variables are not correlated, that simply means that variations on one are not followed by variations in the other. Regardless of that, we must find a way to fully use all these capabilities to find solutions to our problems. As Moran, Cropley, & Kaufman (2014, p. 307) beautifully put:

> *"What creativity and ethics may share the most is that both are difficult. Both take effort, care, and often additional work. Both can mean bucking the path of least resistance and standing up to others who may view such decisions as silly or a waste of energy. But, as history has shown through cases of moral and ethical exemplars with creative approaches to perplexing issues, facing such difficulty— when done thoughtfully, with respect for others, and recognizing the interconnections among us all—can be crucial for the greater good."*

For that reason, a deeper understanding on the relationship between creativity and ethics is necessary, not only to comprehend if one can affect the other positively or negatively, but especially to find ways of the two walking together, bringing moral and creative behavior to create new ways of solving societal challenges. The hypothesis here presented will be tested in the following chapters, aiming at identifying a way to measure responsible innovation behavior at the individual level.

3. Methodology

After reviewing the literature in Chapter 2, it was possible to understand Responsible Innovation in terms of two main individual behaviors: ethical (responsible) and creative (innovation). Thus, to understand and measure these individual characteristics, the research methods for this study were defined. This chapter is dedicated to explaining the development of this methodology, both revisiting what was done in the previous study and explaining what this work focused on. The conceptual model used in this study is shown below.

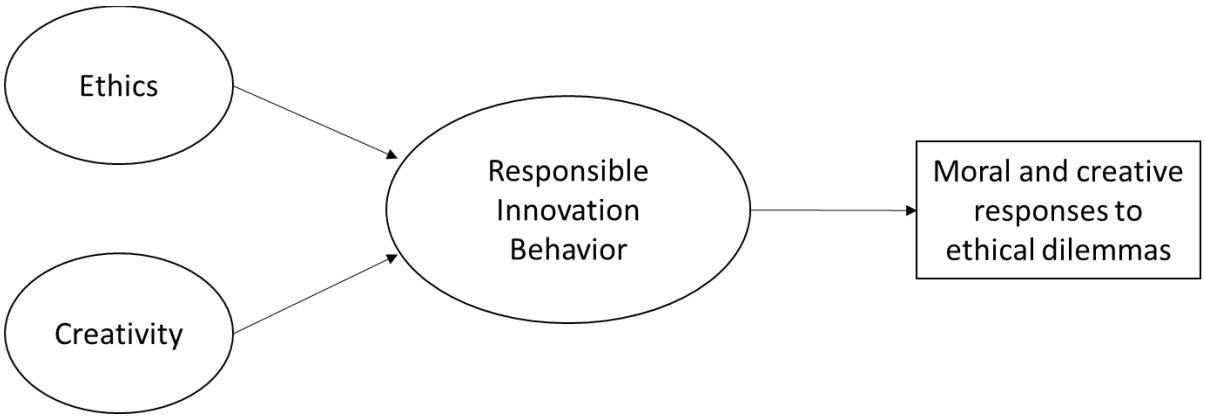

Figure 1 Conceptual model used, separating the part that was tested in this work

This conceptual model will be operationalized using three scales: one to measure the construct creativity, one to measure the construct ethics, and finally the scale that is the object of this study, which should measure Responsible Innovation Behavior and have inputs from both previous constructs. These will be tested also against scenarios that pose an ethical dilemma to the respondents, to see if how they perform in the Likert scales are predicting their responses to real-life situations.

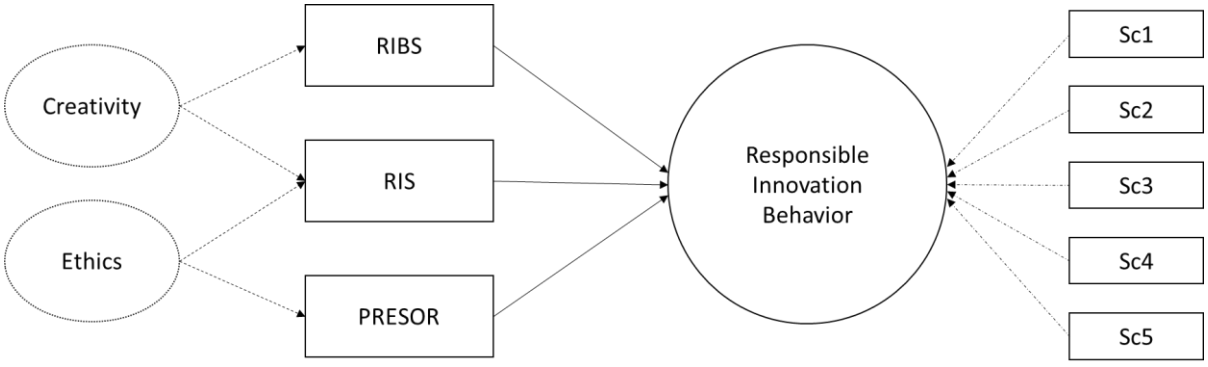

Figure 2 Operationalization of the conceptual model

The central object of study is the Responsible Innovation Scale (RIS), which strives to measure Responsible Innovation Behavior on an individual level. For this, it was defined in the literature review

that two constructs are important, creativity and social responsibility. In order to understand the scale predictive validity, two additional scales were used, one for creativity (RIBS) and one for social responsibility, i.e. ethics (PRESOR), which will be further discussed in this chapter. It is expected that these scales will allow for the measurement of Responsible Innovation Behavior, which will then predict the response behavior in each of the scenarios administered. It is expected that the PRESOR and the RIBS will measure two different constructs, ethics and creativity respectively, but regarding the RIS, some overlap is expected, since it is attempting at measuring responsible innovation behavior, made of creativity and ethics as well. The results obtained for each scenario will be used to validate whether the RIS was able to predict individual behavior towards responsible innovation or not.

3.1 Data gathering

The Responsible Innovation Scale is tested here to confirm its validity, i.e. if it is reliably measuring what intends on measuring. Thus, it needs to be tested with a sample of respondents and statistical analyses conducted to interpret the results. To move forward with the scale validation, one question is concerning sample size. Although there is quite some debate regarding this, there is some consensus around the minimum number of respondents of 100 (Clark & Watson, 1995), being recommended around 150 respondents (Hinkin, Tracey, & Enz, 1997)(Hinkin et al., 1997). Out of more than 400 people contacted, only 147 answered the questionnaire (35% response rate), out of which 56% were male and 43% female (1% not declared). Most of participants were between 18 and 34 years old (93%) and had either completed a Bachelor's Degree (52%) or a Master's Degree (43%). The full split between demographics groups can be seen below.

Table 1 Demographic data of respondents

Age	**18-24**	**25-34**	**35-44**	**45-54**	**55+**
% of participants	33.3	59.9	4.1	1.4	1.4

Gender	**Male**	**Female**	**Rather not say**
% of participants	55.8	42.9	1.4

Highest obtained degree	**High school**	**Bachelors**	**Masters**	**PhD**

% of participants	3.4	51.7	42.9	2.0

The questionnaire and scenarios were administered online, via a link that participants could access from any device. It was possible to leave the questionnaire unfinished, which also caused a lower response rate for the scenarios part. Fortunately, the software recorded responses page by page, so for the scale validation it was possible to have access to all 147 answers, even though only 93 finished the open-ended questions. Participants were briefed that this study aimed at understanding the relationship between ethics and creativity, and were presented first with the scales and lastly with the scenarios.

3.2 Materials and procedure

For this study, participants were asked to fill in a survey that was administered online, and responses were gathered in a voluntary basis. The survey was divided into three parts. The first was a questionnaire consisting of three scales, measuring creativity, ethics and responsible innovation behavior respectively. They all followed a 7-point Likert scale, varying from Strongly Disagree to Strongly Agree. The second part consisted also of questions using a 7-point Likert scale, but this time presenting real life scenarios in which the participants had to select how likely they would follow that course of action. Lastly, the third part consisted of two open ended questions with a Responsible Innovation relevant scenario. They will all be described in detail below.

3.2.1 Part 1: scales

Responsible Innovation Scale. As was mentioned in Chapter 1, this study comes as a continuation of the work started by Ramadhan (2017) in his Master Thesis. After analyzing the literature and connecting the missing gaps, the first version of the Responsible Innovation Scale was developed, containing 12 items. The item development strived to accommodate both the Idea Generation stage, incorporating the concepts of Fluency, Flexibility and Originality explained in Chapter 2 (B. Nijstad et al., 2010; Runco, 2004), and the concept of Idea Realization, focusing on the actions to effectively implement an idea. The scale has 8 items, and some examples of items in this scale are “I am good at coming up with ideas that are novel, but also right”, “I find it easy to generate original solutions that reflect how the problem at hand ought to be solved”, and “It is important to me to explore the various ethical aspects of my ideas”. The full scale can be found in Appendix A.

Runco Ideational Behavior Scale. Another scale used in the questionnaire was regarding creativity. To measure this construct, some tests rely on both verbal and non-verbal cues, demanding a quite extensive evaluation of results, such as the Torrance Tests of Creative Thinking (Kim, 2006), or are split

between different types of creativity, e.g. artistic, scholarly or every day creativity, such as in the Kaufman Domains of Creativity Scale (Kaufman, 2012), or even focused on previous creative outputs, such as the Creative Achievement Questionnaire (Carson, Peterson, & Higgins, 2005). Since the objective was to measure a more general aspect of creativity, it was looked in the literature for a scale that had been extensively validated, not so time-consuming to respond or to evaluate, and it had a general focus on the ideation aspect of creativity, since most of the items in the RIS were related to this. Finally, the Runco Ideational Behavior Scale (RIBS) was chosen as the measure for creativity (Runco, Plucker, & Lim, 2001), for being easy to administer, reliable and highly cited in the literature, and also aligned content-wise to what we are trying to measure with the RIS. Some examples of items, out of the 23 in total, in the RIBS are "I often get excited by my own new ideas", "I come up with a lot of ideas or solutions to problems", and "I try to exercise my mind by thinking things through". The RIBS can be seen in full in Appendix A.

Perceived Role of Ethics and Social Responsibility. For Ethical behavior, the necessity of finding one focus was even more crucial. There are many facets to ethics, many theories and many ways of perceiving its impacts. The main discussion in responsible innovation is how to minimize negative impact of innovations and how to make them more focused on socially desirable outcomes. Thus, in many cases, the ethical dilemma will be between creating something that can be profitable but might have negative consequences to society, or being accountable for these consequences and rethinking the design of the innovation, or coming up with solutions to mitigate these impacts. For this reason, the scale to measure the ethics pillar in this study should be related to this dilemma, not to general ethical problems or different ethics theories. The Perceived Role of Ethics and Social Responsibility (PRESOR) deals exactly with this (Singhapakdi, Vitell, Rallapalli, & Kraft, 1996), on how individuals perceive this dilemma and how much importance they give to the impact of their work in society. Therefore, the PRESOR was chosen as the scale for the ethical behavior construct. This scale contains 16 items. Some examples of items are "To remain competitive in a global environment, business firms will have to disregard ethics and social responsibility" (reverse scored), "Social responsibility and profitability can be compatible", and "Business has a social responsibility beyond making a profit". The PRESOR can be seen in full in Appendix A.

3.2.2 Part 2: Responsible innovation scenarios (Likert-scaled)

In addition to the scales for ethics and creativity, a number of scenarios were presented to the subjects and it was asked which course of action they would choose. This comes to complement the data obtained from the scales, since self-reporting scales might display response bias caused by the social desirability of constructs like creativity and ethics (Van de Mortel, 2008). The scenarios were chosen and written in order to understand if and how high vs low scorers in the scales would behave

differently in real life situations. At first, scenarios that contained both a creative and an ethical side were searched in the literature, so as to make this research more robust and to have some results to compare to. However, this combination was not very common in literature and there were some obstacles in getting access to the scenarios found. Thus, some of them had to be written especially for this study.

The first two scenarios (Toxic Chemical and Serving Size) are retrieved from the study of Gino & Ariely (2012), and pose situations where a profit can be made by acting on a gray moral area, asking subjects how likely they would choose to profit from it anyway. These two scenarios were used on a study to check the relationship between creativity and unethical behavior, leading to the dark side of creativity. The third scenario (Personal Data) described a situation where the subjects would have access to personal data from customers, and asks about the likelihood of them pursuing several different action paths with this data. It was written for this study and the choice of theme was based on a very recurrent topic on ethical debates about the impact of technology on people's privacy. All three scenarios can be seen below.

- *Scenario A.1 – Toxic Chemical*

  "Steve is the Sales and Operations manager of a firm that produces pesticides and fertilizers for lawns and gardens. A certain toxic chemical is going to be banned in a year, and for this reason is extremely cheap now. If Steve buys this chemical, produces and distributes his product fast enough, he will be able to make a very nice profit. If you were Steve, how likely is it you would use this chemical while it is still legal?"

- *Scenario A.2 – Serving Size*

  "Dale is the Sales and Operations manager of a firm that produces health food. Their organic fruit beverage has 109 calories per serving. Dale knows people are sensitive to crossing the critical threshold of one hundred calories. He could decrease the serving size by 10%. The label will say each serving has 98 calories, and the fine print will say each bottle contains 2.2 servings. If you were Dale, how likely is it you would cut the serving size to avoid crossing the 100-threshold?"

- *Scenario A.3 – Personal Data*

  "You are the lead marketer at a large e-commerce company. You are well aware that when your customers shop your online store, they leave an electronic trail that provides lots of information – ranging from their name and address to the types of goods that interest them

when they search the site. These are rich data that, potentially, could generate a lot of extra money for your e-commerce company in all sorts of ways. Your customers cannot finalize a purchase without accepting the privacy terms and agreements, which is a very long document. Please, rate how likely you would do the following:

1) Use their data to internally improve business processes and inventory management.

2) Send emails with promotions without them specifically requesting you to do so

3) Rework this data and sell the information to your suppliers, so they can improve their offerings

4) Offer product customization, based on their personal data (such as name, nationality, etc)"

All the aforementioned scenarios displayed very clear opportunities for profit, ethical dilemmas, and course of action, thus assessing how the respondent would behave in that situation. This was used to measure the ethical, or social responsibility, aspect of innovation, not allowing for creativity measures. For scenario Personal Data, the two more strongly unethical actions were used to calculate the final score. They were the sub-answers 2 and 3, and the average was taken between them for the analysis. The responses ranged from Very Unlikely to Very Likely, also using a 7-point Likert scale, which means that a high score meant high likelihood of taking action despite the moral dilemma.

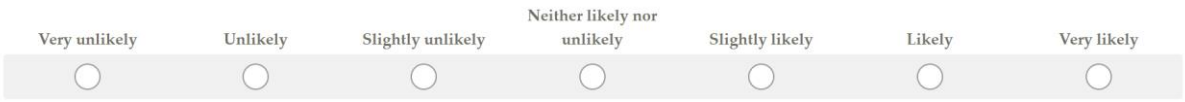

Figure 3 How participants saw the Likert scale response options for all scenarios type A

3.2.3 Part 3: Responsible innovation scenarios (open ended)

Finally, two scenarios were written as open ended questions, to allow for both ethical dilemmas and ideation of actions to take. First, the topics for each scenario were carefully chosen to display an innovation that could have both desirable and undesirable impacts, so as to put respondents really in the shoes of an innovator reflecting about what to do with its most recent discovery. Here, the focus was on something that does not exist and is not on the market yet, which would provide the inventor with a financial benefit as well as recognition from their discovery. Another thing that was taken into consideration while writing was to make sure the ethical dilemma was clear to respondents, but not so clear that it would prime them to only answer according to it. Thirdly, the questions were posed in a way to avoid priming respondents of thinking only about money or profit, instead using lighter words such as "benefit", which can allow for broader interpretations. Each of the scenarios will be explained more in detail below.

- *Scenario B.1 – Intelligence drug*

  "You have recently developed a brain enhancing drug that, in addition to being highly effective, also have minimal to non-detectable side effects. This drug can potentially disrupt the educational system and many other sectors, since the intellectual performance of those taking the drug can increase significantly. However, this drug is extremely expensive to produce. How would you, as the drug developer and owner of the intellectual property, implement this drug in the market? Try to come up with as many as possible original ways to do so (separate your answers in different lines)."

In this case, the innovation is the brain enhancing drug, and the opportunities lie on the fact that it is highly effective and with minimal side effects. The ethical dilemma is made clear later in the text, where it evidently says that the drug is extremely expensive, leading to the natural conclusion that only people with a lot of money would be able to buy it. The question was then how this could be implemented on the market, leaving it for the respondents to choose if they would like to focus on profiting from it or on using if for a different purpose. In that way, a wide range of responses was guaranteed.

- *Scenario B.2 – Skin whitening*

  "While researching new alternatives for skin cancer treatment, you discovered by accident a substance that significantly whitens the skin. You know that cosmetic products with whitening properties are highly popular in some regions of the globe, in which the color of the skin is still a factor for social acceptability and life success. How can you benefit from this discovery? Try to come up with as many as possible original ways to do so (separate your answers in different lines)."

For this scenario, the innovation is the skin whitener and the opportunity is that in some regions of the globe, the color of the person's skin is still important, also pointing out at the ethical dilemma, which is that it could support racism. Again, it was not said how the respondent would profit or make money out of it, but how they could benefit, leaving it up for them to choose which path to take in their ideation. The evaluation and analysis of all responses will be explained in subchapter 3.3.

3.3 Data analysis

After the responses were collected, there was a process of data treatment to be able to run statistical analysis on it, for which it was used the software SPSS. The first step was to reverse the scores of all necessary items, making sure they would not be input in SPSS in the wrong format. After that, several statistical analyses were run in order to understand the correlations between measures.

First, the Cronbach's Alpha of each scale was calculated to determine how much the individual items of it are related to one another, in order to understand the internal consistency, or reliability, of each of the scales used. Then, the histograms for each scale were plotted, as well as the basic statistical values, such as mean, median, standard deviation, were calculated, in order to understand if they were following a normal distribution. Finally, the Pearson correlations were calculated between all scales and scenarios, to see if it was possible to find significant relationships between the variables.

Before we could load the data of the two open-ended scenarios in SPSS, the content of responses had to be rated. The rating procedure used was adapted from the work of Harris, Reiter-Palmon, & Kaufman (2013), which provides a coding benchmark for the study of dark creativity. In their coding procedure, responses were rated in terms of originality and negativity, which in this study was adapted to originality and how ethical the responses were. Originality was rated based on how unique, imaginative and structured by the problem the idea was. Therefore, an idea that was very common or poorly structured according to the scenario would be rated with a low score, whereas a highly imaginative, structured answers, that provided an unexpected or uncommon response to the dilemma, would score high. An ethical response is the one that took into consideration the moral dilemma posed by the scenario, trying to solve it or minimize its impacts, whereas an unethical response was the one profiting from it, regardless of the social impact the idea was causing. They were both graded using a 6-point Likert scale, ranging from "very unoriginal" to "very original", and "very unethical" to "very ethical". Some examples and their ratings are presented below, and all the ideas can be found in Appendix B.

Table 2 Example of responses obtained and the rating given

Originality: 6; Ethics: 1	"Introduce the drug in high studies societies. to people studying MSc or PhD, sell it as an opportunity to improve performance and get to a higher level of efficiency, which would eventually lead to better job opportunities. Clearly state how this drug separates you from the rest both intellectually and make them feel they belong to that exclusive circle. Allow the people buying the product to connect with each other, which creates a network of the upper class and business/ high students, really interesting for everyone."
Originality: 4; Ethics: 1	"Play the race factor. If colour still makes a difference in a certain country, the easiest way to sell the product is to enhace the race factor. Marketing about how belonging to a certain race opens many opportunities in succeeding in life."

Originality: 2; Ethics: 2	"I'd found a company in the regions where this product is most popular and sell it there; I'd sell the license to produce it to companies that sell beauty products."
Originality: 2; Ethics: 3	"Sell the idea to a big cosmetic company. Develop my own way to produce the substance in a large scale."
Originality: 4; Ethics: 4	"Ask for government financial if the drug is so important. Create an ONG to raise funds to lower the cost. Try to improve the producer line to make it cheaper to produce. Cut as much as possible the profit on this drug."
Originality: 1; Ethics: 5	"I wouldn't benefit at all because I think the social stigma associated with darker skins needs to be broken and selling yet another skin whitening product won't help that cause."
Originality: 5; Ethics: 6	"Sell that drug only to people with learning difficulties, permanent or temporary, and only under doctor prescription. Make the drug available only through the public health system so that the economic status doesn't influence on the capacity to obtain that drug. It is important not to profit from selling the drug at the highest cost possible and without a target population as this could strongly impact the society by increasing inequalities depending on economic status."
Originality: 6; Ethics: 6	"I'm against the concept of changing skin colour for social acceptance and hence, would not even consider benefiting from this discovery by means of marketing cosmetics products for general skin lightening. HOWEVER, there are specific purposes for which this product (if tested and proved safe) could be successfully marketed. For example, under eye dark circles lightening to match the skin tone of the rest of one's face (depending on the frequency of use). I think it could work wonders for this particular application."

The rating procedure was done several times, always starting from scratch, to make sure the ratings were consistent. A second rater also analyzed the responses, and the ratings obtained were compared with the ones done by the author. It was found that in 66% of the cases, the rating was exactly the same, in 30% it was different by only one point, showing a divergence in magnitude but not on the direction of the rating, and only 4% of the cases diverged in a significant manner. The Cohen's Kappa was calculated for the measures and obtained a value of $\kappa = 0.56$, with significance of 0 and standard

error of 0.67, which shows a moderate agreement. The ratings and how they differed from first and second rater can be found in Appendix C. After all data was input in SPSS as numbers, the statistical analysis were run, and the results obtained are shown in Chapter 4.

3.4 Pre-analysis

As mentioned in the previous section, the data analysis began by checking the scales reliability. All three scales used displayed a high Cronbach's Alpha (>0.8) as it is displayed in Table 3, showing the scales are reliable. After that, the histograms were plotted for each of the scales. They can be seen in Figure 4 below. Some general statistics for the scales were calculated, which showed they were slightly out of a normal distribution. Thus, the scales were centered prior to the regression analysis conducted later, which can diminish the risk of multicollinearity issues (Field, 2018, p. 371).

Table 3 Statistics for the scales used

	RIBS	**PRESOR**	**RIS**
Cronbach's α	0.904	0.857	0.855
N of items	23	8	16
Valid	147	147	147
Mean	4.859	5.145	4.679
Std. Deviation	0.8049	0.8226	0.9060
Minimum	1.826	2.000	1.500
Maximum	6.696	6.875	6.750

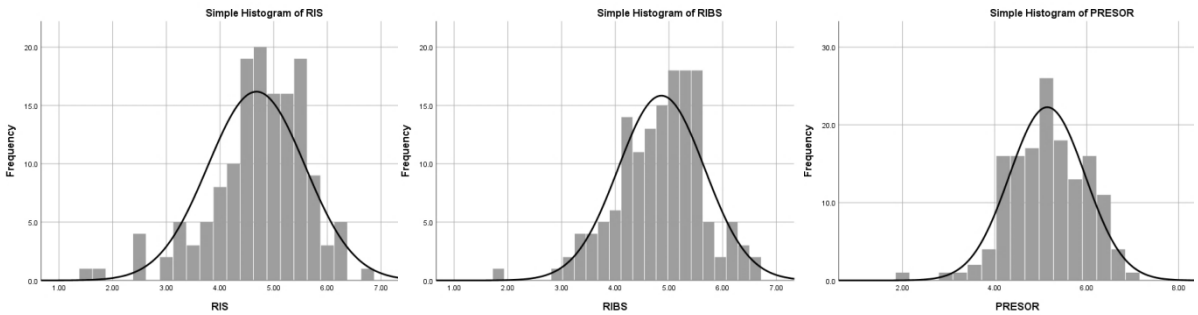

Figure 4 Histograms for RIS, RIBS and PRESOR, respectively

A factor analysis was conducted on all items, both considering 3 and 4 factors, based on the scree plot below. However, for 4 factors the interpretation was more difficult, with few, apparently unrelated

items loading in factor 4. Thus, another factor analysis was conducted forcing a 3 factor solution, and that one is shown below in the Table 4, with only values above 0.4 being kept.

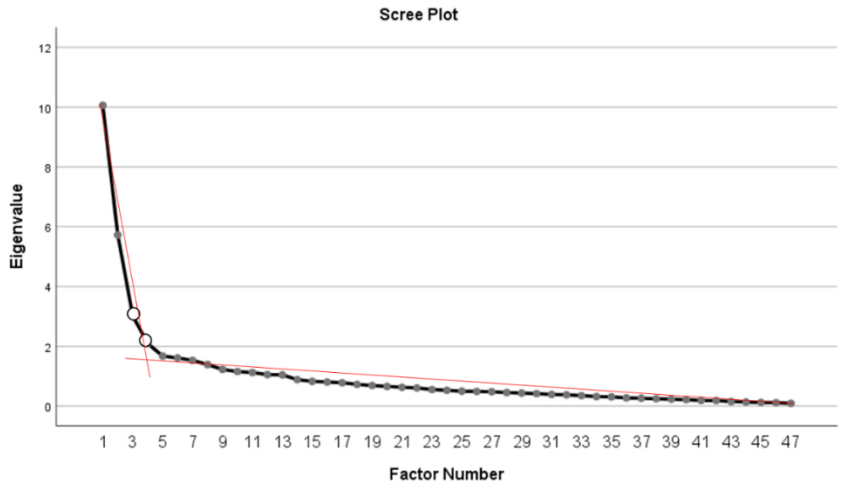

Figure 5 Scree plot

The results for the factor analysis can be seen below, in Table 4.

Table 4 Factor analysis for the items of the 3 scales used in this study (RIS, RIBS and PRESOR)

Factor / **Item**	***Responsible Innovation***	***Creativity***	***Ethics***
R1	0.681	.	.
R2	0.699	.	.
R3	0.717	.	.
R4	0.708	.	.
R5	0.499	.	.
R6	.	.	0.472
R7	0.467	.	.
R8	0.559	.	.
C1	.	0.623	.
C2	.	0.607	.
C3	0.415	.	.
C4	0.638	.	.
C5	0.659	.	.
C6	.	0.676	.
C7	.	0.491	.
C8	0.702	0.439	.
C9	0.573	0.513	.

C10	.		.
C11	.	0.64	.
C12	.		.
C13	.	0.444	.
C14	.	0.559	.
C15	.	0.408	.
C16	.	0.486	.
C17	.	0.456	.
C18	.	0.49	.
C19	.	.	.
C20	0.694	.	.
C21	0.597	.	.
C22	0.496	.	.
C23	0.664	.	.
E1	.	.	0.66
E2	.	.	0.636
E3	.	.	0.525
E4	.	.	0.541
E5	.	.	0.418
E6	.	.	0.624
E7	.	.	0.518
E8	.	.	0.534
E9	.	.	0.437
E10	.	.	0.66
E11	.	.	.
E12	.	.	0.542
E13	.	.	0.625
E14	.	.	0.657
E15	.	.	.
E16	.	.	.

The factor analysis was conducted using a Maximum Likelihood as the method for extraction, and the rotation used was Oblimin, since an oblique rotation assumes that factors are correlated on an item-level, which is a more realistic assumption (Field, 2018, p. 794). It was also calculated the correlation

between factors, shown below. It is possible to see that the factor Responsible Innovation was correlated with Creativity, which might have caused the unexpected split in the items or RIBS between these two factors.

Table 5 Correlations between factors

	1	2	3
1. Responsible Innovation	1.000	.	.
2. Creativity	0.342	1.000	.
3. Ethics	0.047	-0.006	1.000

As it is possible to be seen in the factor analysis, displayed in Table 5 above, the items of the PRESOR scale only loaded in the factor “ethics”, with some items not loading the threshold of 0.4. There was no interference or double measure. For the RIS scale, 7 of the 8 factors were loading in the “responsible innovation” factor, which shows that the scale is consistently measuring the intended construct. The one item that loaded into “ethics” was “It is important to me to explore the various ethical aspects of my ideas”, so, in the presence of the other ethics items, it may have more strongly measured that instead of responsible innovation. However, it was considered that this item is relevant for the desired measure, and since it was proven stable in a previous analysis with only RIS items, it was decided to keep it.

The RIBS scale, however, had some of its 23 factors loading in “creativity” and some loading in “responsible innovation”. This might indicate an issue in the internal consistency of the RIBS, which is supposed to measure a single factor, ideational behavior, which it is used here as a measure of creativity. Some examples of items that loaded in responsible innovation are: “I come up with a lot of ideas or solutions to problems”, “Friends ask me to help them think of ideas and solutions”, and “I have ideas about new inventions or about how to improve things”. These items are more related to creative problem solving. The items loading in creativity are, for instance “I have many wild ideas” and “I like to play around with ideas for the fun of it”, which can be seen as less result driven and more focused on the ideation and originality aspects. Since the three scales are being used to understand responsible innovation behavior, it is considered acceptable to maintain all items from RIBS in this study, loading in both factors. This will, however, be taken into account when analyzing and understanding the results obtained for this scale.

4. Results

4.1 Demographic data

To check if there was any significant differences between demographics, it was run an Independent samples Kruskal-Wallis Test on SPSS, a non-parametric method for testing the distribution among two or more groups, being an extension of the Mann–Whitney U test (McKight & Najab, 2010). The significance level is 0.05, and results are shown in Table 6.

Table 6 Kruskal-Wallis Test for demographic groups

Null Hypothesis	Significance	Decision
The distribution of **RIS** is the same across categories of **Gender**	.192	Retain null hypothesis
The distribution of **RIBS** is the same across categories of **Gender**	.985	Retain null hypothesis
The distribution of **PRESOR** is the same across categories of **Gender**	.082	Retain null hypothesis
The distribution of **RIS** is the same across categories of **Age**	.341	Retain null hypothesis
The distribution of **RIBS** is the same across categories of **Age**	.536	Retain null hypothesis
The distribution of **PRESOR** is the same across categories of **Age**	.068	Retain null hypothesis
The distribution of **RIS** is the same across categories of **Degree**	.820	Retain null hypothesis
The distribution of **RIBS** is the same across categories of **Degree**	.105	Retain null hypothesis
The distribution of **PRESOR** is the same across categories of **Degree**	.508	Retain null hypothesis

It is interesting to notice that the distributions of the scores in the three scales was the same across all demographics. For that reason, these groupings will not be further used in the analysis.

4.2 Pearson correlations

Finally, the analyses for Pearson correlation coefficients were started. These coefficients show how two variables are linearly related, which would then help understand the relationship between two

constructs. The first part of this analysis was to understand how the Responsible Innovation Scale was related to the creativity measure (RIBS) and the ethical measure (PRESOR), as well as the relationship between the two latter. The results are shown in table 7.

Table 7 Correlations between RIS, RIBS and PRESOR

	1	2	3
1. RIS	—		
2. RIBS	0.596 **	—	
3. PRESOR	0.254 **	0.035	—

**. Correlation is significant at the 0.01 level (2-tailed).

This analysis showed that there is a positive significant relationship between RIS and RIBS. This correlation is borderline between moderate and strong, which is a positive sign that the RIS is effectively measuring creative behavior. The correlation between RIS and PRESOR is weak, however still significantly valid, showing a positive correlation between them. However, no significant relationship is seen between the RIBS and PRESOR.

Next, the correlations between each of the Scenarios with the three scales were analyzed. The open-ended scenarios were analyzed both for creativity and ethics, through content ratings, as explained in the previous section. These scores were analyzed against the three scales, as it is shown in Table 8.

Table 8 Correlations between scenarios and scales

	RIS	RIBS	PRESOR
A1. Toxic Chemical	-0.236 *	-0.127	-0.352 **
A2. Serving Size	-0.115	-0.035	-0.263 **
A3. Personal Data	-0.332 **	-0.119	-0.123
B1. Intelligence Drug – Creativity	-0.051	-0.143	-0.056
B1. Intelligence Drug – Ethics	0.260 *	0.156	0.287 *
B2. Skin Whitening – Creativity	-0.048	-0.237 *	0.143
B2. Skin Whitening – Ethics	0.292 **	-0.004	0.346 **

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The first Likert-scaled scenario, Toxic Chemical, was negatively related to both RIS and PRESOR. Scenario A2, Serving Size, was negatively related to PRESOR, but no other significant correlations. Lastly, the total score for Personal Data displayed a negative correlation with RIS, yet nothing with the other two scales. These scenarios did not explore the creative aspect of the situations, since the participants were faced with a specific course of action and had to decide whether to follow it or not. It is, therefore, understandable that no correlation was found between RIBS and the responses. However, it was expected negative correlations between all scenarios and both RIS and PRESOR, since the two scales are touching the social responsibility aspect, and high scorers on these scales should score low on the unethical scenarios. Therefore, it is not clear why scenario Serving Size had no significant correlation with RIS, or why scenario Personal Data had no significant correlation with PRESOR.

This analysis was conducted splitting the scores between creativity and ethics to make sure all effects are identified, instead of calculating one total score. It is possible to see that there are no significant correlations for the Creativity measure of Intelligence Drug, whilst for the Skin Whitening scenario, the creativity measured showed only one significant correlation, an unexpectedly negative correlation with RIBS. Thus, the scores in RIS had no correlation with how creative the responses in the scenarios were. This might be due to the design of the study, in which participants had not much added benefit in spending more time coming up with ideas or did not have that extra time. This could have led the answers to be more common than they would have been in a different context. However, the direction of the social responsibility of participants (ethical score) was correlated with both the RIS and the PRESOR. The lack of appropriate time and context to answer the scenarios would not affect how the participant perceive social responsibility. This might explain why a significant correlation was found between these two scales and the ethical score, and not between creativity and the scales.

The results of these pre-analyses will be used to define whether a linear regression makes sense to analyze the data, or whether no significant results will be found. These more in depth analysis is the subject of the next few sections.

4.3 Analyses between scales

The first step in understanding whether the RIS is measuring what is intended for, is to analyze whether the constructs creativity and ethics, measured by RIBS and PRESOR respectively, can predict the score in the RIS. Based on that, a multiple linear regression analysis was conducted to measure the main effects, considering the RIS as the dependent variable, which represents the outcome whose variation we aim to study, and both RIBS and PRESOR as independent variables, which represent the inputs or potential reasons for variations. The resulting model is shown below, in Table 9.

Table 9 Linear regression between RIS and the two supporting scales

Dependent variable = RIS; $R^2 = 0.410$; F = 50.05; sig of F < 0.001

Independent variable	**β**	**t**	**p**
RIBS	0.662	9.183	< .001
PRESOR	0.257	3.649	< .001

Since both scales had shown a positive correlation with RIS, it was expected to have a positive coefficient in the regression. This was confirmed in the analysis, with RIBS showing a Beta coefficient of 0.662 with p< .001 and PRESOR showing a lower coefficient, of 0.257, yet also with p< .001. This analysis supports the theory that the responsible innovation scale would be measuring both the creativity construct and the social responsibility one. Thus, these results strengthen the predictive validity of the RIS.

4.4 RIS and Scenarios type A

In section 4.2 it was shown that all scenarios had some significant correlations with the scales, thus it is expected that a linear regression will depict some of the main effects between the dependent and independent variables. In the following analyses, the dependent variables are the responses obtained in the scenarios, therefore the outcomes of the variation, and the scales will be used to understand the reason why we see variation, so they will be treated as the independent variables. Once again, all scales were centered before running the analyses. Each scenario will be explained below.

4.4.1 Scenario A1 – Toxic Chemical

The first analysis conducted for scenario Toxic Chemical was a multiple regression, in which it was the dependent variable, and the independent variables were the scores in each of the three scales, RIS, RIBS and PRESOR. Considering a significance value of 0.05, it is possible to see that only the PRESOR scale acted as a predictor in this model, with Beta coefficient of -0.734 and p=0.003. The negative coefficient was already expected, since the scenario posed an unethical action path, and high scores meant the participant would highly likely choose to act in that way. Thus, a high score on PRESOR would mean a more ethical individual, that would then be less likely to act in the way depicted by the scenario.

Table 10 Multiple regression for Toxic Chemical (A1) and the three scales

Dependent variable = A1; $R^2 = 0.143$; F = 4.966; sig of F = 0.003

Independent variable	**β**	**t**	**p**
RIBS	-0.093	-0.293	0.770
RIS	-0.264	-0.973	0.333
PRESOR	-0.734	-3.017	0.003

This analysis, however, does not tell much about the relationship between RIS, our main scale of study, and the scenario's outcome. This is unexpected, since there was a significant correlation of -0.236 between Toxic Chemical and RIS, as shown in Table 8 in section 4.2. One possible explanation is the collinearity between the predictors RIS and PRESOR. In this case, RIS would be predicting the same variation that PRESOR is already predicting, thus the p-value of the relationship RIS-A1 is lowered, becoming insignificant. Another possible source of issues can be the bad consistency of the RIBS, that presented a split between the factors Creativity and Responsible Innovation. This overlap with the items from RIS in the responsible innovation factor might also be diminishing the effects seeing from RIS when all scales are included in the same model. To confirm this hypothesis, a simple regression was run for the A1 (Toxic Chemical), using only RIS as the independent variable. The results are shown in Table 11.

Table 11 Linear regression for A1 and RIS

Dependent variable = A1; $R^2 = 0.056$; F = 5.371; sig of F = 0.023

Independent variable	**β**	**t**	**p**
RIS	-0.511	-2.318	0.023

Table 11 shows that RIS can act as a predictor for the results in A1, with a Beta coefficient of -0.511 and a p-value of 0.023. The negative coefficient follows the same explanation for the negative PRESOR coefficient: high scores on RIS should indicate a more ethical behavior and a lower likelihood that the individual would choose to act in an unethical way. This is a good confirmation that the RIS, by itself, can reliably predict a socially responsible behavior in ethical dilemmas, as the one posed by scenario Toxic Chemical.

4.4.2 Scenario A2 – Serving Size

For scenario Serving Size, the only correlation found was with PRESOR scale. However, the complete model was tested, including the three independent variables. The scores found confirmed what was expected, only the PRESOR significantly predicted the results, with a Beta coefficient of -0.554 and p=0.023. The negative result follows the same explanation for scenario Toxic Chemical, since they were formulated in a similar manner.

Table 12 Multiple regression for Serving Size and the three scales

Dependent variable = A2; R^2 = 0.071; F = 2.261; sig of F = 0.087

Independent variable	**β**	**t**	**p**
RIBS	0.022	0.072	0.943
RIS	-0.092	-0.344	0.731
PRESOR	-0.554	-2.319	0.023

This time, running a simple linear regression only with the RIS scale would not make sense, since there was already no significant correlation between them. In any case, the results for this analysis can be found in Appendix E, yet will not be further discussed here.

4.4.3 Scenario A3 – Personal Data

The score in this Scenario, as explained in Chapter 3, was calculated based on the two most unethical actions choices. Thus, it is expected that the coefficients of the regression model will be negative for RIS. The first analysis, as for the other two type A scenarios, was a multiple regression, using the three scales as independent variables.

Table 13 Multiple regression for Personal Data and the three scales

Dependent variable = A3; R^2 = 0.117; F = 3.934; sig of F = 0.011

Independent variable	**β**	**t**	**p**
RIBS	0.204	0.810	0.420
RIS	-0.646	-3.009	0.003
PRESOR	-0.027	-0.142	0.887

As it was expected from the correlations analysis, there was no significance for RIBS and PRESOR. The RIS, however, was a significant predictor for the scores in Personal Data, displaying a Beta coefficient of -0.646 and p=0.003. Also for this scenario, the RIS was proven able to predict the ethical response to a real life situation, strengthening even more its validity as a reliable scale to measure responsible innovation behavior.

4.5 RIS and Scenarios type B

The last two scenarios, here called type B, are the closest to responsible innovation context, since allow participants to be measured both on regards to creativity and on regards to social responsibility. The scores were then analyzed separately, and are shown for each scenario.

4.5.1 Scenario B1 – Intelligence Drug

For scenario Intelligence Drug, the measure of creativity was unfortunately not significantly correlated to any of the scales used in this study. For this reason, the results for the multiple regression considering it as the dependent variable will not be discussed here, yet it can be found in Appendix E. Nevertheless, the measure for ethics was found to be correlated to both PRESOR and RIS, thus the multiple regression was conducted for this dependent variable, using the same model as for the previous scenarios, with all three scales as the independent variables.

Table 14 Multiple regression for Intelligence Drug - Ethics and the three scales

Dependent variable = B1 ethics; R^2 = 0.105; F = 2.751; sig of F = 0.049

Independent variable	**β**	**t**	**p**
RIBS	0.073	0.304	0.762
RIS	0.195	0.907	0.367
PRESOR	0.344	1.722	0.089

Using this model, no significant result was found. Still, as it happened for scenario Toxic Chemical, one possible explanation would be that the significance of each predictor is being lowered by the collinearity between them. Thus, if RIS and PRESOR are predicting the same variation in the dependent variable, the significance of this effect might be getting lower, to the point of no significance. Since the main object of study is the RIS, a simple linear regression was run considering RIS as the only independent variable, to check whether significance can be found.

Table 15 Linear regression for Intelligence Drug - Ethics and RIS

Dependent variable = B1 ethics; $R^2 = 0.067$; F = 5.211; sig of F = 0.025

Independent variable	**β**	**t**	**p**
RIS	0.365	2.283	0.025

Once again, significance was found once the RIS was analyzed as the only predictor for the scenario outcome. This shows that the scale can be used by itself to determine the behavior participants would have in real life situations. The positive Beta coefficient, of 0.365, is explained by how the rating of ethics was conducted, being the lowest score 1 very unethical, and the highest score 6 very ethical. In that way, a positive coefficient shows that participants that scored high in RIS are having more ethical ideas than participants that scored low on the RIS.

4.5.2 Scenario B2 – Skin Whitening

The last scenario to be analyzed is Skin Whitening, in which scores were given for creativity and ethics, being further individually analyzed. First, the multiple regression was conducted considering its creativity score as the dependent variable and the three scales as independent ones.

Table 16 Multiple regression for Skin Whitening - Creativity and the three scales

Dependent variable = B2 creativity; $R^2 = 0.090$; F = 2.305; sig of F = 0.084

Independent variable	**β**	**t**	**p**
RIBS	-0.545	-2.043	0.045
RIS	0.064	0.268	0.789
PRESOR	0.291	1.317	0.192

For the RIS and PRESOR, no significant values were found. However, the coefficient found for the RIBS was highly unexpected. There was a significant Beta coefficient of -0.545, which meant that high scorers in the RIBS scale, measuring mainly creativity, had actually lower scores on the creativity measure for the real-life scenario. This might, once again, indicate that the design of the questionnaire should be improved, since external factors might be interfering with the participants' performance, or with the rating of responses. The poor internal consistency observed for the RIBS, also already discussed, might be impacting the results, indicating that this scale might not be reliably measuring

the intended construct. This will be further discussed in the next chapter, although it is already worth mentioning that the creativity pillar did not demonstrate the expected results.

Moving forward with the analysis, the same procedure was applied to the ethics measure, which had shown correlations with both PRESOR and RIS. The results of this multiple regression are shown in Table XX.

Table 17 Multiple regression for Skin Whitening - Ethics and the three scales

Dependent variable = B2 ethics; R^2 = 0.176; F = 4.974; sig of F = 0.003

Independent variable	**β**	**t**	**p**
RIBS	-0.445	-1.641	0.105
RIS	0.510	2.107	0.039
PRESOR	0.449	1.997	0.050

As expected, both RIS and PRESOR were significant predictors of the scores for ethics in Scenario Skin Whitening, with Beta coefficient of 0.510 and p=0.039 for RIS, and Beta coefficient of 0.449 and p=0.05 for PRESOR. The positive relationship shows that participants scoring high on the scales also had a more ethical performance in the idea generation scenario.

4.6 Supplementary analysis

This section intends on further validating the RIS scale as measuring both ethics and creativity, using the two supporting scales to do so. The first step in this analysis was to split the scores for both RIBS and PRESOR into low, moderate and high. Since there were 147 participants, it was split into 49 in each category, sorted by low to high scores, having a 1 for low, 2 for moderate and 3 for high.

The graph displayed below if a scatter plot of RIS vs RIBS split by the three groups for PRESOR. What this shows is the moderating effect that PRESOR has on the relationship between RIS and RIBS, which becomes steeper for higher values in PRESOR. Thus, the effect of creativity (measured by RIBS) is stronger when the ethics value is higher, showing that RIS is being affected by both constructs.

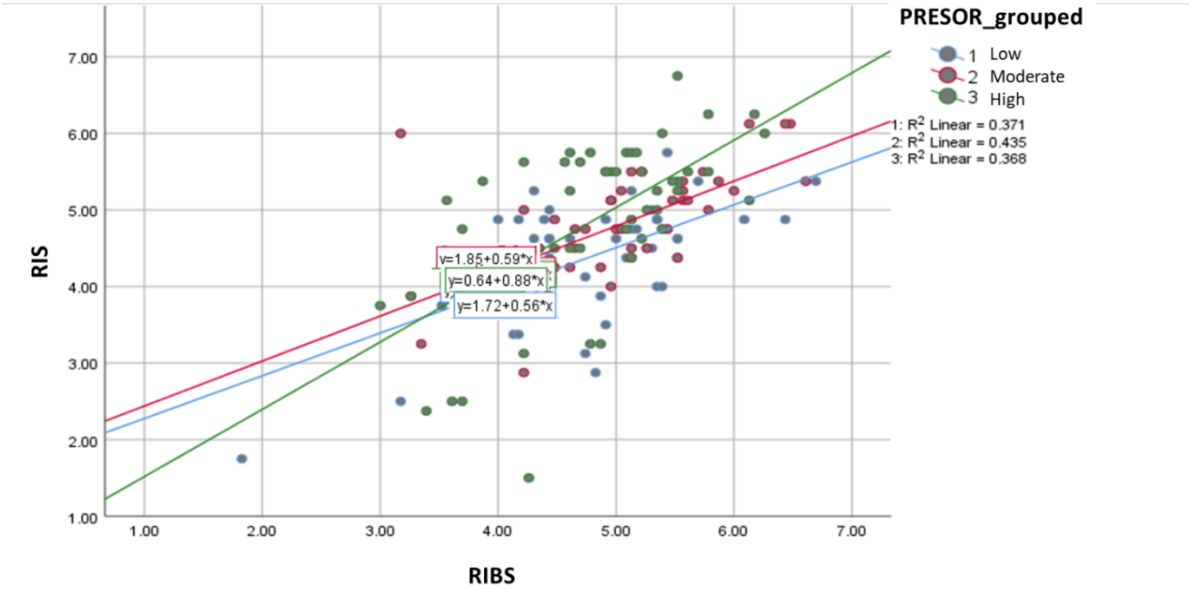

Figure 6 Grouped scatter of RIS vs RIBS grouped by PRESOR (low, moderate and high)

The opposite is also true. The scatter plot of RIS vs PRESOR, grouped by low, moderate and high values of RIBS, also show an increase in steepness the higher the group, showing almost a flat line for the relationship between RIS and PRESOR when there is low creativity. Since RIS was designed to measure a behavior influenced by creativity and ethics, this moderating effect was expected to happen, since each of the scales, RIBS and PRESOR, are only predicting part of the variance in RIS.

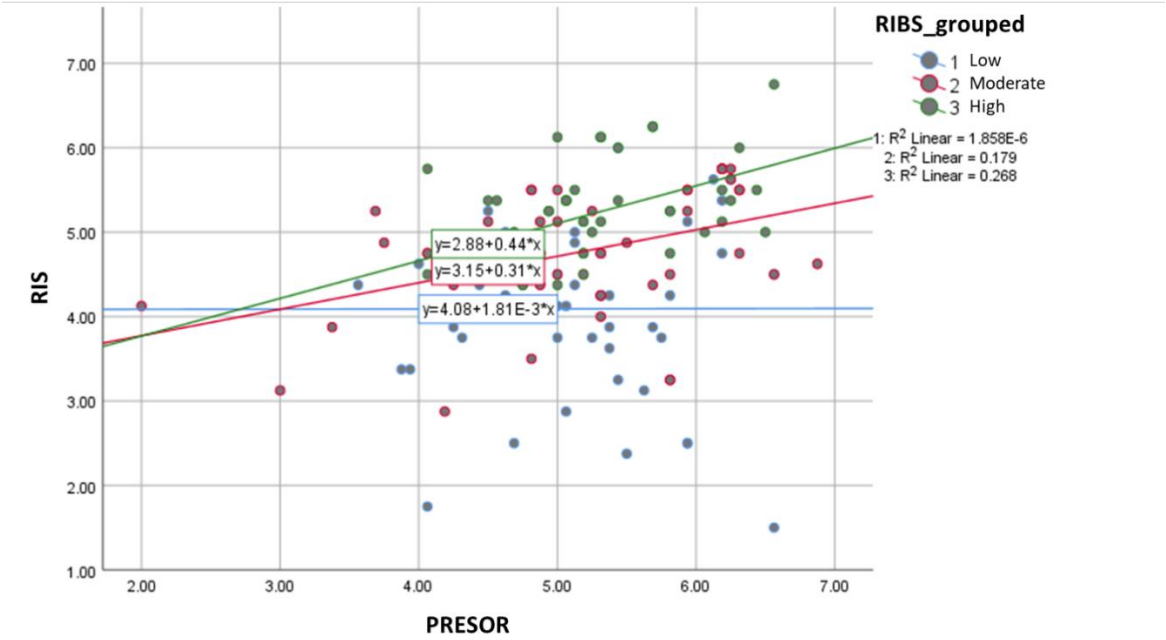

Figure 7 Grouped scatter of RIS vs PRESOR grouped by RIBS (low, moderate and high)

Thus, it can be inferred once again, that RIS is reliably measuring the two constructs it intended on measuring, creativity and ethics, resulting in Responsible Innovation Behavior.

5. Discussion

5.1 Scientific Relevance

It is undeniable that many efforts are being dedicated to researching Responsible Innovation. However, much of these are being dedicated into finding less ambiguous definitions, creating frameworks to be followed, or discussing the role of policy and regulatory institutions in guaranteeing that innovations are being created in a responsible fashion (Owen et al., 2012; von Schomberg, 2011). Less attention is, therefore, dedicated to this concept at the individual level.

The perspective added by this study brings the attention more to the innovator, than the innovation process itself. Realizing how the person understands the role of innovation in society, and how they would behave when confronted with an ethical dilemma inserted in the innovation process, is an important first step for, in the future, understand ways how this behavior can be shifted to a more desirable one. Whilst, for instance in economics, it is important to recognize the main trends in macroeconomics to create adequate policy, understanding micro- and behavioral economics is also crucial to reliably understand the whole picture (Reynolds, 1985). The same is true for responsible innovation. Looking at the macro perspective of how innovations have been developed so far, what are the main trends, what are the root causes of issues, among others, will provide powerful insight. However, it will not provide the entirety of relevant information.

Having a scale that reliably measures responsible innovation can be relevant in numerous ways for scientific development. This area might have been little explored due to the lack of a measurement tool for this construct. One possible use for it is to help identify which factors are leading to a different responsible innovation behavior. For instance, there could be a research on whether different economic backgrounds influence the social responsibility during the innovation process. If the subjects have never actively innovated, it might be difficult to understand whether they would care about the social impact of their innovations or not. Simulating an experiment might help in this case, yet it would be time- and resource consuming, which sometimes might hamper the development of the research. Having and easy way to collect a high number of data can increase the power of the research and help for a first screening on which areas are worth investing further, with more sophisticated research methods. The RIS can be extremely useful for this.

The same would be true for a number of other topics related to Responsible Innovation. For instance, to check for the relationship between area of study, personality traits, social engagement, i.e., any possible factor that would influence the outcome of individual behavior when confronted with an ethical dilemma in the innovation process. It broadens the possibilities of research by providing a reliable and non-complicated measurement tool. Since it is a short scale, it might also lead to more

accurate data, considering that respondents will not get too tired, and as it was proven before, it measures the two constructs that are expected of it.

The scale can also be used as a measure to validate the design of Responsible Innovation experiments. Choosing the types of activities, scenarios, goals of each experiment might be tricky for a complex construct such as responsible innovation behavior. Thus, a pilot study can be created first, using the RIS, a validated scale, to measure whether the experiment is reaching its objective. This will be useful to guarantee that resources for research are invested in experiments that were properly designed, lowering the risk of having non-significant results. It was shown in the literature review that there are no appropriate measures for that end. Therefore, the RIS comes to close yet another gap.

Policy makers can also benefit from the RIS. Even when the focus of research is understanding frameworks and regulations that should be in place to incentivize responsible innovation, they might differ when dealing with different areas of innovation. The type of policy intervention that should be in place for researchers in the public domain might be different than the needs in the private sector. And again, inside these domains there might be another set of different needs, based on the type of industry and trade for instance. Having insights on how individual actors perceive responsible innovation in each of the different sectors might shed a light into how policy can be adapted to serve those different needs. Having such a simple tool to measure responsible innovation behavior can facilitate the work of policy researchers, allowing them to gather enough data in each different area to understand nuances that, before, were simply not feasible. Policy makers can also use the RIS over time, to measure whether the programs put in place are achieving the desired result. For example, if an initiative to regulate innovation is implemented, yet the people in the industry perceive this just as another obstacle to circumvent, and the importance of responsible innovation is still not understood, this will show in the responses obtained with RIS and might help policy makers reevaluate if the impact achieved is the desired one.

Finally, the RIS can also be applied in behavioral research, when trying to understand what type of context might make participants act more socially responsible. It is known that the environment can influence the behavioral output. Therefore, a natural next step for understanding responsible innovation in the individual level would be to understand what kind of situations might prime innovators to be more or less ethical. For example, it could be investigated if priming one group of subjects with messages about profit or survival of the company, priming a second group with messages about social issues, and having a control group, could result in different scores in the RIS.

5.2 Practical relevance

The relevance of RIS in practice stems from the same line of reasoning as the scientific relevance. The main benefits added by it are its reliability to measure a difficult construct and its simplicity to do so with only 8 items. The contexts in which it can be applied are varied, ranging from private companies to educational institutions.

As regulations tighten up and the public opinion influence rises, companies are increasingly concerned with the general concept of Corporate and Social Responsibility (Carroll, 1999; Collier & Esteban, 2007; Sparkes & Cowton, 2004). Responsible innovation represents a crucial part of that. Thus, it is in most companies' interest to be able to understand their employees' behavior and opinions. Although many enterprises train their staff in corporate ethics, this not always results in employee's commitment to socially responsible behavior (Collier & Esteban, 2007), and the RIS could help identify this. Administering RIS in different departments might also enlighten about which areas the lack of responsible innovation might be a bigger problem, allowing the company to dedicate more resources in those specific areas. In addition, when hiring new people, the company could include the RIS in their screening process, although in this situation the response bias due to social desirability might be increased. The same could be true for research institutions, both for appraisal of current researchers and also to help screening for new team members.

Educational institutions might also benefit from the RIS as a way to measure the ethical development of students over the years. Most universities have mandatory courses of ethics for all students, independently of the area of study. The RIS could be applied before and after this course, for instance, to check if the course is having the intended effect in the minds of students, making them more aware of the necessity to rethink the concept of innovation in order to include social responsibility in it. In the educational environment, the RIS can also be used to understand if a different approach to this topic is needed in different areas of study, since it would point out to differences in the individual level.

5.3 Social relevance

Innovation can be seen as something that a group of few – varying from one to the thousands – individuals works on, develops, and deploys. There might be a different group of individuals financing this creation and thinking about how to profit from it. At the same time, a different group of individuals is trying to understand how the innovation process work, how to regulate it, how to control it. However, once the innovation is out, society as a whole will feel its impacts and will have to deal with its consequences. Even though most of the people impacted had no say in the process or arriving at that innovation, they will have to adapt to it and to the new reality shaped by it.

The social relevance of this work is the contribution to a better understanding on how innovation can be made more socially responsible. Even though the Responsible Innovation Scale is only a tool, it can be used to unravel the puzzle that is the inclusion of ethical behavior into the innovation process. The many efforts dedicated to this topic will benefit society by steering innovation to solving societal problems, or at least to be socially conscious on the impacts that it will cause. Understanding responsible innovation means making sure that all stakeholders impacted, whether they have power on the process of innovation or not, will be taken into consideration, and that this behavior will at some point be the norm.

Creativity and innovative behavior can be the solution to many societal problems. As Gruber (1993) wisely pointed out, many ethical dilemmas can only be solved by approaching them in a creative way. The benefit of Responsible Innovation for society is to not allow for innovation to be feared or rejected, but to steer it to a positive outcome. Identifying this behavior, its roots and what can prime it, will allow for the development of a more socially conscious innovation systems, and society will benefit from the effects to come.

For instance, a big societal challenge is how to transform the world to a more sustainable one, using the natural resources more wisely and protecting the environment. To do so, the way to do innovation should be transformed, involving the public within an inclusive innovation politics (Leach et al., 2012). New frameworks on how to incorporate sustainability goals in the decision-making process, during the design of new technologies, are being developed (Hansen, Grosse-Dunker, & Reichwald, 2009), yet the principles in which they are based on are similar to the broader concept of responsible innovation. By understanding how to incentivize this behavior, societal challenges have a higher chance of being tackled by an innovative response.

5.4 Relevance for Management of Technology

The study of Management of Technology aims at understanding how technology can be used to improve products, services and processes, at the same time as being mindful of its effects in society. Technology can strengthen companies and economies competitive advantages, but its use should be responsible and transparent to society. Exploring topics related to responsible innovation is at the core of the study of Management of Technology, which provides perfect alignment with the topic approached in this report.

Creativity, which is also a source of competitive advantage for companies, is approached here in a different way, focusing on how creative behavior can relate to responsible innovation behavior, showing that creativity might be of even bigger importance for solving our societal problems. By putting together the literature on creativity, morality and responsible innovation, this work

summarizes the importance of research in Management of Technology, since apparently unrelated topics can provide ways to improve society through responsible innovation.

5.5 Summary of findings

The analyses described above, although extensive, can be summarized in a few statements. The initial screening of the RIS validity, the core scale of this study, was through analyzing the relationship between it and the scales measuring creativity and ethics. With both the regression analysis, shown in Section 4.3, and the moderating effect investigation shown in the supplementary analysis (section 4.6), it was supported that these two constructs are participating in the scores for RIS, providing evidence in favor of both Hypothesis 1, *Responsible Innovation is positively correlated to ethical behavior* for the positive relationship between PRESOR and RIS, and Hypothesis 2, *Responsible Innovation behavior is positively correlated to Creative behavior*. In addition, there was no significant correlation between the RIBS and the PRESOR, indicating that these two constructs had no influence on one another. In this study, it seemed that creativity and ethics were independent of each other.

The most important part of the study, however, was related to the predictive validity of the scales towards the real-life scenarios posed to participants. The creativity scale, RIBS, did not predict any different behavior between low and high scorers, only showing one significant negative relationship with the measure for creativity in the scenario Skin Whitening, which was unexpected. The PRESOR, scale measuring social responsibility, reliably predicted a more ethical behavior for most of the scenarios, including Toxic Chemical, Serving Size, and the ethical compound of both Intelligence Drug and Skin Whitening. This shows that PRESOR can be a predictor of ethical responses, since there was a significant difference between high and low scorers. Finally, the results obtained for RIS showed that, out of the 5 scenarios investigated, the RIS reliably predicted ethical behavior in 4 of them, Toxic Chemical, Personal Data, and the ethical score for the two open ended ones, Intelligence Drug and Skin Whitening, which supportss our Hypothesis 3a, *Responsible Innovation is positively correlated to moral and creative responses to ethical dillemas*. Nevertheless, there was no significant difference between low and high scorers on RIS in the creativity score, showing that the scale did not predict reliably this construct, providing no support for Hypothesis 3b. The lack of reliability between self-reported creativity and the actual measure on the scenarios might weaken Hypothesis 2. However, there was strong evidence supporting both Hypothesis 1 and 3a on this final part of the study.

5.6 Limitations of the study and suggestions for further work

As it was shown in Chapter 2, Responsible Innovation counts with four pillars: Anticipation, Reflexivity, Inclusion and Responsiveness. Although the Responsible Innovation Scale seems to be very effective in measuring behaviors typically present in Anticipation and Reflexivity, it does not extensively talk

about the latter two. The focus on the ideation stage of innovation is justified by being the moment when the innovators themselves can think about where they want the new invention to go, and how the work should be planned to achieve this objective. The pillars of Inclusion and Responsiveness are more concerned with the correct execution of the innovation process and might be more relevant for the framework in which the innovation systems lie on, thus on the connection between the micro level here investigated and the macro level of policy management. However, this might limit the extent to which RIS can predict also the behavior on later stages. Even though the Inclusion and Responsiveness pillars are more related to the system rather than the individual, if the RIS was formulated in order to comprehend also the individual's views on these pillars, it could provide a more robust measurement tool for responsible innovation behavior.

For the future, a second version of the RIS could be tested, including items specifically linked to these two pillars. Some items for Inclusion could be "I believe the innovator should listen to relevant stakeholders on how the innovation might impact them", or "I like to run my ideas through different people to make sure I am on the right path", or "I believe public values should be included in the innovation process". Similarly, for Responsiveness, some example items could be "I believe innovations should be adaptable to changing environments", or "It is the innovator's duty to make sure innovations are made compliant to society's needs". This might provide a more extensive view on the responsible innovation behavior, including also the sense of accountability and ownership on the innovation process.

Another limitation of this study was regarding the creativity measure used. Even though the RIBS seemed to be highly used in the literature and showed consistent results, that was not the case for this study. On the factor analysis, this scale was splitting between 2 or even 3 factors, whereas in the original publication it was supposed to have only one (Runco et al., 2001). This split between different factors possibly made the results on the regression analysis with the three scales less reliable, since it was not consistently measuring one construct. This might also have been problematic due to significant overlap between the RIBS and the RIS, which might also have impacted the stability and reliability of the analysis. Finally, this scale was also only concerned with the ideation part of creativity, focusing only on measuring divergent thinking. The lack of evidence linking this scale and the results obtained in the scenarios might also be explained by this limited focus. In future studies, it is recommended to find a different measure for creativity.

Finally, the way responses were gathered was not ideal, with respondents spending an average of 11 minutes on the full questionnaire according to Survey Monkey reporting, which led to less creative responses being collected. As Nijstad et al. (2010) showed in their study, the persistence factor is also

important to obtain creative inputs. When there is time constraint, or subjects are not fully dedicated to answering the survey, the number and quality of creative ideas might be decreased. This study collected responses online and offered no compensation for respondents, which caused many to give up once they reached the open-ended questions, which require more thinking. Having a lower number of responses caused the relationships to be less significant, since there was not enough power to it. At the same time, some subjects that scored high in the creativity measure, which means they regarded themselves as highly creative, did not perform as creatively as expected in the scenarios. This does not necessarily mean these individuals were not creative, they might simply not have been focused or motivated enough to come up with multiple creative solutions to the scenario posed.

For future work, it is recommended to have subjects in one place, where it is possible to brief them properly and they will have a dedicated moment to answer the questionnaire. By doing so, it is possible to reduce the number of distractions and ensure respondents take their time. One idea would be to administer this during class, when students are already focused. Another recommendation is to think about offering some compensation for participants, in order to further motivate them to spending time on each question. Finally, it could also be possible to redesign the scenarios in order to avoid having open-ended questions, and possibly measure the constructs without demanding that much time and effort from respondents, thus increasing the quality of responses obtained.

6. Concluding remarks

Understanding responsible innovation is no easy task. Whilst many researchers are still working on conceptualizing and creating a working definition for it, this work was focused on taking a step back and looking at how responsible innovation can be understood at the individual level. Strong evidence was found that there is a positive relationship between Responsible Innovation Behavior and social responsibility, or pro-social behavior. The fact that the RIS could reliably predict the more ethical responses to the moral dilemmas posed to respondents gives a strong indication we are in the right path to understanding the micro-level of responsible innovation.

Further research is needed in order to refine the scale and to validate it with other measures of creativity and innovation, since that was the weakest link in this work. This can be done both by choosing different scales on these topics and by applying the real-life scenarios to respondents in a more suitable environment, where they can spend more time and energy on unleashing their creative potential. This might also be useful to better comprehend the relationship between ethics and creativity, which have caused much debate in the literature and yet showed no significant result here.

The main take-away from this study is that there is a new way of looking at responsible innovation. Whilst is extremely necessary to understand the concept in terms of systems, frameworks and policies, it is as important to look at the individual and how it perceives responsible innovation. The RIS will hopefully pave the way to more researchers looking at this angle, allowing for a better grasp on how we can steer innovation to a more positive and responsible outcome.

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8. Appendices

8.1 Appendix A

Runco Ideational Behavior Scale (Runco et al., 2001)

1. I have many wild ideas.
2. I think about ideas more often than most people.
3. I often get excited by my own new ideas.
4. I come up with a lot of ideas or solutions to problems.
5. I come up with an idea or solution other people have never thought of.
6. I like to play around with ideas for the fun of it.
7. It is important to be able to think of bizarre and wild possibilities.
8. I would rate myself highly in being able to come up with ideas.
9. I have always been an active thinker—I have lots of ideas.
10. I enjoy having leeway in the things I do and room to make up my own mind.
11. My ideas are often considered “impractical” or even “wild.”
12. I would take a college course which was based on original ideas.
13. I am able to think about things intensely for many hours.
14. Sometimes I get so interested in a new idea that I forget about other things that I should be doing.
15. I often have trouble sleeping at night, because so many ideas keep popping into my head.
16. When writing papers or talking to people, I often have trouble staying with one topic because I think of so many things to write or say.
17. I often find that one of my ideas has led me to other ideas that have led me to other ideas, and I end up with an idea and do not know where it came from.
18. Some people might think me scatter brained or absent minded because I think about a variety of things at once.
19. I try to exercise my mind by thinking things through.
20. I am able to think up answers to problems that haven’t already been figured out.
21. I am good at combining ideas in ways that others have not tried.
22. Friends ask me to help them think of ideas and solutions.
23. I have ideas about new inventions or about how to improve things.

Perceived role of ethics and social responsibility (Singhapakdi et al., 1996)

1. Being ethical and socially responsible is the most important thing a firm can do.
2. While output quality is essential to corporate success, ethics and social responsibility is not.
3. Communication is more important to the overall effectiveness of an organization than whether or not it is concerned with ethics and social responsibility.
4. Corporate planning and goal setting sessions should include discussions of ethics and social responsibility.
5. The most important concern for a firm is making a profit, even if it means bending or breaking the rules.
6. The ethics and social responsibility of a firm is essential to its long term profitability.
7. The overall effectiveness of a business can be determined to a great extent by the degree to which it is ethical and socially responsible.
8. To remain competitive in a global environment, business firms will have to disregard ethics and social responsibility.
9. Social responsibility and profitability can be compatible.
10. Business ethics and social responsibility are critical to the survival of a business enterprise.
11. A firm's first priority should be employee morale.
12. Business has a social responsibility beyond making a profit.
13. If survival of a business enterprise is at stake, then you must forget about ethics and social responsibility.
14. Efficiency is much more important to a firm than whether or not the firm is seen as ethical or socially responsible.
15. Good ethics is often good business.
16. If the stockholders are unhappy, nothing else matters.

Responsible Innovation Scale

1. I am good at coming up with ideas that are novel, but also right
2. I find it easy to generate original solutions that reflect how the problem at hand ought to be solved
3. Producing large numbers of solutions for a better future comes natural to me
4. I am good at generating many ideas that capture the responsible side of innovation
5. I have a knack for coming up with many ethical solutions to a problem
6. It is important to me to explore the various ethical aspects of my ideas

7. Transforming new ideas into useful applications (such as new products, services or business models that make the world a better place) means a lot to me
8. I am good at introducing responsible solutions to a meaningful problem into new organizational arrangements

8.2 Appendix B

Answers to open ended scenarios (type B)

Scenario B.1: Intelligence Drug

You have recently developed a brain enhancing drug that, in addition to being highly effective, also have minimal to non-detectable side effects. This drug can potentially disrupt the educational system and many other sectors, since the intellectual performance of those taking the drug can increase significantly. However, this drug is extremely expensive to produce. How would you, as the drug developer and owner of the intellectual property, implement this drug in the market? Try to come up with as many as possible original ways to do so (separate your answers in different lines).		
Answer / Score	Creativity	Ethics
Target rich people that will pay premium by: 1) link the drug usage to wealth generation/increase 2) team up with exclusive social media for advertisement 3) approach private education institutions with an offering	5	2
I would try to sell the idea for big schools that want to improve their results os their students in public exams;	3	3
As a medical only drug, so only people that need it can actually use it and it will be covered by the medical insurance	3	5
Sell it to reach people only Reach out to governments, mass produce to reduce costs, and implement in public schools Take the drug to become smarter and come up with better ideas to distribute the drug	4	4
Ask to the public institutions help for financing Partner with other companies	2	4
introduce it to university students introduce it to parents as early as kidergarten with the oportunity for them to buy it for their child have fliers in as many doctors waiting rooms as possible adds online, on a tv, in magazines, billboards,... have a respectable person that everyone knows talk about it on a talkshow (tv, radio)...	3	3

create catchy phrases that can be found in random places such as bathroom stalls the main focus group would be parents, university students and people with stressing jobs		
Try to apply for subsidising for the product to lower the costs Enter multiple national markets at the same time to increase client base for larger scale production and lowering costs Make it a niche product for high prices only available for wealthy consumers	3	3
* Start an enterprise and get funding to start production * Sell this technology to a leading pharmaceutical company	3	3
To help students when studying To increase effectiveness of employees For musicians to perform better General purpose pill for daily use Chess player enhancement	4	4
I would sell it for people developing technologies to cure serious diseases	5	6
I would sell to the US Army.	6	4
Sell the drug with a relatively low profit, enough to keep up with the cost of running the company. Try to provide R&D staff free portions of the drug to find ways to produce the drug in a more inexpensive way. Once that is achieved, sell the drug with the same profit margin.	5	4
Promoting in tv series with people that want to try sonmething crazy and make them aware of the side effects	4	2
As a good and efficient product, but with some side effects.	1	3
Check first the potential side effects Guarantee that there are not long term severe side effects Work with federal institutions to evaluate the positive/negative sides for other sectors	2	4
go to insurance company and see if I can be in the insured package	4	5

go to Universities/educational companies and propose them to give for free if people subscribe. Its a win win; higher chance of passing and higher % of people that pass (advertisement) set up a savings programm for the government to reduce education cost due to more people passing quicker		
Advertising the drug as the 'number one education hack drug' of all time. Especially emphasizing the non-detecable side-effects and by targeting students.	3	2
Produce a few and gain public awareness, then expand	1	3
Sales by dealer in silence	1	2
Advertisement in social media	2	3
-offer it with a really high price linked to a limit of production. -high price with limit in production and lottery system in order to give all people the possibility to get the drug	4	5
I would use mentally challanged people as subjects for this drugs. This will be done only after proper and legal permissions of their loved ones. If the drug enhances their mind to become a normal functioning humans of the society then I would propose for advocating the expand of this use.	6	6
Look for the appropriate customer: Such as, within rich countries, focus on the business class/high class. Offer them the product as a competitive advantage over the rest of the people, and very exclusive due to the price. This exclusivity adds an extra benefit in the eyes of the upper classes. Introduce the product through important, successful celebrities different for each country. For example, offer the product for free to certain celebrities to try them out and make publicity of it. Such as important, successful CEOs or even presidents, which can be seen as intelligent and influential, so that people interested in following those career's paths would bemore interested in buying the drug.	6	1

Introduce the drug in high studies societies. to people studying MSc or PhD, sell it as an opportunity to improve performance and get to a higher level of efficiency,which would eventually lead to better job opportunities. Clearly state how this drug separates you from the rest both intellectually and meke them feel they belong to that exclusive cirlce. Allow the people buying the product to connect with each other, which creates a network of the upper class and business/ high students, really interesting for everyone		
Crowdfounding	1	3
For special situation, for example who has any dificultty of learning, deslexy	5	5
Promote it for people that have some sort of dementia to help them be included in society. As it is expensive, partnership with companies, kind of as if it was a social program. Promote it among researchers as long as their research is officially committed to responsible researching Promote among doctors that work long shifts on the emergency room, especially surgeons	6	7
- get subsidies from governments to improve healthcare - sell to companies for a lot of money under exclusivity so they have a competitive advantage - use the drug yourself to make better ideas to put it in the market	4	2
Sales in rich countries Sales /marketing at private schools Sales to governments, who want to distribute this evenly / equally. Sales to people with brain disfunction	5	4
I will show the test results and the benefits.	1	3
-market the drug by calling it a game changer in the future of children (careers of children will no longer be restricted because of reduces intellectual ability). Good future career = good money = payback for expensive drug.	4	2

- Target Global Leader programmes/MBA to ensure the expensive drug reaches the correct target group, who will promote the drug in their inner circles	5	2
Sell that drug only to people with learning difficulties, permanent or temporary, and only under doctor prescription. Make the drug available only through the public health system so that the economic status doesnt influence on the capacity to obtain that drug. It is important not to profit from selling the drug at the highest cost possible and without a target population as this could strongly impact the society by increasing inequalities depending on economic status.	6	7
Design a long ass survey to see if people are willing to take the drug and then start producing. Take pre orders and then start producing. Team up with an existing pharma company to use their machinery to produce the drug	2	3
As it is a drug that can change the sapiens as a specimen, I would try to get found with the governments to make I available to an high amount of population.	2	5
- sell on prescirption only (to lower overuse) - sell freely on the market pharmacies - get it into retailers - distribution via schools / special education centres -	3	3
I wouldn't want to be involved in the production of such product.	1	5
Take the drug myself in order to develop exclusive ideas how to implement it Dont implement it since it will lead to an even stronger imbalance between poor and rich	3	5
I would focus on possible clients looking for cheating in exams	4	3
Contact the richest persons to buy them Producing it and selling it to middle class people asking for a payment monthly forever| Contacting a big farmaceutical company	4	2

Selling it to struggling students Take the pill and come up with more ideas		
Sell it at university	1	3
Brain tablets. Take your brain somewhere it never thought before.	3	3
Limit the monthly usage Precautionary messages on label Intial price to be high Limit the side effects by using it small quantities in different food and beverage products	2	3
Through Brain surgeons to showcase the benefit of my drug with their patients. To hospitals dealing with mentally-ill people	5	5
Market the drug to students directly as long as the drug is complaint the laws of the EU.	2	3
The drug that will help you outsmart your teachers! The investment that makes you the smartest one in the entire office. Outsmart without the headache! Bring your business further by outthinking the competition	4	3
Try to integrate it to education taxes Sell it to the government directly Introduce it first in elite private universities	4	3
- I wouldn't sell it in a retail or a place where people can easily reach. I would sell it within a prescription for the ones who wants it.	1	4
Invest in r&d to decrease the cost of production	1	4
Sell at profit in shops Make deals with educational institutions for the benefit of their students Make deal with government for equal access for all students	3	4
- Set up a service pay system so also people with less money can have access and benefits - via social media advertisements	4	5

- I would be very clear on the side effects that do exist (we are talking about younger brains here probably) - I would sell it in a packaging that has a limited amount of drug so that for example students will not use it all the time, but only when they really need it		
I would approach pharmaceutical companies and have them produce the drug since legislation on the production of a drug is very stringent and you have to comply with many sanitary and safety requirements. After the drug is produced, I would try advertise the product in the news and create a website to ship and sell it worldwide. To have some profits and be able to increase the scale of the product, I would then sell high quantities of it to big companies. After the product starts being popular in the market, I would try to be independent from the pharmaceutical company that is producing it so far and produce it on my own.	4	3
- try a contract with public health insurance - try to reduce production costs	3	4
Ask for funding of the government to start this drug in the market, if it has a positive outcome, most people will try to pay for it. (but it would be only focused in the high and medium class - maybe it would induce an even greater discrepancy of classes). Mass production of the drug could also be an option, reduce the costs of the product by increasing the initial investment. It would make the drug more accessible to everyone without the barrier of high cost. Get it to be a subsidised drug. If it would enhance greatly their performance, everyone should be able to get it.	4	5
Lobby for a legislation that forbids its use to people with above-threshold intellectual performance and that subsidizes it for people bellow-threshold. Lobby for subsidies for the drug Sell it with extra margin to be able to donate it to low-income families	6	6

Sell it with a lot of margin that allows you to do more reseach to lower it's production costs		
I would first need to know if the side effects are proven to be safe and within EU regulations Not keen to develop a not 100% safe product	1	4
Sell small doses Prove that the drug is working and that it is worth the money	1	4
I'd do it simple, exactly as a product which ímprove the brain with minimal effects	1	3
1) I would determine the cost of the drug depending on the financial capability of the buyer, like people are paying tax based on how much they earn, that should level out the price gap for poorer and richer people 2) I would determine if the person even needs the drug based on their profession - scientists and high-end-knowledge workers would be able to get the prescription, because the mental output of their work is more valuable compared to some other professions. 3) I would let governments develop social system handouts to level the price gap. 4) Another way would be to implement the drug on the market as low cost as possible, because people will definitely buy that drug and the widespread the drug is, the faster the development of technology and innovation of all humankind. 5) I would limit the drug to only University students for them to attain the knowledge that they can from their Uni and then afterwards it is up to them to apply that knowledge after their studies without the help of the drug. 6) Limit the drug to companies that accept the "agreement" to provide their products for the greater good for free, eg. company that comes up with water filter for dirty water, they are obliged to give away a certain percentage of that product to African villages for free.	6	7

Only make it accessible to people that could help others better with the drug. Provide to emergency personnel Provide to SAR teams If other companies would start to sell to other people, make the drug receipt public	5	5
Funding from governent Funding from private sector (financial services) Association from pharma industry IP Sharing Crowdfunding Buy manufacturer Use different ingredient providers Reduce active ingredient Sell to insurance company Charge super premium price	3	2
As I am against most drugs, I prefer not to answer this.	1	4
1) Start the "trial" tests in laboratories, in certain conditions; 2) If it's prove sucessfull, i'll start the test with animals (rats, dogs, etc.); 3) After this process, i wilk start the human tests (selecting a parcel of specific peoples, students from colleges specifically), and follow the development. 4) If all the steps above are sucessfull, i will sell all the project to an big group to they administrate it, like Bayer, Pfizer, etc.	2	3
Scale up the production so it would get a cheaper product. Partner with government education programs. Marketing the drug. Use the drug to think about this question. Fast learning = less time in school = cheaper school.	3	4
- if i would care only about money, I'd sell the drug to some big pharmaceutical company and fuck off to Bali - a more ethical approach, imho, would be to reach out to some silicon valley folks / venture capitalist to get funds and be in control	4	3

of the development, distribution and consequences (including risk of failing). The second option it's probably what I would do if I was this person, but overall I don't agree with brain enhancing drugs. Creativity & performance can spark cause of drugs, but they shouldn't be driven by drugs.		
Pertnership with universities.	1	5
- Allow only a selected group of individuals to use it. - Research how to make the drug more accessible by reducing its manufacturing costs. - Ask the government for help in making this drug available to most of the population (the government could pay for part of it, for example)	3	4
I would not market this drug as an intelligence enhancer. I think that is an ethically irresponsible move. If there are ways that this can be used to help children who are developmentally challenged, I might market it as a solely experimental limited trial drug.	4	5
* Fundraising * Share purchasing * Private equity * Go to Dragons Den	2	4
online advertising with promotional videos	1	4
Feasibility Make sure it is FDA or EMA-approved. Ask friends, business people, medical consultants and a whole range of people about the ethical consequences of such a drug. Short term Identify a sufficiently ethical business model for the drug. Market it as a medicine for disadvantaged people who normally suffer in terms of intellectual performance. At first, it is assumed only the rich subset can afford it. As manufacturing volume increases, the drug should become cheaper and all intellectually disadvantaged people can use it. Long term If there are truly no side-effects, which is never the case for any drug, then perhaps there is a case that it is a great beneficial for society if as many people take it as possible. However, it should not be restricted to those who can afford it. Therefore, the government	5	6

should provide everyone the opportunity to take it for free, so that there will not be a dystopian future scenario dominated by the rich drug-taking overlords. Like universal education, but in a pill!		
Put the infomation available for others companys Ask for goverment financial if the drug is so important Create an ONG to raise funds to lower the cost Try To improve the producer line To make it cheaper To produce Cut as much as possible the profit on this drug	4	4
deploy it in the water source, then sit back and watch	6	4
After all the health tests and legalization issues, I would sell it in the market normally, as any other medicament. If the costs to produce it are very high, so must be the final price.	2	3
Partner with big, established pharmaceutical company to produce the drugs and sell it as supplements to potential customers	2	3

While researching new alternatives for skin cancer treatment, you discovered by accident a substance that significantly whitens the skin. You know that cosmetic products with whitening properties are highly popular in some regions of the globe, in which the colour of the skin is still a factor for social acceptability and life success. How would you benefit from this discovery? Try to come up with as many as possible original ways to do so (separate your answers in different lines).

Asnwer / Score	Creativity	Ethics
1) introduce a new line of premium cosmetics into the market with heavy advertising 2) sell part of the technology to already existing cosmetic companies	3	3
I would try to sell it to bif companies of cosmetics, only. I don't think that there shoud be a public/governamental investment in such kind of things	3	3
Make a product and sell it	1	3
Make something up to deal with vitiligo	5	5
If the treatment is not dangerous, the substance could be used to kickstart a new business	3	3

Sell the substance to a cosmetic company, after putting a registered mark on it		
Even though it would bring me money I consider this wrong so I would not share this research.	1	6
Target those regions were this product can be sold effectively and enter those markets Enter the market for pigment diseases where this substance could reduce pigment stains	4	3
* Sell this technology to a leading cosmetic company and ask for profit share in return of the success of the product * Approach models and ask them to endorse this product on social media. After this gets popular, make the sellers approach with good offers to buy the technology.	4	3
Sell it as a whitening skin cream to specific markets	2	2
Selling the product for people with spots on their skin Selling the product for people with scars as a result of burns	5	6
I would sell as beauty treatment in the parts of the globe being white people is an advantage.	3	1
I could sell the substance to the highest bidding cosmetic company and in that way remove myself from any further development og usage of the substance. I could sell it as a cosmetic product for those finding themselves needing it.	3	3
Promoting it with people that have a skin imperfection and smoothen the imperfection	2	4
Sell it over the whole globe, but exploit this ability in the parts where coulor is a factor. Use small lettering at the packaging that shows the side effects in all country's. Use larger letters/other fonds to expicitly mention side effects in the parts where colour is a factor. (and some variations on this, with other fonds/ colours, but always the distinction)	3	1

I would apply this discovery to cosmetics products for treating marks or irregularities of skin but never for changing the while skin color	4	6
brand it "nivea" and sell to next to sun tanning products in drugstores Sell to official plastic surgens and beauty thearatpist	4	3
first you should check the health-risks if you want to maintain the initial succes if aimed at profit only, then you should, as fast as possible, go selling the new skin whitening product.	2	3
In the particular populair regions	2	3
I will not introduce this product on the market	1	6
I would apply for a patent If it is not dangerous bring it to the market	1	3
-generate a lucrative business with it and spending the revenue in research in order to get the best scientists and laboratory equipment	2	4
I would not introduce any such kind of product in market. There is a reason why natives of some geographical locations have a relatively darker skin tone due to years of evolution. Although, whitening skin does not mean immediate extinction of their race, but I would move on and focus on skin cancer treatment research	1	6
Play the race factor. If colour still makes a difference in a certain country, the easiest way to sell the product is to enhace the race factor. Marketing about how belonging to a certain race opens many opportunities in succeeding in life. However, it's a very unethical idea.	5	1
Commerce with it	1	3
Treatment of diseases as spot in skin, vitiligo	5	5
Promote it among people that have diseases that affect the skin tone and that suffer from this condition Use it to create awareness against ideals regarding skin colors Investigate a variant that whitens the skin temporarily instead, for cosmetics market	5	6
- patent it. - sell to companies that make cosmetics products	5	5

- look for ways to use it clinically, like for example to treat discolourings after burns, or birth marks etc.		
I think this discovery can enhance funding for (skin) cancer treatment. While people buy it for reasons that I wouldn't personally, (given that's it's safe/ doesn't harm people) it's their decision to spend their money like this. If I can then do something good with this money in curing the ill, I would be proud.	4	4
Maybe, I'd use to treat the vitiligo.	5	5
-I'm against the concept of changing skin colour for social acceptance and hence, would not even consider benefiting from this discovery by means of marketing cosmetics products for general skin lightening. HOWEVER, there are specific purposes for which this product (if tested and proved safe) could be successfully marketed. For example, under eye darkcircles lightening to match the skin tone of the rest of one's face (depending on the frequency of use). I think it could work wonders for this particular application.	6	7
- Sell a range of whitening products, e.g. facial cream, hand cream, foot cream, body cream - Target different nations with different brand names, to make it look like the products are made specifically for India, for Africa etc.	4	2
I would only bring it to market for the treatment of pigment skin diseases like vitiligo. Modification of racial features for social acceptability should not be used to make money out of it. It is not ethical and it encourages racism.	5	6
Market it as a drug that makes you look like Michael Jackson. Run ads on dating sites in such countries.	4	2
As a cosmetic effect without any significant improvement for the individual, I would capitalize and sell the drug for the highest return possible.	1	2
-sell patent to a company who is already an expert - license patent to the above - become a supplier to big rganizations - startup to turn it into creams etc and sell it	3	3
I wouldn't want to be involved in the production of such product.	1	6

Sell it to the cosmetic brands and use this extra money to invest in cancer treatment / research (but only if the product does not have side effects).	3	4
I would develop the drug specifically for that use	2	3
Use it for my cancer research Sell it to a cosmetics company Crerate a cosmetic company selling the products	3	3
Sell it in developed countries where there might be s matket... Korea Japan China	3	3
Sell the idea to a big cosmetic company. Develop my own way to produce the substance in a large scale	2	3
Make it available on a global scale, and not publicize it as a beauty product. But as a method to help people overcome racism and solving their issues permanently	4	2
I wouldn't proceed, as this will fuel the concept of racism. The point is to accept people as they are.	1	6
Develop a product and sell it to the people which would like to buy it, given the product is legal to sell and distribute.	2	3
Have your skin colour your way. Skin colour does matter and you are finally in control! Skin colour isn't a choice of nature anymore, it's yours to choose! Take matters into your own hands	4	2
Sell it to cosmetic laboratories in bulk as an ingredient for their product line Sell the patent	2	3
- As some people prefers this, and this is a personal choice, it is okay to implement to market. - I wouldn't make many campaigns on it as not to create diversity within people.	2	3
Make and sell a patent to a big firm	2	3
Most likely wouldn't sell it, but would patent it if possible.		4

- If it is a permanent change, I would maybe talk to cosmetic plastic surgeons/doctors for people who have skin darkening issues - If it is not permanent, it could be used as a cosmetics and in that case I could make money off of it by selling it (only if it is safe, not permanent and animal cruelty free and does not harm the environment) and use the money to continue my research - If I don't care about people, I would just sell it as a cosmetic product aimed at people in those communities and make profits	4	3
I'd found a company in the regions where this product is most popular and sell it there;	2	2
I'd sell the license to produce it to companies that sell beauty products;		
- sell this substance not only for medical/pharmacy firms but also for cosmetic firms (higher price for cosmetics)	3	3
Collaborating with cosmetic companies to include this in their products. Firstly, patent the process to obtain this substance.	2	3
I would market it in the countries with demand for the product	2	2
again: need to know cause and effect and long term implications and if proven 100% safe - via influencers - launch via style icons - enhancing inner beauty	2	3
Sell in china	2	2
I'd sell it to whitenning skin, simple like that. Its not means something negative	1	2
1) Sell that substance on those markets for a hefty profit. 2) Make deals with cosmetics companies that they can add this substance in their products for a percentage of their profit. 3) Patent this discovery. 4) Try to market skin colour change is some parts of the world to obtain huge demand for your product. 5) Raise the tradition values in Japan to further increase the popularity of being pale. 6) Promote Michael Jackson as the icon of skin colour change and link that to his success - followers and profit guaranteed.	6	2

Share that particular discovery on research platform, continue to research skin cancer treatment	3	5
Open business to sell cosmetic Sell discovery to cosmetic	2	3
The idea of having people benefited by the color of their skin is really cruel. I prefer not to answer about this.	1	6
IMHO, i didn't see any benefit in this product, it just will increase the racism with the peoples who don't have acess of this product.	1	6
Sell this technology to producers of products. Stabilish the relation between the product and the whitening of the sckin.	2	2
I'm against it, I don't think whitening people should be a thing even if this will bring them a lot of benefits. I believe it's a very wrong solution to an important social problem. Nevertheless, I would be quite challenged by the idea of pursuing option 1 from my previous answer: sell it to Big Pharma and live a rich life. Human, after all.	2	4
That's far away from my area of knowledge, I don't know what to propose.	1	4
- Investigate the side-effects do using this substance as a skin whitener. - depending on the results, sell it in the certain regions of the globe that would pay well for it	2	2
I wouldn't benefit at all because I think the social stigma associated with darker skins needs to be broken and selling yet another skin whitening product won't help that cause	1	6
* If it is working against cancer, still bring it on the market (everywhere in the world), but also flag this side effect * Bring it on the market in Asian countries as whitening product and also flag the positive side effect that its skin cancer treatment	2	3
Market it as a original product through online advertising	1	3
Probably nothing. There are already products that whiten the skin, and making yourself white carries with it a stigma that likely negates	1	6

the increased social acceptability and life success. Also, it feels wrong as a business.		
Sell it as a make up in acesible price	2	3
Focus on skin cancer research and let other opportunist exploit race segregation	2	6
If the product is legal in those countries, I do not see any problem to sell it. It is up to the customer to decide to buy it or not.	2	3
Develop a line of beauty products in the regions that has certain beauty standards	3	3

8.3 Appendix C

Rater 1

ID	creativity 1	ethics 1	creativity 2	ethics 2
10309912788	4	2	3	2
10283592566	4	2	3	3
10278289974	3	5	1	3
10278259918	5	4	4	6
10278264463	2	3	3	3
10277521474	3	3	1	5
10282334814	5	2	4	4
10280499343	2	3	5	3
10281004293	4	4	3	2
10296123384	5	5	5	6
10278360904	5	3	2	2
10278250881	6	4	3	3
10312358189	4	3	3	4
10278549119	1	3	5	2
10291187387	3	4	4	5
10282338169	5	3	4	3
10278459222	3	3	1	3
10278283862	2	3	2	2
10278481678	1	2	1	5
10277520771	2	3	2	3

Rater 2

ID	creativity 1	ethics 1	creativity 2	ethics 2
10309912788	5	2	3	3
10283592566	4	3	3	3
10278289974	3	5	1	3
10278259918	4	4	5	5
10278264463	2	3	3	3
10277521474	3	3	1	5
10282334814	3	3	4	3
10280499343	3	3	4	3
10281004293	4	4	2	2
10296123384	5	6	5	6
10278360904	5	3	3	2
10278250881	5	4	3	3
10312358189	4	2	3	4
10278549119	1	3	3	1
10291187387	2	4	4	6
10282338169	4	5	4	3

10278459222	3	2	2	3
10278283862	1	3	2	3
10278481678	1	2	1	5
10277520771	2	3	1	3

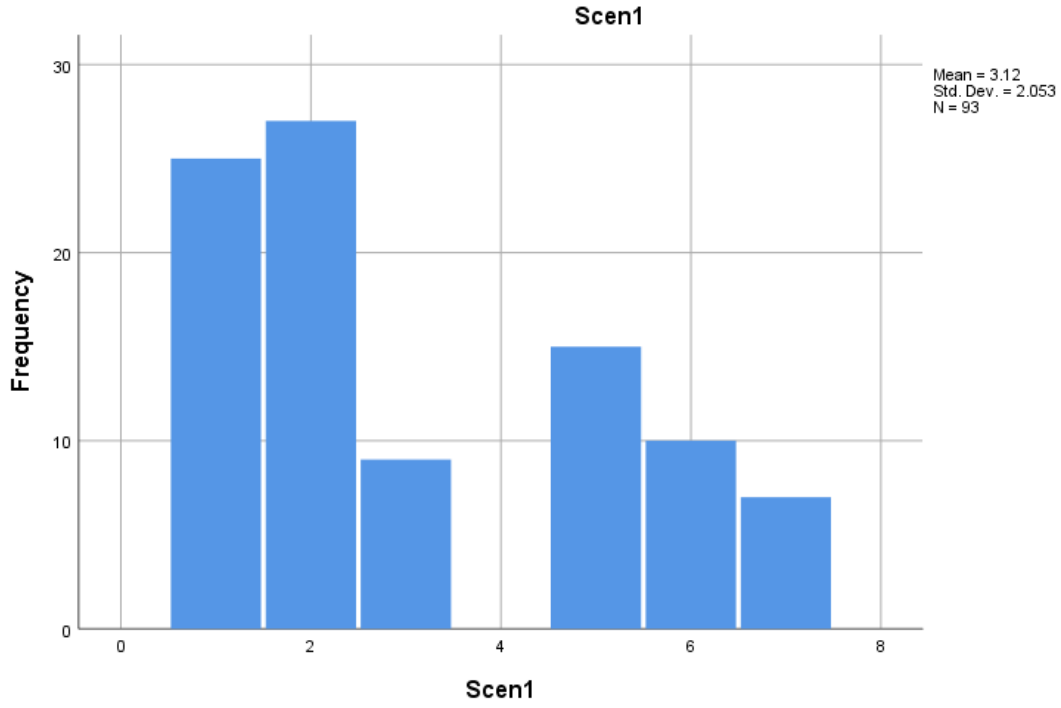
Divergence in responses

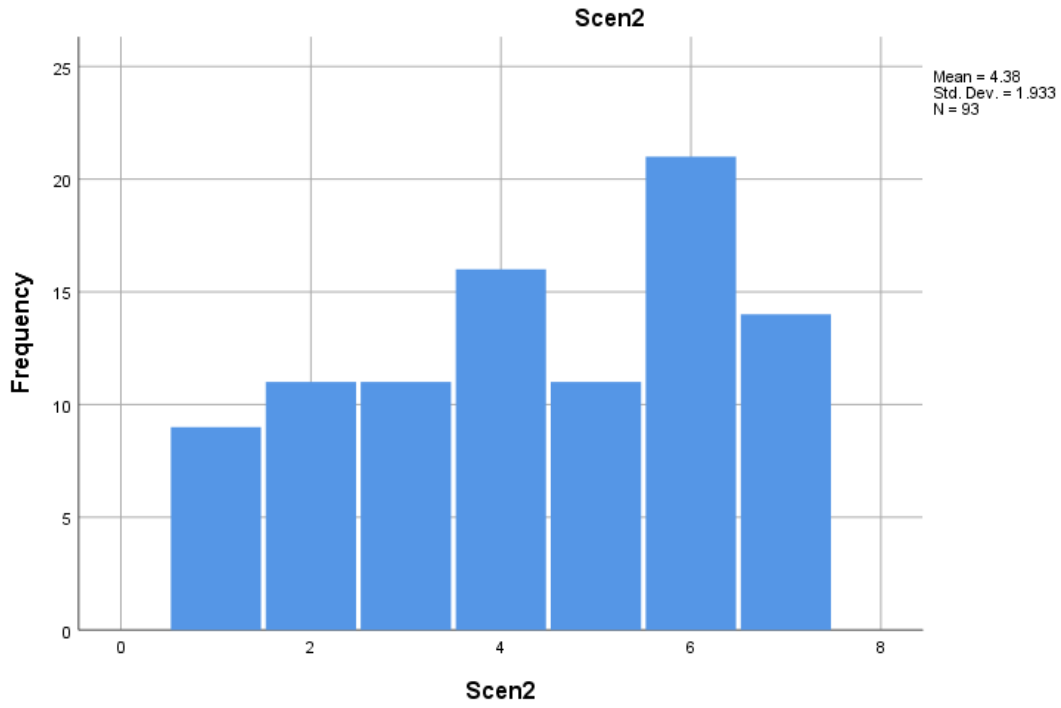
ID	c1	e1	c2	e2
10309912788	1	0	0	1
10283592566	0	1	0	0
10278289974	0	0	0	0
10278259918	-1	0	1	-1
10278264463	0	0	0	0
10277521474	0	0	0	0
10282334814	-2	1	0	-1
10280499343	1	0	-1	0
10281004293	0	0	-1	0
10296123384	0	1	0	0
10278360904	0	0	1	0
10278250881	-1	0	0	0
10312358189	0	-1	0	0
10278549119	0	0	-2	-1
10291187387	-1	0	0	1
10282338169	-1	2	0	0
10278459222	0	-1	1	0
10278283862	-1	0	0	1
10278481678	0	0	0	0
10277520771	0	0	-1	0

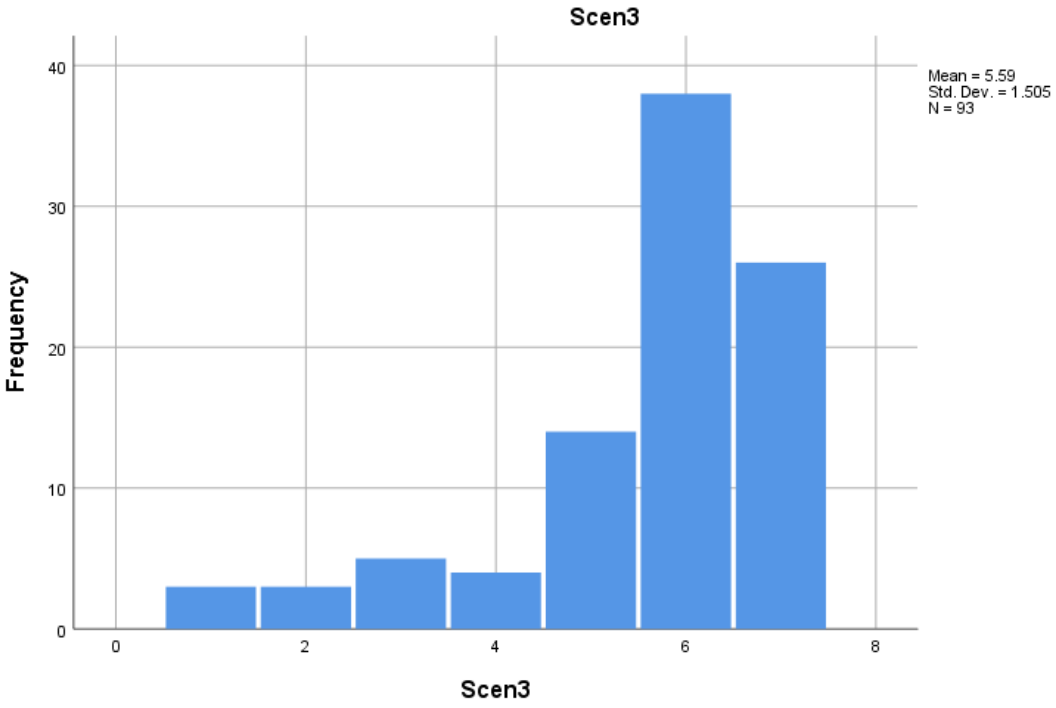
same	12	14	13	14	66.25%
+-1	7	5	6	6	30%
+-2	1	1	1	0	3.75%

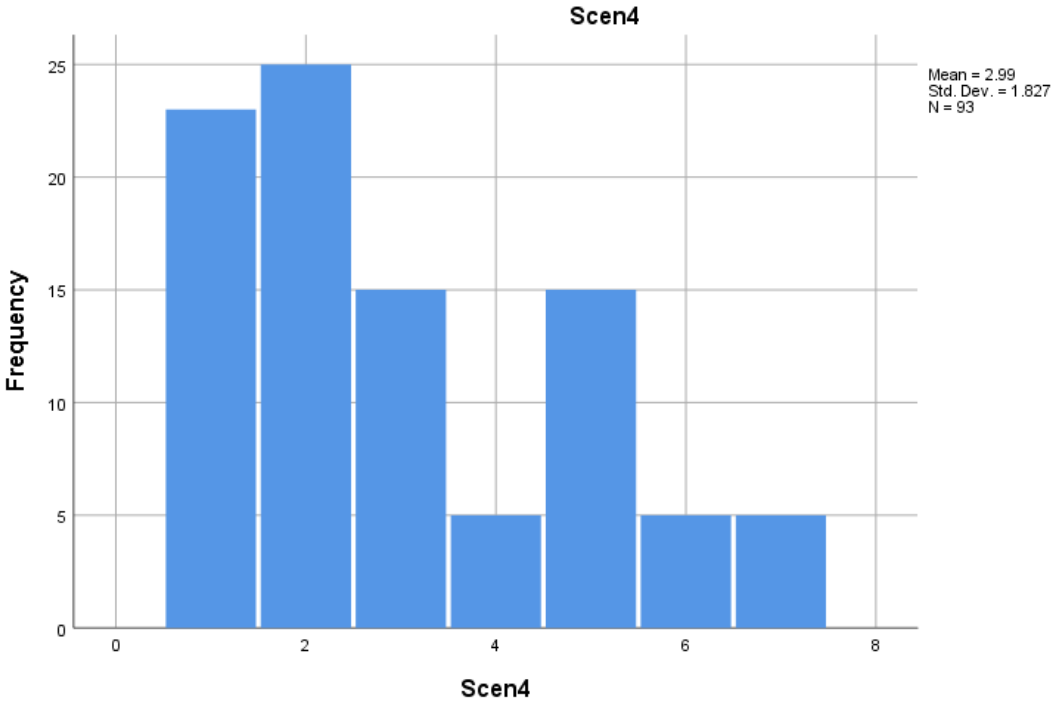
8.4 Appendix D

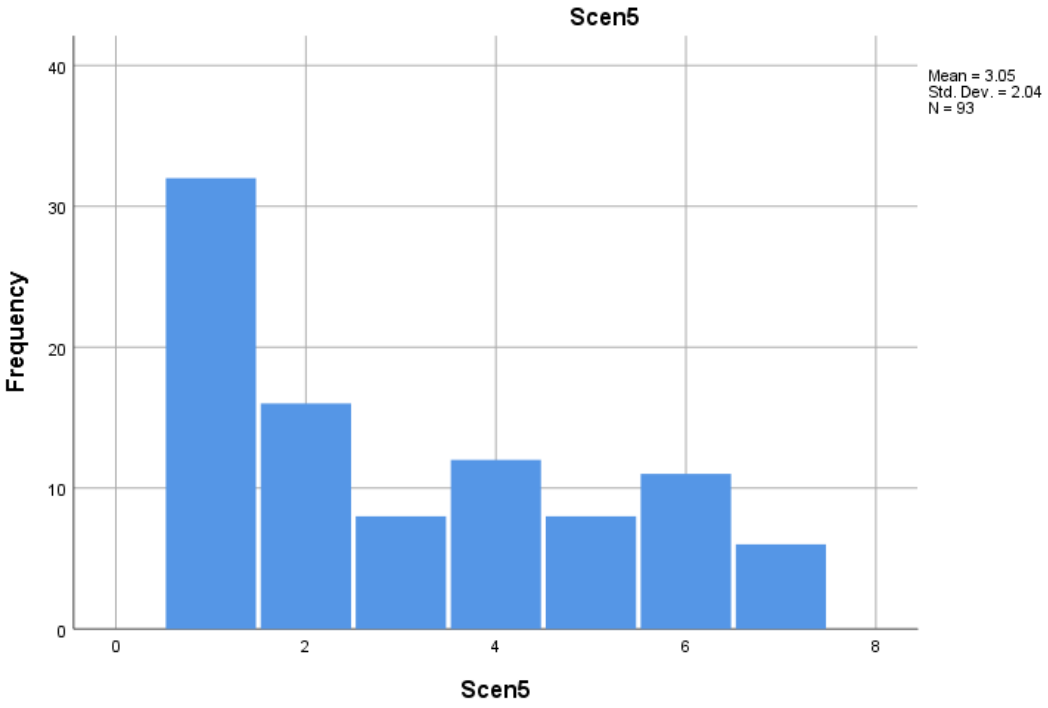
Distribution of responses for each scenario.

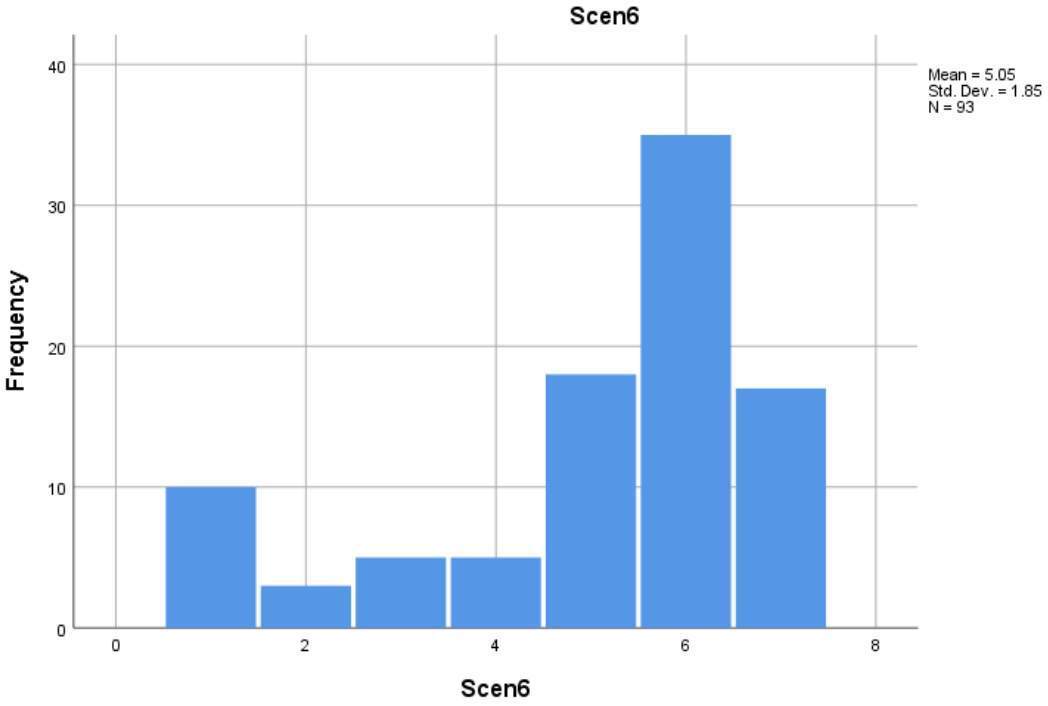





Scen3
Mean = 5.59
Std. Dev. = 1.505
N = 93
Frequency
40
30
20
10
0
0
2
4
6
8
Scen3

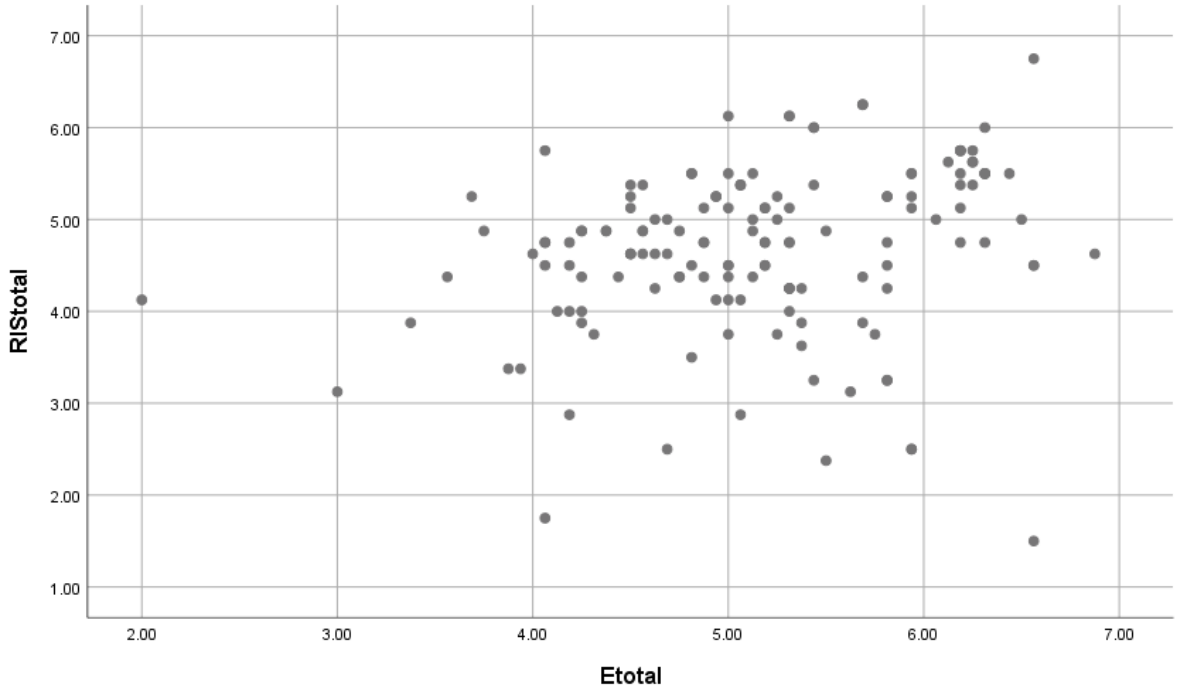

Scen4
Mean = 2.99
Std. Dev. = 1.827
N = 93
Frequency
25
20
15
10
5
0
0
2
4
6
8
Scen4

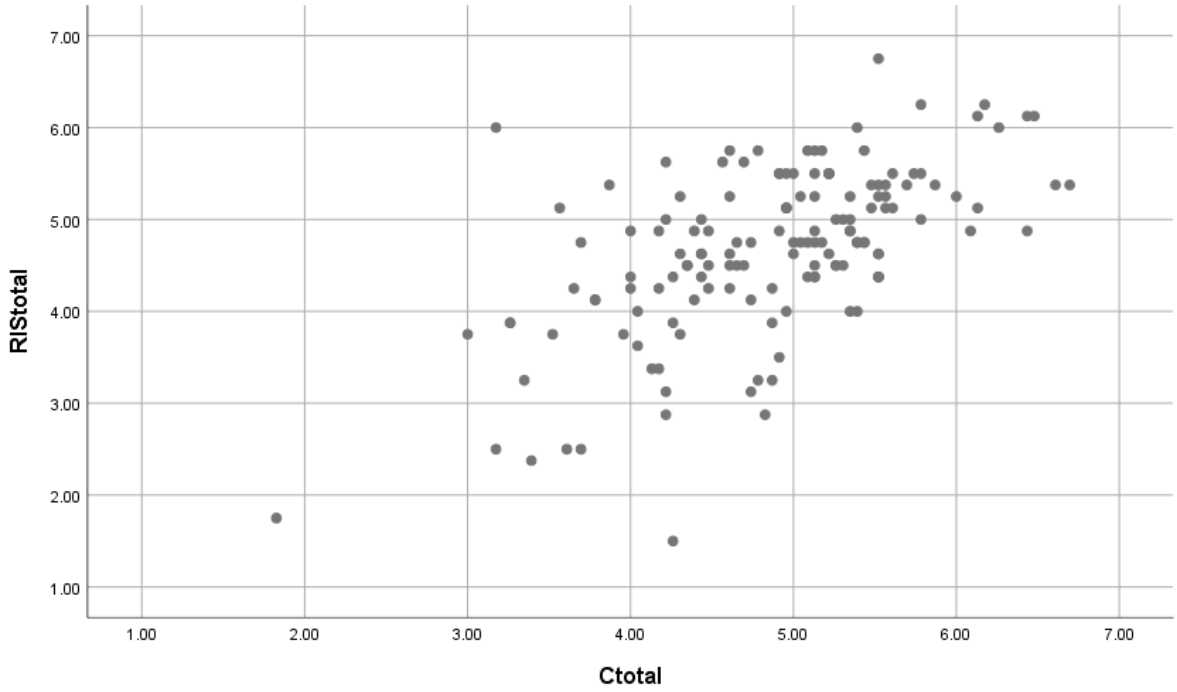

Scen5
Mean = 3.05
Std. Dev. = 2.04
N = 93
Frequency
40
30
20
10
0
0
2
4
6
8
Scen5


Scen6
Mean = 5.05
Std. Dev. = 1.85
N = 93
Frequency
40
30
20
10
0
0
2
4
6
8
Scen6

8.5 Appendix E

Scatter plot between Creativity and Ethics scale, against the RIS scale.





8.6 Appendix F

Linear Regressions for the variables with no significant correlations

Dependent variable = A2; R^2 = 0.013; F = 1.230; sig of F = 0.270

Independent variable	**β**	**t**	**p**
RIS	-0.235	-1.109	0.270

Dependent variable = A3; R^2 = 0.110; F = 11.25; sig of F = 0.001

Independent variable	**β**	**t**	**p**
RIS	-0.560	-3.353	0.001

Dependent variable = B1 creativity; R^2 = 0.025; F = 0.601; sig of F = 0.616

Independent variable	**β**	**t**	**p**
RIBS	-0.388	-1.232	0.222
RIS	0.141	0.500	0.618
PRESOR	-0.126	-0.482	0.631

Dependent variable = B1 creativity; R^2 = 0.003; F = 0.184; sig of F = 0.669

Independent variable	**β**	**t**	**p**
RIS	-0.089	-0.429	0.669

Dependent variable = B2 creativity; R^2 = 0.002; F =0.165; sig of F = 0.686

Independent variable	**β**	**t**	**p**
RIS	-0.074	-0.406	0.686

Dependent variable = B2 ethics; R^2 = 0.085; F =6.711; sig of F = 0.012

Independent variable	**β**	**t**	**p**
RIS	0.481	0.292	0.012

8.7 Appendix G

Factor analysis with 4 factors

Component Loadings	Responsible Innovation	Creativity	Ethics	Factor 4
R1	0.802	.	.	.
R2	0.781	.	.	.
R3	0.796	.	.	.
R4	0.841	.	.	.
R5	0.617	.	.	.
R6	.	.	.	-0.453
R7	0.557	.	.	.
R8	0.736	.	.	.
C1	.	0.666	.	.
C2	.	0.575	.	0.543
C3	.	.	.	.
C4	0.608	.	.	.
C5	0.623	.	.	.
C6	.	0.641	.	.
C7	.	0.64	.	.
C8	0.583	.	.	0.414
C9	0.409	.	.	0.423
C10	.	.	.	.
C11	.	0.785	.	.
C12	.	0.446	.	.
C13	.	0.549	.	.
C14	.	0.657	.	.
C15	.	0.525	.	.
C16	.	0.583	.	.
C17	.	0.521	.	.
C18	.	0.657	.	.
C19	.	.	.	.
C20	0.754	.	.	.
C21	0.585	.	.	.
C22	0.628	.	.	.
C23	0.666	.	.	.
E1	.	.	0.532	.
E2	.	.	0.706	.
E3	.	.	0.666	.
E4	.	.	.	-0.44
E5	.	.	0.626	.
E6	.	.	0.539	.
E7	.	.	0.55	.
E8	.	.	0.706	.
E9	.	.	.	.
E10	.	.	0.662	.
E11	.	.	.	.
E12	.	.	0.46	.
E13	.	.	0.679	.
E14	.	.	0.772	.
E15	.	.	.	.
E16	.	.	.	.