

**Radboud University Nijmegen**

**Master Business Administration Thesis**

**Consumer age and adoption of technologies:**

A study on the influence of consumers' cognitive age, cognitive capabilities and cognitive assets on their Technology Readiness.



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## Abstract

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Many technological companies try to increase the adoption of their (new) technologies. The increase of purchase and use benefits the company performance in terms of competitive advantage and sales. Different studies have been conducted in order to explain consumer adoption behaviour and provide a list of predictors. In scientific work there is discussion on which consumer characteristics actually determine technology adoption (Rojas-Méndez, Parasuraman, & Papadopoulos, 2017). The study of Rojas-Méndez et al. (2017) used the Technology Readiness Index (TRI) 2.0 (Parasuraman & Colby, 2015) as a model to explain adoption through Technology Readiness (TR) and emphasized their doubt about age having a direct influence on TR. It was suggested that cognitive capability mediated the relationship between age and TR. With regard to cognitive capability a distinction is made between cognitive assets and capabilities (Murman, 2015). This research includes two innovations: on the one hand it is the difference between cognitive assets and cognitive capabilities as separate variables in the model and on the other hand the mediating role of both cognitive capabilities and cognitive assets. The influence of consumers' cognitive age, cognitive capabilities and cognitive assets on Technology Readiness is examined.

A quantitative research design was used to examine the relationships between those variables. A cross sectional regression, ANOVA and mediation analysis has been performed on data of 418 consumers, collected through a survey.

The analyses initially determined multiple significant relationships between cognitive age and TR dimensions: optimism, innovativeness, discomfort and insecurity. The distinction between cognitive assets and cognitive capabilities and including both as mediator resulted into new insights with regard to these relationships. The relationship between cognitive age and optimism is partially mediated through cognitive assets. An increase of cognitive age decreases cognitive assets resulting into lower optimism. A positive direct relationship between cognitive age and optimism remained in contradiction to theory. The relationship between cognitive age and innovativeness is fully mediated by cognitive capabilities and cognitive assets. When cognitive age increases, cognitive capabilities and cognitive assets decrease, resulting into lower consumer innovativeness. The relationship between cognitive age and discomfort is partially mediated through cognitive capabilities. The increase of cognitive age leads to a decrease of cognitive capabilities and an increase of discomfort. A positive direct relationship between cognitive age and discomfort remained in line with theory. No mediation effect was determined for the relationship between cognitive age and

insecurity. A negative direct relationship between cognitive age and insecurity was confirmed, opposing theory. The relationship between cognitive age and overall TRI-score is fully mediated through cognitive capabilities and cognitive assets. An increase of cognitive age decreases cognitive capabilities and cognitive assets resulting into a declining TRI-score between the cognitive age of 18 and 28, a constant TRI-score between the cognitive age of 29 and 48 and a declining TRI-score after the cognitive age of 49 is reached (curvilinear). The analyses showed that the effect of cognitive age on TR is accounted to cognitive capabilities and cognitive assets. No direct relationship between cognitive age and overall TRI-score is determined.

The explanatory power of the models was weak on average due to the fact that adoption and TR is a complex phenomenon. Altogether, the results indicate that instead of cognitive age, cognitive capabilities and assets predict TR to a small extent.

Cognitive assets and capabilities decrease as cognitive age increases, resulting into a lower TR. For technological companies the outcomes of the research emphasized the importance of ensuring that technologies are well designed and easy to use (Czaja et al., 2006). Businesses can invest into research that examines in what way their technology requires customers to use their cognitive capabilities and assets. By redesigning their products or services in a way that less cognitive capabilities and assets are needed for comprehending/usage, the adoption increases.

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# **1. Introduction**

The introduction provides information about the research context, problem statement, aim of the research, objective, research question and relevance of the research. This to create a brief understanding on why it is performed and with what purpose. In this research the Technology Readiness of consumers is studied and an attempt is made to explain a consumer's predisposition towards technology with use of demographic and psychographic variables.

## **1.1 Context**

From the beginning of human activity technology has played a major role in human civilization. Technology functioned as a means to make life better, to solve problems, to get rid of predicaments and to provide a better future (Arthur, 2009). From the start technology has been progressing. It can be treated as a historically evolutionary process with discontinuities which were connected with technological breakthroughs, also called "technologization" (Zacher, 2017). This technologization led to the industrial revolution (18<sup>th</sup> century) and the scientific/technological revolution (20<sup>st</sup> century) where many novel products and services were invented but also required new skills and competencies of people (Zacher, 2017). Currently the most important role is played by the information (digital) revolution which refers to networking of society (Zacher, 2017). Throughout time, more and more consumer needs have been fulfilled with technology causing society increasingly depending on technology. But, scientific work also indicates that it is not self-evident that a new technology is adopted automatically by consumers. According to Lin, Shih, and Sher (2007) much research has tried to explain the technology adoption by consumers characteristics. In scientific work there is discussion on which consumer characteristics actually determine technology adoption (Rojas-Méndez et al., 2017). That is where my research finds its purpose.

Technology can have many shapes and forms and a lot of literature can be found on this topic. The exact definition of "technology" is unclear as it can be a branch of knowledge, a study of techniques, a practice or even an activity (Arthur, 2009). Different technology definitions are described in the theoretical review. For this study technology is defined as "*the means available to a culture to fulfil a human purpose*" (Arthur, 2009, p. 28). For technology to have an impact on society it is important that it is diffused and adopted in society. Diffusion of technology is defined in accordance to the diffusion of innovations theory (Rogers, 2003). The diffusion of technology is defined as "*the process through which technology is communicated through certain channels and adopted over time among the members of a social system*" (Rogers, in Bianchi, De Massis, & Sikimic, 2013, p.2). Adoption

refers to the purchase (buying behaviour) and actual use of a technology.

There are two research paradigms that explain technology adoption. One paradigm focuses on how a technology's attributes affect an individual's perception of a technology (Godoe & Johansen, 2012). The Technology Acceptance Model (TAM) is one of the most popular models used (Godoe & Johansen, 2012) and is technology-specific. The second paradigm focuses on the latent personality dimensions to explain the use and acceptance of technologies, meaning that an individual's personality influences the acceptance of technology in general (Godoe & Johansen, 2012). A widely used method based on this approach is the Technology Readiness Index (Parasaruman, 2000). Because this study focuses on the predisposition towards technology in general the TRI is used for explanation (not technology-specific). The TAM is excluded from the research.

Explaining and predicting user adoption has received a lot of attention in both academia and practice (Lin et al., 2007). Rogers (2003) states that consumers' age is related to adoption. Age is divided in chronological age and cognitive age. Chronological age refers to the time someone has lived. Cognitive age refers to the self-report of an individual's age, also measured in years (Barak & Schiffman, 1981). Nierling and Dominguez-Rué (2016) performed research on the relationship between chronological age and TR. Empirical evidence showed that the adoption of technology by elderly (65+-age) was not as smooth as among younger consumers, indicating a negative relationship between age and TR. Another study was done by Caison, Bulman, Pai, and Neville (2009) who found a negative relationship between age and TR when exploring the Technology Readiness of nursing and medical students at a Canadian University. Eastman and Iyer (2005) found empirical evidence that consumers with a lower cognitive age use internet more often than those with a higher cognitive age. Rojas-Méndez et al. (2017) performed a study on the influence of demographics (age, gender and educational level) on Technology readiness and found the following significant relationships: The increase of age leads to lower TR, males are more TR than females and a higher educational level increases TR. The following assumption was made about the relationship between age and TR: "*Older people tend to perceive a reduction in the own cognitive capabilities to learn, which could be a barrier for them to embrace and use new technology*" (Hertzog & Hulstsch, in Rojas-Méndez et al., 2017, p. 22). Rojas-Méndez et al. (2017) claim that other researchers disagreed with this assumption and that additional testing is needed for the relationships between demographics and TR. This leaves a theoretical "gap" that my research tries to fill. This study examines the relationship between age and TR but divides age into chronological and cognitive age and adds the mediation variable

cognitive capability (a term introduced in this TR-research by Rojas-Méndez et al. (2017)). It turns out that I have to distinguish here between cognitive assets and capabilities (Murman, 2015).

## **1.2 Aim of the research**

The research has both a scientific and practical aim. Both aims are intended to extend knowledge and current scientific work on the impact of (cognitive) age on TR.

The scientific aim is to extend the current scientific work on this subject. By performing this study new insights can be added to current theories about Technology Readiness and adoption.

The practical aim is to provide practical knowledge and advice to businesses that are technology-based. The research insights, provided to these businesses, could be used to adjust engineering/marketing activities to improve adoption.

## **1.3 Problem statement**

The objective of this research is to examine the relationship between consumers' (cognitive) age and TR and the possible mediation effect of cognitive capabilities and assets. To fulfil this goal and in order to systematically perform this research the following problem statement is proposed:

*“ To what extent do (cognitive) age, cognitive capabilities and cognitive assets of consumers determine their Technology Readiness and what do the results imply for future introduction of technology-based products or services in general? ”*

To answer the problem statement the following five research questions were developed:

1. *What is the TRI?*
2. *How does a consumer's (cognitive) age influence his/her TR and related dimensions optimism, innovativeness, discomfort and/or insecurity?*
3. *To what extent do the cognitive capabilities and cognitive assets of a consumer mediate the relationship between his/her (cognitive) age and Technology Readiness in total and for each of the four dimensions separately?*
4. *What do the results imply for the introduction and acceptance of new products and services that are based on new technologies?*

## **1.4 Relevance**

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The relevance of the research is based upon its theoretical and practical contribution. The theoretical relevance is based upon the history of research concerning Technology Readiness. According to Rojas-Méndez et al. (2017) there is a long tradition in research of focusing on predictors of adoption of new technology. Along with those studies contradicting theories arose whether demographic variables were or were not predictors. This study tries to provide new scientific insights to better understand the predictors of TR and to contribute to the discussions regarding this topic. The theoretical knowledge provides input for the practical implications. The practical relevance is that businesses better understand the differences in TR due to (cognitive) age differences. The results can be used for understanding and segmenting markets. This improves the fit towards customers resulting into higher adoption. This is important because profits of a company depends on the customers' willingness to embrace and use technologies. From the customers view technology-based products and services better suit their needs and thus create more value for them.

## **1.5 Research outline**

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To systematically answer the research question and sub-questions the research structure is designed as follows: In chapter two a theoretical framework is made to create a theoretical foundation regarding this research. The theoretical framework contains the central concepts and ends with a conceptual model and hypothesized effects. In chapter three the methodology is elaborated which describes the research strategy, data collection and analysis. This is followed by presenting the research results in chapter four. In chapter 5 the research results are discussed and conclusions and recommendations are set.

## **2. Theoretical framework**

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This chapter, with the literature review, will give an answer to the problem statement by using the existing literature. Available scientific work is analysed to provide definitions and to discuss theories regarding the possible effect of (cognitive) age, cognitive capability on Technology Readiness. The information is gathered through a desk research strategy. The chapter first discusses technology, adoption, TR, consumer age, cognitive capability and ends with the conceptual model.

### **2.1 Technology**

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Since the dawn of human civilization there has been a long process of ongoing inventions that continuously pushed the limits of technology (Zacher, 2017). Technology is the output of a continuous process people undertake to improve life and fulfil human needs. It can be seen as an application of knowledge to put it into practical purposes, transforming it into a method, process or device. The exact definition of technology is therefore unclear. Research does try to pinpoint the exact meaning and to define technology. According to Arthur (2009) the definition of technology is threefold:

The first definition is that technology is a “*means to fulfil a human purpose*”. Meaning that the technology can be a method, process or device to fulfil a human purpose. An example could be a speech recognition algorithm. The second definition is that technology is an “*assemblage of practices and components*”. This covers electronics and biotechnology that exist out of collections of technologies and practises. The third definition defines technology as the “*collection of practices and components available to a culture*” (all cited from Arthur, 2009, p. 28). For this particular research I combine these definitions and define technology as the means, practices and components available to a culture to fulfil a human purpose.

It is stated that technology has a recursive structure, existing technologies become building blocks for the creation of new technologies (Arthur, 2009). Technology often finds its origin through certain phenomena. For example accidents in traffic result into the technology of self-driving cars where accidents are the phenomena and the software in self-driving cars the technology. This means that technology is born by capturing certain phenomena and put them to use (Arthur, 2009). This has led to uncountable inventions in the past and will lead to in the future. The inventions are generated by a historically evolutionary process with discontinuities that are connected with technological breakthroughs (Zacher, 2017). History has showed many developments such as the industrial revolution (18<sup>th</sup> century) and the

scientific revolution (20<sup>th</sup> century). In the present period of technological development the most important role is played by the information revolution (Zacher, 2017). This revolution refers to digitalization where the communication has become online and interactive. Borders are virtually deleted and impact the way of living. The most typical example for this is the Internet which had a tremendous impact on business and people. But, as earlier mentioned definitions indicate, technology has many shapes and forms. It can be physical, digital, a product, service, technique, method and so on. Technology arises through phenomena to fulfil a purpose and improve something. According to Meuter, Ostrom, Bitner, and Roundtree (2003) this means improving operations, increase efficiencies for companies or provide benefits for customers. Because of this technology has a positive loading. According to (Park & Jayaraman, 2003) technology is the key to enhance the quality of life for everyone, from new-borns to senior citizens.

Nowadays the technological innovations have accelerated, leading to shorter product lifecycles. New products emerge from time to time (Cui, Bao, & Chan, 2009). For example, every year new mobile phones, computers and cameras are introduced to the consumers. According to Cui et al. (2009) more frequently than in the past users of technology have to face the dilemma of choosing between keeping the existing product or using the new technology because of the higher amount of technology introductions.

## **2.2 Adoption of technology**

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A new technology is not automatically adopted by consumers, the characteristics of the user and of the innovation can have an influence on using it. The use of technology is often referred to as adoption. Adoption does not only imply the buying behaviour but also refers to actual usage (Rogers, 2003). Meaning that a technology is adopted when full use is made out of a particular innovation (Rogers, 2003). There is a lot of discussion on the exact list of characteristics that influence adoption. According to Meuter et al. (2003) very little is known about the factors that influence technology adoption. Adoption is of interest of both consumers and companies: companies can become more competitive and achieve higher profits and consumers experience benefits in increased convenience, control and freedom of action (Rojas-Méndez et al., 2017).

According to Rogers (2003) the adoption of a certain technology depends on two types of characteristics. First the adopter characteristics that consist out of socio-economic variables (age, education, income, etc.), psychological variables (opinion, intelligence, etc.) and

communication-related variables. Secondly the perceived innovation characteristics that consist out of relative advantage, (non-)compatibility, complexity, trial ability and observability. For this study the adopter characteristics and psychological variables are interesting. The perceived innovation characteristics are ignored because this study focuses on technology in general and these are technology specific. Rojas-Méndez et al. (2017) performed research on socio-economic and psychological variables. The study indicated that an increase of age negatively affects TR and that a higher education positively affects TR. Income showed no relationship with TR. The study also made the suggestion that intelligence is related to age and therefore to TR.

All earlier mentioned variables together represent the perception of a person towards a technology and why someone would adopt or resist (new) technology. According to Cui et al. (2009) resistance depends on the degree of change required and consumers' existing belief structure. An example of this could be that people are satisfied with a current product and its technology or have the fear for making life more complicated. According to Godoe and Johansen (2012) it is important to explain and predict user adoption of new technology. Not only because of possible financial losses for businesses but also to increase the chance of creating value for consumers by improving the fit between (new) technology and customer needs and preferences.

According to Godoe and Johansen (2012) the adoption of technology can be explained by the Technology Acceptance Model (TAM) and the Technology Readiness index (TRI). The technology acceptance model is based upon the theory of reasoned action of Fishbein and Azjen (1975)(Godoe & Johansen, 2012). The model explains and predicts behaviour towards a particular technology. This behaviour is based upon two determinants within TAM. The first one is perceived usefulness, which is defined as *“the extent to which a person believes that using a particular system will enhance his or her performance”* (Davis in Lin et al., 2007, p. 643). Secondly perceived ease of use which is defined as *“the extent to which a person believes that using a particular system will be free of effort”* (Davis in Lin et al., 2007, p. 643). The TRI index is based upon the overall state of mind of a person. This is the result of a gestalt of mental enablers and inhibitors that collectively determine a person's predisposition to use new technologies (Davis in Lin et al., 2007, p. 643). This refers to the explanation that the adoption of technology in general depends on the individual's opinion towards it. The TAM and TRI are interrelated but according to Lin et al. (2007) there is also an important difference as the next citation reveals: *“It is intuitively accepted that TAM and TR are*

*interrelated, although the measurement of usefulness and ease of use in TAM is specific for a particular system (i.e., system-specific) while TR is for general technology beliefs (i.e., individual-specific)*” (Lin et al., 2007, p. 644). I agree with this statement since the many shapes and forms of technology also imply differences in use(fullness). In this case the TRI will be used for explaining technology adoption because this study is about technology in general not a particular technology for which TAM would be suitable. The “Technology Readiness” and Technology Readiness Index (TRI) (Parasaruman, 2000) will be further elaborated in the next chapter 2.3.

### **2.3 Technology Readiness (TRI)**

The roles of technology in customer-company interactions and the number of technology-based products and services have been growing rapidly (Parasuraman, 2000). Customers are dealing with products and services that are becoming increasingly sophisticated from a technological standpoint (Parasuraman, 2000). The company-customer interaction is undergoing major changes. This has implications for the company and customer as well. The question “Why do certain individuals adopt new technologies where others do not?” has become more important, especially to companies who provide technology based products and services (Tsikriktsis, 2004, p. 42). The adoption and diffusion of innovation literature posits that the individuals’ perceptions about using an innovation influence adoption behaviour (Tsikriktsis, 2004, p. 42) . There are multiple theories about this subject. A relatively new promising concept that improves understanding the distinctive behavioural process behind the adoption of technology based products and services, is Technology Readiness (Tsikriktsis, 2004).

The Technology Readiness refers to the “*propensity to embrace and employ new technologies for accomplishing goals in home life and at work*” (Parasuraman & Colby, 2015, p. 59). The TRI examines the general beliefs about technology, it does not examine the competence for a specific technology. The original TRI found its origin in literature about people-technology interactions. The interactions with (new) technology awaken positive and/or negative feelings towards technology which causes corresponding variations in people’s propensity to embrace and employ new technologies (Parasuraman & Colby, 2015). The TRI measures these negative and positive feelings to indicate whether an individual wants to adopt (new) technologies.

The Technology Readiness Index (TRI) is a tool to measure these general beliefs about technology. It is a multiple-item scale to assess people's readiness to interact with technology (Parasuraman, 2000). Recently, Parasuraman and Colby (2015) improved the original TRI to the TRI 2.0. In this review we are focusing on the most recent version (TRI 2.0). The Technology Readiness construct consists out of four dimensions: optimism, innovativeness, discomfort, insecurity:

- Optimism is defined as “*a positive view of technology and a belief that it offers people increased control, flexibility and efficiency in their lives*” (Parasuraman & Colby, 2015, p. 60).

According to Tsikriktsis (2004) optimism is a general dimension. It tries to capture specific feelings that suggest that ‘technology is a good thing’. The belief that technology creates value by giving more control over people's daily life could be an indicator.

- Innovativeness is defined as “*a tendency to be a technology pioneer and thought leader*” (Parasuraman & Colby, 2015, p. 60).

This dimension measures the extent to which an individual believes he/she is at the forefront of trying out new technology (Tsikriktsis, 2004). This can be either products or services. This person is considered by others as an opinion leader on technology-related issues. When someone is in most cases the first one to acquire a new technology among their friends could indicate innovativeness (pioneer).

- Discomfort is defined as “*a perceived lack of control over technology and a feeling of being overwhelmed by it*” (Parasuraman & Colby, 2015, p. 60).

Discomfort refers to the extent to which people are paranoid about technology-based products or services (Tsikriktsis, 2004). They believe that technology tends to be exclusionary rather than inclusive of all people. An indication for this could be the belief that technology is not designed for use by ordinary people (Tsikriktsis, 2004).

- Insecurity is defined as “*distrust of technology, stemming from scepticism about its ability to work properly and concerns about its potential harmful consequences*” (Parasuraman & Colby, 2015, p. 60).

This is somewhat related to discomfort but focuses more on distrust. Someone who does not consider to do business with a company that can only be reached online indicates insecurity.

The first two dimensions, optimism and innovativeness, are so called drivers. This means that optimism and innovativeness are contributing positively to Technology Readiness. The other two dimensions, discomfort and insecurity, are called inhibitors and demotivate Technology Readiness. The TRI 2.0 measures TR by 16 items (Parasuraman & Colby, 2015). The dimensions are distinct which means that an individual can possess different combinations of traits sometimes leading to strong drivers tempered by strong inhibitors (Parasuraman & Colby, 2015, p. 60). For every TR-component a mean is calculated that indicates a positive or negative feeling towards (new) technology. Also an overall TRI-score is calculated to measure the overall Technology Readiness. This is a 5-point scale, the higher the score the higher the Technology Readiness. It is possible to experience technology paradoxes with the TRI meaning that a high score on a driver can be neutralized by a high score on a inhibitor (Parasuraman, 2000).

Parasuraman and Colby (2015) suggest that segmenting consumers, based on their TR, can be insightful in order to determine differences in customer characteristics. For this reason a segmentation scheme was created that consists out of five segments: explorers (high motivation, low inhibition), pioneers (high motivation, high inhibition), skeptics (low motivation, low inhibition), hesitators (moderate motivation, high inhibition) and avoiders (low motivation, high inhibition). Elderly find themselves most in the avoiders segment. Besides characterizing the segments by their degree of motivation and inhibition, the segments are further characterized by describing their degree of optimism, innovativeness, discomfort and insecurity (Tsikriktsis, 2004). This characterization is presented in table 1.

**Table 1: Characterization of segments**

	Optimism	Innovativeness	Discomfort	Insecurity	TRI-score
Explorers	High (4,63)	High (4,09)	Low (2,36)	Low (2,67)	3,92
Pioneers	High (4,24)	High (3,93)	High (3,86)	High (4,12)	3,05
Skeptics	Low (3,47)	Low (3,03)	Low (2,81)	Low (3,46)	3,06
Hesitators	High (4,06)	Low (1,91)	High (3,32)	High (3,69)	2,74
Avoiders	Low (2,62)	Low (1,80)	High (3,62)	High (4,27)	2,13

In table 1 an indication is given of the scores on TRI-dimensions and overall TRI-score for each segment, based upon the segmentation analysis of Parasuraman and Colby (2015). This research also provides a brief description of the segments. Explorers are curious and believe technology is an important tool. They have a low degree of resistance and do not need much

support. Pioneers hold both strong positive and negative beliefs about (new) technology. Other than explorers, pioneers have worries and anxiety. The skeptics have a somewhat detached view from (new) technologies. These are typically individuals with less extreme positive and negative beliefs. These individuals seek confirmation of technology's benefits before adopting it. The avoiders have a high degree of resistance. They do not believe (new) technology creates any value for them. Last, the hesitators stand out due to their low degree of innovativeness (Parasuraman and Colby, 2015, p. 13). They do believe that (new) technology is beneficial but their high inhibition blocks adoption.

The tremendous growth of technology-based products and services, and the increasing rate at which companies are turning to technology to streamline how they market to and serve customers, call for a thorough assessment of customers' Technology Readiness (Parasuraman, 2000, p. 317). The propensity to embrace technology varies widely, resulting from an interplay between drivers (optimism, innovativeness) and inhibitors (discomfort, insecurity) of Technology Readiness (Parasuraman, 2000, p. 317). Examining the TRI scores can help companies to answer questions germane to the company's technology strategies and related management (Parasuraman 2000, p. 317). It is then interesting to examine mentioned segments and find the differences in demographic, lifestyle or purchasing characteristics. This to find out which technology-based systems will be the conduit for customer-company interactions, the types of systems that are likely to be most appropriate, the pace at which the systems could be implemented, and the types of support needed to assist customers experiencing problems with technology-based systems (Parasuraman 2000, p. 317). This is also supported by Parasuraman and Colby (2015). The determination of TR for a customer group will give managerial insights for marketing. High TR-customers (explorers) are interested in new technology and are able to master (new) technology with minimal help. Low TR-customers (hesitators, avoiders) will prefer basic functionality and need more support and reassurance.

## **2.4 Demographic predictors of TR**

Studies have suggested that demographic characteristics age, gender and educational level may help to explain behaviour in the context of technology adoption (Rogers, 2003 ; Rojas-Méndez et al., 2017). In research age, gender and educational level are determined as predictor variables of the outcome variable TR.

Age is defined as "*the period of time (years) someone has been alive*" (Cambridge university press., 2019). According to Meuter et al. (2003) there is a lot of discussion on

whether age is an important determinant of adoption or not. Some scholars find significant evidence where others do not. This might depend on the technology studied and problem statement. Caison et al. (2009) explored the Technology Readiness of nursing and medical students at a Canadian University. There were three major findings in the research. One of the major findings was that medical students who were older than 25 had a negative Technology Readiness score whereas those under 25 had a positive score (Caison et al., 2009). More recently (Rojas-Méndez et al., 2017) studied the Technology Readiness of younger people versus their older counterparts in the USA and Chile. A significant difference was found. Younger consumers scored higher on TR than older consumers. A significant negative relationship between age, optimism and innovativeness was found and a significant positive relationship between age, discomfort and insecurity. The study also suggested that the relationship between age and TR is mediated by cognitive capability. This will be further elaborated in chapter 2.5. Besides chronological age scientific work also mentions the impact of cognitive age on the use of technology. Eastman and Iyer (2005) found empirical evidence that consumers with a lower cognitive age use internet more often than those with a higher cognitive age. Cognitive age is described as a self-report of an individual's age perception and is measured in years (Kasper, 2018 ; Barak & Schiffman, 1981). The term is operationally defined through 4 dimensions: feel-age, look-age, do-age and interest-age. The mean of these ages represents the cognitive age. Kasper (2018) mentions that differences between chronological and cognitive age results into behavioural differences. Like chronological age I think cognitive age might also be related to TR and mediated by cognitive capability. Therefore both will be included within the research.

Gender (sex) is defined as *“the physical and/or social condition of being male or female”* (Cambridge university press., 2019). Research reports that males are more eager to adopt (new) technology than females (Tsikrikitis, in Rojas-Méndez et al., 2017). But this study also mentions that other studies found no evidence to confirm this.

The educational level is defined as *“the level of teaching or learning someone has accomplished in a school or college”* (Cambridge university press., 2019). Rojas-Méndez et al. (2017) found empirical evidence that more educated individuals are more prone to adopt (new) technology than less educated individuals, but they also mention that other studies did not find a significant relationship and argue the necessity of additional testing.

In the section on ideas for further research, Rojas-Méndez et al. (2017) suggest that occupation might be of importance to explain consumer technology adoption. Occupation is defined as *“the job or type of job that a person has”* (Cambridge university press., 2019).

Personally, I think that this could be a significant determinant for the disposition towards technology. People with technology related jobs create skills and knowledge regarding technology which can influence their TR.

Besides (cognitive) age, variables gender, educational level and occupation will be included within the research as (possible) predictors of TR. The inclusion will make the analysis on (cognitive) age more strict.

## **2.5 Cognitive capability as mediating variable**

In their article Rojas-Méndez et al. (2017) discuss the validation of demographic variables as predictors of TR. They question the direct relationship between age and TR and suggest that the relationship between age and TR is explained by a third variable that functions as a mediator in this relationship. Older people tend to perceive a reduction of their cognitive capability to learn, which could in turn be a barrier for TR. A mediator is defined as “a variable that reduces the size and/or direction of the relationship between a predictor variable and an outcome variable and is statistically associated with both” (Field, 2013, p. 879). Cognitive capability refers to a person’s ability or power to perform certain mental activities or tasks (Murman, 2015). The abilities can be divided into crystallized abilities and fluid abilities. Crystallized abilities are acquired memory that is overlearned, familiar and well-practiced (Harada, Natelson Love, & Triebel, 2014). Crystallized abilities can also be regarded as cognitive assets or resources someone possesses, like vocabulary and general knowledge for example. Fluid abilities are the cognitive capabilities to process and learn new information, solve problems and manipulate one’s environment (Harada et al., 2014). These do not depend on the earlier mentioned assets. According to Murman (2015), the most important changes in cognition, caused by ageing, are declines in fluid cognition and refers to speed of processing, working memory and executive cognitive function/reasoning. Processing speed refers to the speed with which the earlier mentioned cognitive abilities can be executed (Harada et al., 2014). Working memory refers to the ability to mentally store information and simultaneously be able to manipulate that information (Harada et al., 2014). Executive functioning/reasoning refers to the ability to self-monitor, plan, organize, reason, be mentally flexible and problem-solve (Harada et al., 2014). According to Murman (2015) there is a decline in fluid abilities from age 20 to 80. The consequence of the decline of fluid abilities is that learning is compromised at older ages (Murman, 2015) indicating that a person’s ability to process and learn new information will decline when ageing (Harada et al., 2014). This suggests that older people will find more trouble when adopting (new)

technologies. It is, as far as the author knows, unknown if this also changes the general beliefs of people towards new technology. Based on the compromised learning ability it is predicted that an increase of age decreases cognitive capabilities and therefore decreases the TR. With regard to cognitive assets no relationship with TR is suggested because assets (crystallized abilities) refer to memory that is overlearned, familiar and well-practiced. This is not applicable to new technologies. Therefore a new interpretation is given to cognitive assets: a person's skills, understanding and knowledge related to technology. Unlike crystallized abilities, the cognitive assets now refer to the acquired memory that is less overlearned but instead more manipulated in order to learn something new (new technologies). Cognitive assets increase by storing newly learned material. Mental manipulation and storage of new information is compromised as (cognitive) age increases (Murman, 2015). Therefore a negative relationship is expected between cognitive age and cognitive assets. From now on a distinction is made between cognitive capabilities and cognitive assets and both are included as mediator.

## **2.6 Conclusion**

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As mentioned the literature review is held to answer the problem statement with the currently available scientific work. Besides that, the review also provides useful information in regard to TR (Technology, adoption, TRI, demographic predictors, and cognitive capability). A definition of technology is set and adoption is elaborated. The TRI-dimensions and related segmentation is known. The information about predictors and cognitive capability was useful in order to answer the problem statement. The earlier mentioned problem statement is: *“To what extent do (cognitive) age, cognitive capabilities and cognitive assets of consumers determine their Technology Readiness and what do the results imply for future introduction of technology-based products or services in general?”*. Based on the review of scientific work a negative relationship is found between (cognitive) age and TR. It was proved that younger people were more technology-ready than their older counterparts in both the USA and Chile; specifically, in the TRI younger consumers scored higher on the drivers optimism and innovativeness, and lower on the inhibitors discomfort and insecurity, in both of the countries studied. The research proved that the performance of mental abilities decrease along the increase of age. A mediation effect of cognitive capabilities and cognitive assets between (cognitive) age and TR has been suggested (Rojas-Méndez et al., 2017), but is not yet performed as far as the author knows. That is where this study finds its purpose.

## 2.7 Conceptual model & hypotheses

This chapter provides a visualization of the research question through a conceptual model and sets hypotheses. As earlier mentioned, in this study the relationship between age and TR is investigated by using mediator cognitive capability. The interactions between (cognitive) age, cognitive capabilities, cognitive assets and TRI are shown in figure 1.

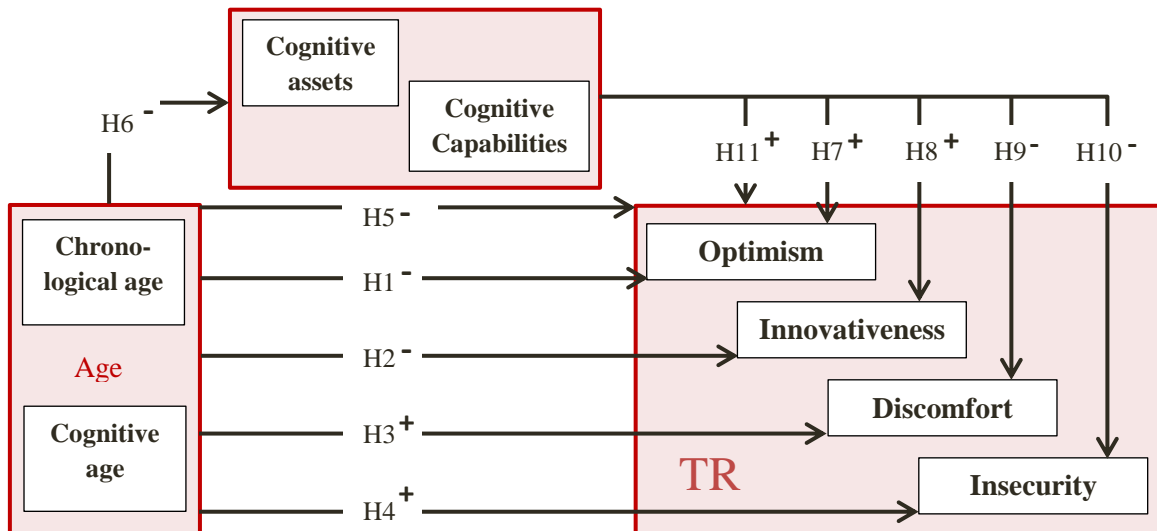


Figure 1: Conceptual model

In the conceptual model age is represented as the independent variable and TR is stated as the dependent variable. The TR is divided into the earlier mentioned TRI-dimensions according to Parasuraman and Colby (2015). Age has hypothesized interactions with the different dimensions of the TRI. These hypotheses will be analysed and are presented as hypotheses *H1*, *H2*, *H3* and *H4*. In case of the mediation a hypothesized relationship is set between age and cognitive capabilities and cognitive assets. This is presented as *H6* within the conceptual model. The hypothesized interactions between cognitive capabilities, -assets and TRI-dimensions are presented as *H7*, *H8*, *H9* and *H10* in the conceptual model. The effect of age and cognitive capabilities and -assets on the overall TRI-score is presented as *H5* and *H11*.

The dimension *optimism* refers to the positive belief that technology can create value for its users by giving them more control, flexibility and efficiency in their lives (Parasuraman & Colby, 2015). Optimism is a driver for TR and therefore induces a positive predisposition towards technology. Based upon the literature findings of Rojas-Méndez et al. (2017) the increase of a person's age induces a decrease of his/her TR. This leads to the prediction that the increase of (cognitive) age results into a decrease of optimism. The following hypothesis is set:

*H1: Increase of (cognitive) age results into lower optimism*

Being *innovative* means that a person is ahead regarding the use of technology in comparison with his environment. It is a tendency to be a technology pioneer and thought leader (Parasuraman & Colby, 2015). Like optimism, innovativeness is a driver of TR. The negative relationship between age and TR results into the prediction that the increase of (cognitive) age decreases innovativeness. The following hypothesis is set:

*H2: Increase of (cognitive) age results into lower innovativeness*

The *discomfort* towards technology is created by a perceived lack of control over technology and a feeling of being overwhelmed by it (Parasuraman & Colby, 2015). Having discomfort towards technology induces a negative disposition towards technology and therefore lowers the TR. Discomfort is a so called inhibitor of TR. The negative relationship between age and TR results into the prediction that the increase of (cognitive) age increases discomfort. The following hypothesis is set:

*H3: Increase of (cognitive) age results into higher discomfort*

Insecurity or distrust of technology is about the scepticism for technology to work properly and the concerns about its potential harmful consequences (Parasuraman & Colby, 2015). Being insecure about technology leads to a negative disposition towards technology and lowers the TR. Like discomfort insecurity is an inhibitor. The negative relationship between age and TR results into the prediction that the increase of (cognitive) age increases insecurity. The following hypothesis is set:

*H4: Increase of (cognitive) age results into higher insecurity*

Besides the hypothesized interactions on TRI-dimensions the effect of (cognitive) age on the overall TRI-score will also be analysed. The following hypothesis is set:

*H5: Increase of (cognitive) age results into a lower overall TRI-score*

Rojas-Méndez et al. (2017) suggested that the relationship between (cognitive) age and TR is mediated by cognitive capabilities and cognitive assets: a decrease in cognitive capabilities or cognitive assets results into a lower TR. Murman (2015) indicates that the increase of a person's age decreases his/her cognitive capabilities and assets. The following hypotheses are set:

*H6a: Increase of (cognitive) age results into a decrease of cognitive capabilities*

*H6b: Increase of (cognitive) age results into a decrease of cognitive assets*

In case of an ideal mediation the variables cognitive capability and -assets reduce the size and/or direction of the relationship(s) between (cognitive) age and TR to zero (Field, 2013). This means that the earlier described effects of (cognitive) age on TR are actually caused by cognitive capabilities and/or cognitive assets. Based upon theory of Harada et al. (2014) and Murman (2015) cognitive capabilities and cognitive assets decline during life. This compromises new learning and might also change the general beliefs towards new technologies (TR). Because of the compromised learning it is suggested that the predisposition towards new technologies will be influenced in a negative way, leading to the following hypotheses:

*H7a: Lower cognitive capabilities results into lower optimism*

*H7b: Lower cognitive assets results into lower optimism*

*H8a: Lower cognitive capabilities results into lower innovativeness*

*H8b: Lower cognitive assets results into lower innovativeness*

The suggested negative influence on TR indicates that the inhibition increases, this increases discomfort and insecurity towards new technologies. The following hypotheses are created:

*H9a: Lower cognitive capabilities results into higher discomfort*

*H9b: Lower cognitive assets results into higher discomfort*

*H10a: Lower cognitive capabilities results into higher insecurity*

*H10b: Lower cognitive assets results into higher insecurity*

Besides the hypothesized interactions on TRI-dimensions the effect of cognitive capabilities and cognitive assets on the overall TRI-score will be analysed. This leads to the following hypotheses:

*H11a: Lower cognitive capabilities results into lower overall TRI-score*

*H11b: Lower cognitive assets results into lower overall TRI-score*

For this study, data about consumers' age, cognitive capabilities, cognitive assets and TR needs to be collected and analysed. The next section answers how this is realised.

### **3. Methodology**

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In this section the methodology used for this research is elaborated. To collect data and test the hypothesized model a survey is used. This survey finds its foundation in the TRI 2.0 (Parasurman & Colby, 2015). The study is twofold which includes a preparation phase and the main phase. In the preparation phase the target group (sample) is determined and the survey was tested to evaluate whether it is understandable. The main phase includes the actual measurement of TR. The data collection, measurement of variables (operationalisation), data analysis and research ethics will be discussed in the following sections.

The research is based upon the deductive theory construction (Babbie, 2013). Deductive reasoning moves from the general to the specific, meaning that a theoretical expectation is made and tested accordingly (Babbie, 2013, p.22). In this study a theoretical review is held that resulted into certain expectations (hypotheses). The purpose of the study is to explain the indicated relationships between (cognitive) age, cognitive capabilities, cognitive assets and TR.

#### **3.1 Preparation**

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The survey is based upon the TRI 2.0 (Parasuraman & Colby, 2015) but extended (this extension is further explained in section 3.2). First a translation of the TRI 2.0 is made to increase the response, otherwise non-English speaking consumers would automatically be excluded. The translation is completed with the help of an acquaintance who lived several years abroad and is skilled in the English language. The translations were made independently and compared, resulting into the translations presented in appendix I. The acquaintance improved grammar and changed some terms used within the translations of the questions.

For the preparation 6 people (aged 65-85) have been selected (mix of gender and education) from the nearby rest home (Bruggerhof, Hunsel) to test the survey. These higher aged consumers were selected on purpose. If the survey is understandable for older consumers, most likely it is also for younger consumers. The respondents were asked to fill in a paper version of the survey and to evaluate it. The researcher was present during this pre-test of the questionnaire. Remarks were noted and used for improvement. It appeared that the definition of “Technology” had to be improved and some terms, used within the questions, had to be adjusted. The exact remarks and pre-test report is found within appendix II. The final survey version is presented in appendix III.

## **3.2 Main phase**

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In this section the data collection, measurements, data analysis and research ethics are elaborated.

### **3.2.1 Data collection**

The data for research is collected by conducting a survey. The survey was sent to people with an age of 18 and more (similar to the approach taken by Parasuraman & Colby, 2015). Besides an online version also a paper version of the survey was created to increase the response (especially of elderly). Some people may not have a computer or might prefer a paper version. The survey was sent to a large amount of people living in the area of Midden-Limburg. Participants have been approached on the streets, in retirement homes and through local recreational clubs, but in most cases they were contacted by e-mail or by putting the survey (paper version) in their mailbox. Based upon the sample calculation by Qualtrics XM (Radboud University, 2019) with a confidence level of 95%, large population (>100.000) and margin error of 5%, 385 respondents are needed.

The survey has ran for almost 8 days. In total, more than 750 people were contacted leading to 418 respondents. After deleting the surveys that were filled in incompletely or showed a response bias, 400 respondents remained. The target for the sample was to get a balanced mix of respondents' age, gender and education. Out of the respondents 96% completed the survey online and 4% offline. The respondents had a mean cognitive age of 36 years a mean age of 41 years with a range of 18-83. The ratio between men/women was 54/46 and their educational level ranged between no education and university. The distribution of age is as follows: 18-40 (206), 41-65 (149), 66-80 (45).

### **3.2.2 Measurements**

By conducting the survey, data of consumers' (cognitive) age, cognitive capabilities, cognitive assets, gender, educational level, occupation and TR is collected. The questions from the TRI 2.0 (Parasuraman & Colby, 2015) are about statements on which respondents answer from strongly disagree (1) to strongly agree (5; on this 5-point Likert scale). Each (latent) variable will be elaborated on how it is measured, in appendix IV the exact questions/statements that are used in the survey are mentioned.

*Chronological age* is measured in the survey through a simple question. It represents the period of time someone has been alive (numbers of years). Respondents were asked to fill in their age. Variable 'age' is a so called ratio variable (Babbie, 2013). This is a level of

measurement describing a variable with attributes that have all the qualities of nominal, ordinal and interval measures but in addition are based on a 'true zero' point (Babbie, 2013, p. 182).

*Cognitive age* is, like chronological age, a ratio variable and is also measured in years. The operationalisation is different. The term is operationally defined through 4 dimensions: feel-age, look-age, do-age and interest-age (Kasper, 2018). Respondents are asked to fill in their perception of age on the four dimensions.

*Gender* is a so called nominal variable whose attributes are different from another (categorical)(Babbie, 2013). This variable is measured by a single statement, determining whether someone is *male* or *female* (dichotomous). The coding of variable gender is made as follows: male (1) and female (2).

*Educational level* belongs to the so called ordinal measures (Babbie, 2013). These variables have attributes that can be logically ranked (categorical). Educational level is an ordinal measure because it ranges from lower to higher levels. The educational level is measured by a single statement in which respondents have to fill in their highest accomplished educational level. The coding of variable educational level is made by use of 7 educational levels : no education (1) – PhD (7).

*Occupation* is determined by a nominal measurement (Babbie, 2013). The variable is measured by a single question asking if a person's job was technology related. Technology related jobs are found in engineering related fields (electrical, mechanical, chemical, software and I(C)T). The question asks whether someone had a job within these fields. The coding for the variable occupation is as follows: yes (1), no (2).

*TR* is measured by using the TRI 2.0 (Parasuraman & Colby, 2015). This index measures TR through 16 items (statements) based upon the 4 dimensions: optimism, innovativeness, insecurity and discomfort. All four dimensions are measured by four items. All TRI-items are measured by using a 5-points Likert scale: strongly disagree (1) – strongly agree (5).

An important insight from the literature review was the distinction between cognitive capabilities and cognitive assets, together representing cognitive capability (section 2.5). Due to their differences it is insightful to measure and analyse both variables separately.

*Cognitive capabilities* are measured by determining someone's broad ability to reason (Salthouse, Pink , & Tucker-Drob, 2008). The research of Salthouse et al. (2008) examines the history of measuring fluid intelligence (cognitive capabilities). They describe fluid intelligence as an ability to discriminate relations, in which quality of reasoning, novel

problem solving and adaptation to new situations are the most important aspects. Woodcock and Mather (in Salthouse et al., 2008) state the following about the measurement: “*Fluid intelligence is best measured with tasks that are novel – i.e. those that require one to discover the essential relations of the task for the first time and draw inferences that could not have been worked out before. Tasks intended to measure fluid intelligence should not depend heavily on previously acquired knowledge or earlier-learned problem-solving procedures*” (Salthouse et al., 2008, p.465). In other words fluid intelligence is about learning something new without being too dependent on earlier gained knowledge (cognitive assets). According to the literature (Murman, 2015 ; Salthouse et al., 2008) the fluid intelligence affects the new learning capabilities. A high fluid intelligence increases the ease of new learning and therefore learning and using a (new) technology becomes easier. High difficulty on comprehending (new) technology indicates compromised learning and a lower fluid intelligence. Essentially, fluid intelligence determines how much mental effort a person needs to put into learning and using new technology, the measurement can be fulfilled accordingly. Six items are created for the measurement and ask respondents about their mental performance when learning (new) technologies. Items about mental effort and time needed to learn something new are asked. The measurement is completed by using a 5-points Likert scale: strongly disagree (1) – strongly agree (5).

*Cognitive assets* are measured by determining a person’s skills, understanding and knowledge related to technology. It is assumed that when people are skilful or knowledgeable regarding technology, their TR is influenced. The foundation for my new scale on measuring cognitive assets is provided by the items measuring ‘perceived ease of use’ of technology (Davis in Lin et al., 2007). This determinant refers to the belief that using a particular system is free of effort. Normally, the focus lies on a specific technology and the user-friendliness. For this study the items are transformed, focusing on new technology in general and how much knowledge and insight someone has in regard to new technology. Items like “I have knowledge of technology” are asked. Five items are created for the measurement. The measurement is again completed by using a 5-points Likert scale: strongly disagree (1) – strongly agree (5).

### **3.2.3 Data reliability and validity**

In this section the reliability and validity of measurements (appendix V) will be checked. The analysis has been fulfilled by making use of IBM SPSS statistics. Validity and reliability

needs to be determined to decide whether an instrument actually measures what it sets out to measure and whether an instrument is consistent in different situations (Field, 2013).

First a multi-item measurement is performed by making use of the factor analysis. With this method, the loading of items on the variables (factors) can be evaluated. The best case scenario is that every item has a high loading onto the corresponding variable (factor). The factor analysis defines the structure among the variables to evaluate validity. An exploratory factor analysis (EFA) has been conducted for the four TRI-dimensions, cognitive age, cognitive capabilities and cognitive assets. The sample size (400) is big enough to conduct an EFA (Hair, Black, Babin, & Anderson, 2014). Appendix V describes the factor analysis in detail.

All items, except the fourth item of insecurity (INS4-doing business online), had a sufficient factor loading. This item is therefore removed (see appendix V). For cognitive assets, three items (CA1-knowledgable, CA2-experienced and CA5-skillful) have been removed due to violation of discriminant validity (see appendix V). All the other items complied to the factory analysis criteria. By deleting previously mentioned items the construct validity of the measurements is increased.

After completing the factor analysis, the reliability of item scales for TRI-dimensions, cognitive age, cognitive capabilities and cognitive assets were measured with the Cronbach's alpha (appendix V). All values exceed the criteria of 0.6 and no items can be deleted that increase the value with 0.05 or more (Hair et al., 2014). This indicates reliable measurement scales, also for the two new scales that were specifically developed for this study (cognitive capabilities and cognitive assets). In table 2 the Cronbach's alpha value of each variable is presented.

**Table 2: Cronbach's alpha values**

	Optimism	Innovativeness	Discomfort	Insecurity
Cronbach's alpha	0,650	0,795	0,696	0,681
	Cognitive age	Cognitive capabilities	Cognitive assets	
Cronbach's alpha	0,964	0,911	0,737	

### 3.2.4 Data analysis

In this section the data analysis will be elaborated. The data retrieved from the conducted survey is analysed by using IBM SPSS Statistics (from now on SPSS). First the survey output is examined with SPSS to determine the amount of missing data and invalid answers. The

missing data can decrease the sample size and statistical power. For missing data the distinction is made between missing data at random (MAR) and missing data completely random (MCAR). In this case the missing data in the survey is 0%. All questions asked had an obligatory label. Respondents could not finish the survey without filling in every single question. Therefore it is not needed to perform the Little's MCAR-test to check whether there was missing data, if it was completely at random and lower than 10% (Hair et al., 2014).

Then the data is checked on response sets. Questions and answers are compared extensively (in terms of content) to determine whether respondents' answers show certain patterns that are invalid like answer sets that show frequently the same answers (11111, 22222, 44444, 55555). Twelve respondents showed response sets, this data has been removed. In some cases, frequently answering "neutral" was ignored.

After cleaning the data, the data distribution (normality) is checked for the variables optimism, innovativeness, insecurity, discomfort, cognitive capabilities, cognitive assets and the overall TRI-score. Normality is not a strict assumption for regression analysis since this technique is known for its robustness (Hair et al., 2014, p. 204). But, the distribution influences the correlations between variables which is the foundation of multiple regression and should therefore be determined. Skewed variables can influence multiple regression results. The normality is determined by using the kurtosis- and skewness-values (figure 2).

		TRI_OPT	TRI_INN	TRI_DIS	TRI_INS	CC_TOT	CA_TOT
N	Valid	400	400	400	400	400	400
	Missing	0	0	0	0	0	0
Mean		3,6956	3,0281	3,1900	2,4050	3,3413	3,7825
Skewness		<b>-,545</b>	<b>-,128</b>	<b>-,274</b>	<b>,194</b>	<b>-,532</b>	<b>-,946</b>
Std. Error of Skewness		<b>,122</b>	<b>,122</b>	<b>,122</b>	<b>,122</b>	<b>,122</b>	<b>,122</b>
Kurtosis		<b>1,676</b>	<b>-,086</b>	<b>-,260</b>	<b>-,549</b>	<b>-,323</b>	<b>1,890</b>
Std. Error of Kurtosis		<b>,243</b>	<b>,243</b>	<b>,243</b>	<b>,243</b>	<b>,243</b>	<b>,243</b>

		TRI_INS_SQRT	CC_TOT_2			TRI_SCORE
N	Valid	400	400	N	Valid	400
	Missing	0	0		Missing	0
Mean		1,5318	11,7819	Mean		3,0797
Skewness		<b>-,157</b>	<b>-,012</b>	Skewness		<b>-,158</b>
Std. Error of Skewness		<b>,122</b>	<b>,122</b>	Std. Error of Skewness		<b>,122</b>
Kurtosis		<b>-,475</b>	<b>-,436</b>	Kurtosis		<b>-,294</b>
Std. Error of Kurtosis		<b>,243</b>	<b>,243</b>	Std. Error of Kurtosis		<b>,243</b>

(note: OPT = optimism, INN = innovativeness, DIS = discomfort, INS = insecurity, CC = cognitive capability, CA = cognitive assets)

**Figure 2: Frequency tables for normality check**

Variables show normality when the skewness value divided by its standard error is less than 2 and/or the kurtosis value divided by its standard error is less than 2, ignoring the negative sign (-). As an example, for variable optimism the skewness is checked by dividing 0,545 by 0,122 (= 4,5). The value of 4,5 is higher than the criteria value of 2, therefore the variable shows non-normality. This calculation is replicated for all variables on both skewness and kurtosis. The total TRI-score shows a normal distribution. Figure 2 displays, with red, which variables do not comply. In this case all variables, except innovativeness, show non-normality. Transformations were executed on those that did not comply but the linearity did not improve for most variables. For variable insecurity and cognitive capabilities the transformation SQRT (square-root) and ^2 (squared) did improve the distribution (figure 2). This implies that from now on the transformed variables insecurity and cognitive capabilities are used within the analyses. The non-normality of variables has to be taken into account for the analysis results.

The first step of data analysis is to examine the descriptive statistics. With the descriptive statistics an impression is received from the included variables and their scores.

Then a simple regression analysis is executed for the variables included in the conceptual model: (cognitive) age, cognitive capabilities, cognitive assets and the TRI-dimensions. The individual relationships between the variables are examined. In order to do this the Pearson correlation coefficients (correlation matrix) between the variables are presented together with the regression analysis results.

After the simple regression an ANOVA is conducted. The ANOVA is a technique for analysing group mean differences (categorical variables). The role of categorical variables gender, educational level and occupation in relation to TRI is examined. These variables might function as possible predictors besides cognitive age.

Then the multiple regression is conducted. This analysis includes all variables that appeared to be relevant in the simple regression analysis and ANOVA. This results into a stricter analysis and more reliable statements in regard to the hypotheses.

Last, a mediation analysis is conducted. Mediation occurs if the original relationship between (cognitive) age and TRI-dimensions is reduced significantly in strength by including a third variable (mediator). The significance of mediation can be determined by using confidence intervals. The total, direct and indirect effects will be measured with Hayes's PROCESS tool (Field, 2013) in order to determine the mediation effect of cognitive capabilities and cognitive assets.

### **3.3 Research ethics**

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The research ethics, also mentioned as “norms for conduct” within research, are important for both researcher and participants. The research ethics protect the integrity of the research itself and the research participants. When conducting the survey I will maintain obligations towards the respondents (Sudman, 1998).

By conducting the survey, participants will not be harmed. This means that I will not ask questions that will embarrass, ridicule, belittle or distress participants (Sudman, 1998). I will try to give the participants convenience by accenting to them that they do not have to fill in any questions that gives them an inappropriate feeling. Also, I will not try to persuade the participants in any way to take part in the research.

The participants will receive adequate information about the survey. This includes an introduction of myself, a brief description of my education and estimation of the amount of time needed to complete the survey. The participants will be informed about the purpose of the study, for what the collected data will be used and who will be in possession. Data will not be used for any other purpose without the participant’s consent (Sudman, 1998). The data will be held in confidence. This promise of confidentiality will be explicitly mentioned within the survey. The respondents cannot be identified based upon their answers. The data will not be provided to anyone or anything from which the respondent is not aware of.

## 4. Results & Conclusions

In this section the analysis, results and the corresponding conclusions will be elaborated. The data preparation in the methodology section provides a well-founded basis for analysis. By performing the analyses, the earlier set hypotheses and conceptual model will be evaluated. The section outline is as follows: descriptive overview, simple regression analysis, ANOVA analysis, multiple regression and mediation analysis.

### 4.1 Descriptive overview

In total, 418 consumers participated in the research from which 400 gave valid answers. Approximately 75% of the respondents live in the township of Leudal (Midden-Limburg). Out of the 400 respondents, 216 were male and 184 were female (ratio: 54/46). Also, more than 70% of the respondents has a job. The remaining part exists mostly out of students or retired people. The average age of the respondent is 41 and ranges from 18 to 83. Respondents were also asked to fill in whether their occupation was engineering related. This is applicable to 26% of the respondents. In table 3 an overview is provided of all included variables within the conceptual model. For the additional variables education (EDU), occupation (OCC1 and OCC2) and gender (GEN), the descriptive statistics are displayed in appendix VI.

**Table 3: Descriptive statistics overview of conceptual model variables**

	Age	Cognitive age	Optimism	Innovative-ness	Discomfort (reverse)	Insecurity (reverse)	TRI	Cognitive capabilities	Cognitive assets
N Valid	400,00	400,00	400,00	400,00	400,00	400,00	400,00	400,00	400,00
Missing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Mean	41,27	36,37	3,70	3,03	3,19	2,41	3,08	3,34	3,78
Std. Deviation	18,17	13,93	0,57	0,82	0,68	0,74	0,45	0,79	0,63

From the descriptive statistics the basic sample information is derived. The variables discomfort and insecurity are reversed in order to create the TRI-score. A high score indicates low discomfort/insecurity and a low scores indicates high discomfort/insecurity.

Looking at the descriptive results, a difference is seen between the means of age (41,27) and cognitive age (36,37). As expected, on average people feel less old than what they truly are. This difference, of about five years, is quite often found in empirical studies (see Kasper, 2018). For the following variables the scores are compared to the standard of value 3 (neutral). Respondents show quite some optimism (3,70) towards technology on average, indicating a positive view and belief. Looking at the scale of the items in appendix VI,

respondents especially agree to the fact that technology contributes to a better quality of life and freedom (mean = 3,94). The scores on innovativeness (3,03) and discomfort (3,19) are rather neutral, indicating that on average people are not that innovative and do not show that much discomfort towards technology. On the other hand, there is quite some insecurity regarding technology (2,41), which means that respondents are sceptic about its ability to work properly and show concern about its potential harmful consequences. Last, on average the respondents score quite high on their cognitive capabilities (3,34) and cognitive assets (3,78). This suggests that the average respondent knows technology better than just how to handle/comprehend it.

Before going further into detail, the descriptive statistics can be further explained with the findings from the conversations with respondents. Besides the online survey, some older respondents (65+-age) have been contacted offline. In some cases the author was invited into their houses. This resulted into conversations in which the respondents elaborated on their answers and thoughts. All offline respondents emphasized the importance and benefits of technology and showed optimism towards it. But, at the same time they showed discomfort and insecurity. In their opinion technology is often too difficult to handle and has a negative effect on relationships. This is in accordance to the earlier mentioned cognitive capability (3,34) and insecurity value (2,41) Last, technology is developing in a fast manner and sometimes too difficult to comprehend (cognitive capabilities) and keep track of.

## **4.2 The simple regression analysis**

Besides determining the descriptive statistics for each variable the individual relationships between the variables are examined. In order to do this the Pearson correlation coefficients (correlation matrix) between the variables are presented (table 4). The correlation matrix shows multiple significant correlation coefficients between variables, but no causality. In addition to the correlation matrix a regression analysis is conducted to examine the individual causal relationships into more detail. Hair et al. (2014) describes several assumptions that need to be checked before a regression analysis can be performed: symmetric distribution of variables, variables have a metric measurement level, linearity between independent variable(s) and dependent variable, no multicollinearity and the standardized residuals must show homoscedasticity. The procedure and results are found within appendix VII. Not all assumptions are met. As known from section 3.2.4 not all variables are normally distributed. This violation can be ignored due to the robustness of the (multiple) regression method (Hair

et al., 2014)(appendix VII). Cognitive age shows a curvilinear relationship with the TRI-score variable. When examining this relationship with the (multiple) regression analysis, the centred cubic cognitive age variable needs to be included (appendix VII). For all other relationships the variables are original (not centred, no polynomial terms). As expected, there is severe multicollinearity between the variables age and cognitive age (appendix VII). Age and cognitive age cannot be included both within the regression analysis.

In order to choose age or cognitive age as the independent variable it is important to determine which variable shows the highest goodness of fit with the overall TRI-score and TRI-dimensions (see figure 3).

TRI-score	R	R Square	Correlation	Cognitive capabilities	Cognitive assets
Age	0,148	,022	Age	-,451**	-,165**
Cog. age_centre^3	0,258	,066	Cog. age	-,476**	-,201**

Optimism	R	R Square	Discomfort	R	R Square
Age	0,085	,007	Age	0,336	,113
Cog. age	0,067	,004	Cog. age	0,348	,121

Innovativeness	R	R Square	Insecurity (SQRT)	R	R Square
Age	0,217	,047	Age	0,117	,014
Cog. age	0,265	,070	Cog. age	0,107	,011

Remark: Cog. Age\_centre^3 refers to the centred cubic cognitive age variable and Insecurity (SQRT) refers to the square root transformation of the insecurity variable. \*\*. Correlation is significant at the 0.01 level (2-tailed). \*. Correlation is significant at the 0.05 level (2-tailed).

**Figure 3: Goodness of fit results (TRI)**

For TRI-score (0,066), innovativeness (0,070) and discomfort(0,121) cognitive age shows a higher fit with the dependent variables in comparison to actual age (3 out of 5). With cognitive age as a stronger predictor than actual age a better explanation of TRI and its four dimensions can be realized. Also, in regard to cognitive capabilities and cognitive assets, cognitive age fits better in terms of content. This is confirmed by the fact that cognitive age shows a higher correlation with cognitive capabilities (-4,76\*\*) and cognitive assets (-2,01\*\*) than age does (see figure 3). The variables show affinity due to the cognitive aspect. For these reasons cognitive age is selected as the independent variable.

All assumptions are checked and violations have been solved. Therefore it is allowed to conduct the simple regression analysis. The simple regression analysis procedure and

results are described in detail in appendix VII. For hypothesis 1-6 the analysis results will be described and explained in relation to whether the hypothesis is confirmed or rejected.

**Table 4: Correlation matrix of variables**

	Age	Cognitive age	Cognitive capabilities	Cognitive assets	Optimism	Innovativeness	Discomfort	Insecurity	TRI-score
<b>Age</b>	1								
<b>Cognitive age</b>	,938**	1							
<b>Cognitive capabilities</b>	-,451**	-,476**	1						
<b>Cognitive assets</b>	-,165**	-,201**	,436**	1					
<b>Optimism</b>	,085	,067	,094	,192**	1				
<b>Innovativeness</b>	-,217**	-,265**	,591**	,501**	,279**	1			
<b>Discomfort (reverse)</b>	-,336**	-,348**	,468**	,284**	,089	,263**	1		
<b>Insecurity (reverse)</b>	,117*	,107*	,016	,035	,339**	,129**	,235**	1	
<b>TRI-score</b>	-,148**	-,185**	,480**	,408**	,611**	,691**	,615**	,655**	1

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

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

In order to confirm hypothesis 1-6 the correlation coefficients from table 4 and regression results from appendix IX are interpreted. The results show a non-significant positive correlation coefficient (0.067) between cognitive age and optimism and non-significant regression model ( $p = 0,182$ ). Therefore no significant relationship is found and hypothesis 1 is rejected. For cognitive age and innovativeness the results show a significant negative correlation coefficient (-0,265\*\*) and significant regression model ( $\beta = -0,265 \mid p < 0,01$ ). The increase of cognitive age results into a decrease of the innovativeness of consumers and H2 is confirmed. The results show a significant negative correlation coefficient (0,348\*\*) between cognitive age and discomfort and significant regression model ( $\beta = 0,348 \mid p < 0,01$ ). The variable discomfort is reversed, the increase of cognitive age increases feelings of discomfort towards technology. This means that Hypothesis 3 is confirmed. For cognitive age and insecurity the correlation coefficient is significant (-0,107\*) as well as the regression model ( $\beta = -0,107 \mid p < 0,05$ ). The variable insecurity is reversed, an increase of cognitive age decreases the feeling of insecurity. Therefore, hypothesis 4 is rejected. A significant negative relationship is found between cognitive age and the TRI-score. The correlation coefficient is negative and significant (-0,185\*\*) as well as the regression model ( $p < 0,01$ ). In this case the standardized betas ( $\beta$ ) in the regression model cannot be interpreted because the polynomial terms of cognitive age are included. The figure in appendix IX shows a decline of the TRI-score between the age of 18 and 28 . Then, the TRI-score stays constant until the age of 48. After the age of 48 the TRI starts

declining again. Hypothesis 5 is partially confirmed. Between cognitive age and cognitive capabilities (-0,476\*\*) and between cognitive age and cognitive assets (-0,201\*\*) the correlation coefficient is significant and negative. The regression model shows a significant negative relationship with cognitive capabilities ( $\beta = -0,476 \mid p < 0,01$ ) and cognitive assets ( $\beta = -0,201 \mid p < 0,01$ ) for cognitive age. This means that the increase of cognitive age results into a decrease of both cognitive capabilities and assets, therefore both H6a and H6b are confirmed.

Looking at the significant simple regression models it is important to summarize the standardized beta value/correlation coefficient between cognitive age and variables. These are as follows: cognitive capabilities (-0,476), discomfort (-0,348), TRI-score (-0,281), innovativeness (-0,265), assets (-0,201) and insecurity (0,107) (appendix IX). Cognitive capabilities appears to be most related (highest correlation) to cognitive age, insecurity the least related. The R<sup>2</sup>-values range between 4,1% and 22,7% (appendix IX) which indicates a weak explanatory power (Hair et al., 2014). This was expected since technology adoption is a complex social phenomenon. In order to make the analysis more strict other (possible) relevant predictors for the TRI-score and TRI -variables besides cognitive age must be examined. For variables gender, educational level and occupation an ANOVA is conducted.

### **4.3 ANOVA analysis**

The ANOVA is a technique for analysing group mean differences (categorical variables). Besides cognitive age, categorical variables gender, educational level and occupation may be of importance in predicting the TRI-score and TRI-dimensions. First the analysis assumptions were checked in order to determine whether the survey data was suitable, then the actual ANOVA analysis was conducted.

#### **4.3.1 ANOVA assumptions**

The first assumption demands independent observations. This assumption is violated when responses in a group are not made independent from another group (Hair et al., 2014). In this case the assumption is met because the respondents completed the survey individually and did not share a particular experience. Also, the survey ran for a short period of time.

Secondly, the populations should be distributed normally. As described in section 3.2.4 some variables show non-normality that cannot be solved with the use of transformations. Due to the central limit theorem (Hair et al., 2014), the violation of this assumption has little impact because the sample size is high (400). The violation is allowed.

Third, the dependent variables must have metric measurement levels. This assumption has been confirmed before in section 4.2. Likert scale data of the TRI-dimensions is analysed at the interval measurement scale (Boone & Boone, 2012) and is therefore metric.

Fourth the independent variables must have a categorical measurement level. As mentioned within the section measurements (3.2.2) the variables gender, educational level and occupation are categorical.

#### 4.3.2 ANOVA analysis results

The mean differences for gender, educational level and occupation are examined by interpreting the ANOVA results presented in appendix X. In table 5 a summary of the ANOVA outcomes is presented for educational level.

**Table 5: Overview of ANOVA outcomes for educational level**

Educational level	Innovativeness		Discomfort		TRI-score	
	Mean	Difference	Mean	Difference	Mean	Difference
1 Geen onderwijs / basisonderwijs	2,00	*(6, 7)	2,45	*(6)	2,48	*(5, 6, 7)
2 Vmbo-basis / kader, MBO 1 / LTS / LBO / VBO	2,61	*(6, 7)	2,84	*(6, 7)	2,88	*(6, 7)
3 Vmbo-gemengd / theoretisch / MAVO / ULO / MULO	2,66	*(6, 7)	2,91	*(6)	2,95	
4 MBO 2, 3 of 4 / MTS	3,02		3,08	*(6)	3,01	*(6)
5 HAVO / VWO	2,91		3,26		3,11	*(1)
6 HBO-bachelor / WO- bachelor	3,24	*(1, 2, 3)	3,41	*(1, 2, 3, ,4)	3,20	*(1, 2, 4)
7 WO-doctoraal / WO-master / HBO-master	3,30	*(1, 2, 3)	3,36	*(2)	3,21	*(1, 2)

\*(.). Difference between levels is significant at the 0.05 level (2-tailed)

For *educational level*, significant group mean differences are found with regard to innovativeness, discomfort and TRI-score. Consumers with an educational level of 6 (3,24) or 7 (3,30) show a significantly higher degree of innovativeness than the consumers with an educational level of 1 (2,00), 2 (2,61) or 3 (2,66). This suggests that with the increase of educational level the innovativeness of consumers increases. Consumers with an educational level of 1 (2,45), 2 (2,84), 3 (2,91) or 4 (3,08) show significantly more discomfort (reversed variable) towards technology than consumers with an educational level of 6 (3,41). Also a significant difference of discomfort was found between levels 2 (2,84) and 7 (3,36). This could indicate that an increase of educational level results into less discomfort. Last, significant differences were found for the TRI-score. Consumers with an educational level of 1 (2,48) show significant lower TRI-scores than consumers with an educational level of 5

(3,11), 6 (3,20) or 7 (3,21). A significant difference was also found between consumers with an educational level of 2 (2,88) and those with level 6 (3,20) or 7 (3,21). Consumers with an educational level of 4 (3,01) have a significant lower TRI-score than consumers with educational level 6 (3,20). Altogether, the results suggest that the increase of educational level of consumers and the increase of TRI-score of consumers go hand in hand. Looking at the group sizes (appendix X), it is important to mention that the group size of level 1 is very small (less than 7). The results for educational level 1 should therefore be interpreted with caution.

For *gender*, significant mean differences were found between males and females with regard to optimism, innovativeness and TRI-score. The degree of optimism is significantly higher for males (3,78) in comparison to females (3,60). Also, males appear to be more innovative (3,31) than females (2,65). Last, the TRI-score of males (3,19) is significantly higher than the TRI-score of females (2,95). This result indicates that males are more technology ready than females are.

For *occupation*, significant mean differences were found between respondents with an engineering related job and without an engineering related job in regard to optimism, innovativeness and TRI-score. Consumers with an engineering related job (3,82) are more optimistic towards technology than those without an engineering related job (3,65). Also, consumers with an engineering related job (3,53) are more innovative than those without (2,85). Last, consumers with an engineering related job have a significant higher TRI-score (3,27) than consumers with a job unrelated to engineering (3,01).

The results indicate that for educational level there are only significant differences on TRI-score, innovativeness (driver) and discomfort (inhibitor). Gender and occupation show significant differences for TRI-score, optimism and innovativeness (drivers), not for the inhibitors. The roles of educational level, gender, occupation, cognitive capabilities and cognitive assets will be further examined in the multiple regression analysis.

#### **4.4 Multiple regression**

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The regression analysis becomes more strict by including gender, educational level and occupation together with cognitive age. In this section, the multiple regression analysis is conducted. Before running the analysis, dummy variables were created for gender and occupation. Educational level is included as a metric variable (interval measurement level) because the attributes are rank-ordered (lowest = 1 and highest = 7). Stringently this is not allowed, but in terms of interpretation it is advantageous in this case. With regard to multiple

regression assumptions, no significant violations are detected. The multiple regression analysis results are presented in detail in appendix XI.

For optimism, the multiple regression model is significant ( $p < 0,01$ ). Cognitive age and optimism are positively related, the increase of cognitive age increases optimism for consumers ( $\beta = 0,149 \mid p < 0,01$ ), H1 is rejected. Secondly, a positive significant relationship is found between cognitive assets and optimism ( $\beta = 0,148 \mid p < 0,01$ ). The relationship between cognitive capabilities and optimism is non-significant ( $p = 0,652$ ). Hypothesis 7b is therefore confirmed and hypothesis 7a is rejected. Last, educational level and optimism are positively related ( $\beta = 0,115 \mid p < 0,05$ ).

The multiple regression model is significant for innovativeness ( $p < 0,01$ ). No significant relationship is found between cognitive age and innovativeness ( $p = 0,736$ ), H2 is rejected. A significant positive relationship between cognitive capabilities and innovativeness ( $\beta = 0,394 \mid p < 0,01$ ) is found. Secondly, cognitive assets and innovativeness are positively related ( $\beta = 0,243 \mid p < 0,01$ ). The results confirm both hypothesis 8a and 8b. Also, males appear to be more innovative than females ( $\beta = 0,198 \mid p < 0,01$ ). Last, consumers with an engineering related job are more innovative than those without ( $\beta = 0,139 \mid p < 0,05$ ).

For discomfort (reversed) the multiple regression model is significant ( $p < 0,01$ ). Based upon the results, cognitive age and discomfort appeared to be positively related ( $\beta = 0,125 \mid p < 0,05$ ). An increase of cognitive age increases the feeling of discomfort, H3 is confirmed. Secondly, a significant negative relationship is determined between cognitive capabilities and discomfort ( $\beta = -0,347 \mid p < 0,01$ ), confirming hypothesis 9a. The relationship between cognitive assets and discomfort appeared to be non-significant ( $p = 0,053$ ). Hypothesis 9b is rejected. Also, males experience more discomfort than females ( $\beta = 0,110 \mid p < 0,05$ ). Last, a significant negative relationship is found between educational level and discomfort ( $\beta = -0,115 \mid p < 0,05$ ).

The multiple regression model appears to be non-significant ( $p = 0,150$ ) for insecurity. Only a significant (negative) relationship between cognitive age and insecurity (reversed) is determined ( $\beta = -0,140 \mid p < 0,05$ ). Hypotheses 4,10a and 10b are rejected.

For the overall TRI-score, the multiple regression model appears to be significant ( $p < 0,01$ ). First, a significant relationship is found between cognitive age and TRI-score ( $p < 0,01$ ). Both the linear term as well as the cubic term appear to be significant. For polynomial terms it is not allowed to interpret/compare the  $\beta$ -values because they are related and refer to the same variable. Looking at the curve estimation figure in appendix IX, the relationship

between cognitive age and TRI-score is visualized for all polynomial terms. Based upon the results hypothesis 5 is partially confirmed (see section 4.2). Secondly, cognitive capabilities and the overall TRI-score are positively related to each other ( $\beta = 0,334 \mid p < 0,01$ ). Also, between cognitive assets and overall TRI-score a significant positive relationship is determined ( $\beta = 0,202 \mid p < 0,01$ ). Hypothesis 11a and 11b are confirmed. Last, males have a significant higher overall TRI-score in comparison to females ( $\beta = 0,116 \mid p < 0,05$ ).

The adjusted R<sup>2</sup>-values range between 0,9% and 48,8% (appendix XI). The explanatory power is weak on average (Hair et al., 2014). This was expected since technology adoption is a complex social phenomenon. When comparing the simple regression results with the multiple regression results, a couple of differences are noticed. Unlike the simple regression, the multiple regression found a significant positive relationship between cognitive age and optimism. Still, hypothesis 1 is rejected due to the incorrect direction of the relationship. Secondly, the simple regression found a significant negative relationship between cognitive age and innovativeness, the multiple regression did not. For discomfort the findings were in line. The multiple regression model appeared to be non-significant for insecurity unlike the simple regression model. Last, the multiple regression results for the overall TRI-score were in accordance with the simple regression results. In regard to the overall TRI-score, cognitive capabilities (0,334) proved to be a stronger predictor than cognitive assets (0,202). In table 6 a summary of the multiple regression analysis outcomes is presented.

**Table 6: Overview of multiple regression outcomes**

	Optimism (adj. R <sup>2</sup> = 0,063)		Innovativeness (adj. R <sup>2</sup> = 0,488)		Discomfort (adj. R <sup>2</sup> = 0,258)		Insecurity (adj. R <sup>2</sup> = 0,009)		TRI-score (adj. R <sup>2</sup> = 0,319)	
	$\beta$	Sig.	$\beta$	Sig.	$\beta$	Sig.	$\beta$	Sig.	$\beta$	Sig.
Cognitive age	,149	,009	-,014	0,736	-,125	0,013	,140	,017	-	-
Cog. age_centre	-	-	-	-	-	-	-	-	,253	,007
Cog. age_centre^2	-	-	-	-	-	-	-	-	-,023	,636
Cog. age_centre^3	-	-	-	-	-	-	-	-	-,250	,005
Cognitive capabilities^2	,028	,652	,394	,000	,347	,000	,055	,389	,334	,000
Cognitive assets	,148	,008	,243	,000	,096	,053	,028	,631	,202	,000
Gender_male	,097	,071	,198	,000	-,110	,022	,080	,150	,116	,012
Educational level	,115	,035	,041	,303	,115	,018	,002	,978	,090	,056
Occupation_engineering	,050	,368	,139	,001	-,007	,881	-,008	,893	,061	,195

Remark: the variables cognitive capabilities^2 and Cog. age\_centre(^2^3) refer to the transformed variable in regard to assumption violation (regression) and the polynomial terms

## 4.5 Mediation analysis results

Based upon the scientific literature review a mediation effect is hypothesized between cognitive age and TR (see figure 1). In this section the mediation analysis will be conducted by using Hayes's PROCESS tool (Field, 2013) and results will be evaluated. The two suggested mediators cognitive capabilities and cognitive assets are examined in the mediation analysis. The mediation analysis results for the TRI-score and TRI-dimensions are presented in appendix XII.

In order to have a mediating effect, the relationships between cognitive age, cognitive capabilities and cognitive assets must be significant. The results show a significant negative relationship between cognitive age and cognitive capabilities ( $B = -0,1705 \mid p < 0,01$ ) and between cognitive age and cognitive assets ( $B = -0,0091 \mid p < 0,01$ ). An increase of cognitive age results into a decrease of cognitive capabilities and cognitive assets, hypotheses 6a and 6b are confirmed.

Cognitive age did not have a significant effect on optimism ( $B$  (total) =  $0,0027 \mid p = 0,1823$ ). When including the mediators into the model a significant positive relationship did appear between cognitive age and optimism ( $B$  (direct) =  $0,0058 \mid p < 0,05$ ), rejecting H1. The indirect effect of the mediation was counteracting on the direct effect of cognitive age. The relationship between cognitive age and optimism is partially mediated through cognitive assets ( $B$  (indirect) =  $-0,0015 \mid [-0,0049 -0,0009]$ ) but not through capabilities. An increase of cognitive age decreases cognitive assets resulting into lower optimism. Based upon these findings it is determined that hypothesis 7a is rejected and hypothesis 7b is confirmed.

Cognitive age has a significant effect on innovativeness ( $B$  (total) =  $-0,0155 \mid p < 0,01$ ). With the inclusion of the mediators the positive relationship between cognitive age and innovativeness is non-significant ( $B$  (direct) =  $0,0011 \mid p = 0,6597$ ), rejecting H2. The relationship between cognitive age and innovativeness is fully mediated by cognitive capabilities ( $B$  (indirect) =  $-0,0131 \mid [-0,0059 -0,0014]$ ) and cognitive assets ( $B$  (indirect) =  $-0,0035 \mid [-0,0166 -0,0099]$ ). Cognitive age decreases cognitive capabilities and cognitive assets resulting into lower consumer innovativeness. The findings confirm hypotheses 8a and 8b.

The results show a significant positive relationship between cognitive age and discomfort(reversed) ( $B$  (total) =  $0,0169 \mid p < 0,01$ ). When including the mediators the positive direct relationship between cognitive age and discomfort remains ( $B$  (direct) =  $0,0079 \mid p < 0,01$ ), confirming H3. The relationship between cognitive age and discomfort is

partially mediated through cognitive capabilities (B (indirect) = 0,0080 | [-0,0110 -0,0053]) but not through cognitive assets. The increase of cognitive age leads to a decrease of cognitive capabilities and an increase of discomfort. Based upon these findings, hypothesis 9a is confirmed and hypothesis 9b is rejected.

The mediation model appeared to be non-significant for insecurity (p = 0,0657). Nor cognitive capabilities (p = 0,2510) nor cognitive assets (p = 0,5372) appeared to have a significant effect on insecurity. A mediation effect is excluded. The negative relationship between cognitive age and insecurity(reversed) is significant (B (direct) = -0,0026 | p < 0,05). The findings reject hypothesis 4 and reject hypotheses 10a and 10b.

Finally, the results reveal a significant negative relationship between cognitive age and TRI-score (B (total) = -0,0060 | p < 0,01). When including the mediators, the direct relationship between cognitive age and overall TRI-score becomes non-significant (B (direct) = 0,0018 | p = 0,2665), rejecting hypothesis 5. The relationship between cognitive age and TRI-score is fully mediated through cognitive capabilities (B (indirect) = -0,0062 | [-0,0080 - 0,0044]) and cognitive assets (B (indirect) = -0,0016 | [-0,0028 -0,0006]). An increase of cognitive age decreases cognitive capabilities and cognitive assets resulting into a decline of TRI-score until the cognitive age of 28 is reached, a constant TRI-score until the cognitive age of 48 is reached and a declining TRI-score after the cognitive age of 48. The findings confirm hypotheses 11a and 11b.

The R<sup>2</sup>-values range between 5,3% and 42,3% (appendix XII) which indicates weak explanatory power (Hair et al., 2014). This was expected since technology adoption is a complex social phenomenon. In table 7 a summary of the mediation analysis outcomes is presented.

**Table 7: Overview of mediation analysis outcomes**

	Total effect	Direct effect	Indirect effect	Mediation
Optimism	0,0027	0,0058 *	-0,0015 *	partial
Innovativeness	-0,0155**	0,0011	-0,0166*	full
Discomfort	-0,0169**	-0,0079**	-0,0080*	partial
Insecurity	not applicable	not applicable	not applicable	not applicable
TRI-score	-0,0060**	0,0018	-0,0078*	full

\* significance p < 0,05 | \*\* significance p < 0,01



## **5.1 Interpretation of results**

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The results show that H1 is rejected within all three the analyses. In the multiple regression and mediation analysis a significant positive relationship was found but the direction was contrary to the expectation. The increase of cognitive age resulted into an increase of optimism. For innovativeness (H2), a significant positive relationship with cognitive age was confirmed by the simple regression but not by the multiple regression and mediation analysis. The introduction of other relevant predictors (multiple regression analysis) showed that the relationship was actually non-significant. Due to the fact that this analysis is more strict the hypothesis is rejected. The analyses did find a significant negative relationship between cognitive age and discomfort (H3). In line with the theoretical expectations, the increase of age increases discomfort among consumers. The insight was confirmed by all three analyses, making it more reliable. It was expected that insecurity increases when the cognitive age of consumers increases (H4). All three analyses confirm that this is not the case, which is surprising. Instead, a significant negative relationship was determined within the analyses, indicating that the insecurity decreases when cognitive age increases. Besides the TRI-dimensions, the overall TRI-score was examined within the research. The simple regression as well as the multiple regression confirmed a negative relationship between cognitive age and overall TRI-score (H5). This was in line with the expectations. However, the mediation analysis showed that the relationship was actually fully mediated by cognitive capabilities and cognitive assets (see H11). Therefore, this hypothesis was rejected.

In regard to the possible mediation effect, the relationship between cognitive age and cognitive capabilities and cognitive assets was examined. Based upon the literature findings, it was expected that the increase of consumers' cognitive age decreases their cognitive capabilities and cognitive assets. Looking at the results, the analyses show that this hypothesis is confirmed (H6a & H6b). This confirmation induced the possibility of mediation. The multiple regression and mediation analysis showed a positive significant relationship between cognitive assets and optimism (H7b), in line with the expectations. A mediation effect was determined. There is a significant indirect negative effect of cognitive age on optimism through cognitive assets, not through cognitive capabilities. It was expected that cognitive capabilities and –assets were positively related to innovativeness. These hypotheses (H8a & H8b) were confirmed by the multiple regression and mediation analysis. The mediation analysis revealed a mediating effect. There is a significant indirect negative effect of cognitive age on innovativeness through cognitive capabilities and cognitive assets. For

discomfort, negative relationships with cognitive capabilities and cognitive assets were hypothesized (H9a & H9b). The analyses only confirmed H9a, an increase of cognitive capabilities resulted into less discomfort. A mediating effect was confirmed in the mediation analysis. There is a significant indirect positive effect of cognitive age on discomfort through cognitive capabilities. For insecurity, the multiple regression and mediation analysis did not find a significant relationship with cognitive capabilities or cognitive assets (H10a & H10b). The mediation model appeared to be non-significant. Last, a significant positive relationship was hypothesized between cognitive capabilities and TRI-score (H11a) and between cognitive assets and TRI-score (H11b). The analyses confirmed both. A mediation effect is determined. There is a significant indirect negative effect of cognitive age on TRI-score through cognitive capabilities and cognitive assets.

## **5.2 Reasoning on results**

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Contradicting the study of Rojas-Méndez et al. (2017), no relationship or opposing direction of the relationship was confirmed between cognitive age and optimism and between cognitive age and insecurity (H1 and H4). Both were surprising results. However, this insight was in line with the conversations held with a number of respondents (65+), during the data collection. These respondents repeatedly emphasized the fact that they were optimistic towards new technology because of how it improved their lives. A possible explanation is that older aged consumers experienced more technological progression and breakthroughs than younger consumers. They are more aware of the potential of technology. For insecurity, a possible explanation is found why consumers become less insecure when cognitive age increases. Looking at optimism and insecurity, these variables do not include the aspect of usage of technology. Blaschke, Freddolino, and Mullen (2009) state that older people have a positive attitude (optimistic, no insecurity) towards technology but experience more difficulty in usage. Innovativeness and discomfort somewhat include this aspect and their results are in line with the expectations. Another explanation could be that perceived ease of use and usefulness (Godoe & Johansen, 2012) is influential. With regard to the overall TRI-score (H5), the relationship with cognitive age appeared to be curvilinear and partially in line with the expectations. The TRI-score declines between the age of 18-28. Then, the TRI-score stays constant until the age of 48 is reached. After the age of 48 the TRI starts declining again. A possible explanation is that consumers start to notice/experience the decrease of their cognitive capability after the age of 48 (Murman, 2015), which decreases TR.

The multiple regression confirmed the importance of predictors gender, educational

level, occupation, cognitive capabilities and cognitive assets. The variables showed multiple significant relationships with the TRI-dimensions and made the analysis more strict. The inclusion of these variables made the relationship between cognitive age and innovativeness non-significant (H3). Males, higher educated consumers and consumers with an engineering related job showed a significantly higher TR. A possible explanation is provided by Cooper (2006) who found empirical evidence that males experience lower levels of anxiety and more comfort in the use of technology. Bayo-Moriones and Lera-López (2007) state that people with a higher educational level show higher adoption because they are better able to cope with technology. This theory may also explain why consumers with an engineering related occupation show higher Technology Readiness. They are more experienced and therefore better able to comprehend and cope with technology.

In line with the theory of Murman (2015) and Harada et al. (2014), cognitive age is negatively related to cognitive capabilities and assets (H6a and H6b). This finding can be explained content wise due to the fact that these variables share the cognitive aspect. The effect of cognitive capabilities and cognitive assets on TRI-score and TRI-dimensions was suggested. For every dimension, besides insecurity, a significant relationship with cognitive capabilities and/or cognitive assets was determined (H7-9). A possible explanation is given by Czaja et al. (2006) who states that cognitive capabilities and cognitive assets influences adoption behaviour because adoption of new technologies requires learning new skills. When this is compromised negative feelings arise or the other way around. Cognitive capabilities and cognitive assets functioned as significant mediators in the relationships between cognitive age, TRI-score and TRI-dimensions. Higher cognitive assets increase optimism and innovativeness resulting into a higher TRI-score. Higher cognitive capabilities increase innovativeness and decrease discomfort which results into a higher overall TRI-score. In contradiction to the expectations, cognitive assets and cognitive capabilities were not always acting both as mediators (H7, 9). A suitable explanation is not found but this might be valuable to investigate in future research.

In regard to the research question, research findings indicate that the effect of cognitive age on TR is accounted to cognitive capabilities and assets. The explanatory power of the relationships is weak since it is a complex phenomenon. The direct relationship between cognitive age and overall TRI-score is non-significant. Altogether, the insights point to the conclusion that instead of cognitive age, cognitive capabilities and cognitive assets predict TR to a small extent.

### **5.3 Theoretical implications**

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Prior research often focused upon examining the influence of chronological age on adoption behaviour (Meuter et al., 2003 ; Rojas-Méndez et al., 2017). In this paper both cognitive age (Kasper, 2018) and chronological age are included and compared in terms of fit with Technology Readiness. A theoretical contribution was accomplished by determining that cognitive age shows a higher fit with TR. Future research should focus more on cognitive age instead of chronological age only.

This research was the first to make a distinction between cognitive assets and cognitive capabilities and to examine the mediating role of both cognitive capabilities and cognitive assets. An innovation was the new interpretation given to cognitive assets. For both constructs, a reliable and valid measurement was accomplished. The analyses showed that the effects of cognitive age on overall TRI-score and TRI-dimensions are accounted to cognitive capabilities and cognitive assets. Cognitive capabilities influence innovativeness and discomfort and cognitive assets influence inhibitors optimism and innovativeness. Instead of cognitive age, cognitive capabilities and cognitive assets predict TR to a small extent. Value is added to current scientific work by proving their relevance and both cognitive capabilities and cognitive assets are added to the list of TR-predictors (Meuter et al., 2003).

Rojas-Méndez et al. (2017) and others found empirical evidence for a linear negative relationship between age and TRI-score. This research was first to find empirical evidence that a curvilinear relationship between cognitive age and overall TRI-score exists. Another important finding was the fact that the direct effect of cognitive age does not result into a decline of optimism and incline of insecurity in contrary to the findings of Rojas-Méndez et al. (2017).

### **5.4 Managerial implications**

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Technological companies are constantly looking to improve the adoption of their products and/or services. An improvement of adoption leads to more competitive advantage and higher profits. The research proves that having technology-related knowledge (assets) and learning abilities (capabilities) are important in regard to consumers' adoption of (new)technology. Increased cognitive assets and/or -capabilities increase consumers' TRI-score and therefore the adoption of technology. As known from this research, cognitive assets and capabilities decrease as cognitive age increases. For companies this induces two possibilities: either improving the skills, understanding and knowledge of technology for (cognitive) older consumers or making technology easier to comprehend. After all, it is not

possible for companies to increase consumers' fluid intelligence.

The first possibility suggests that companies train or educate (future) customers with a higher cognitive age (Czaja et al., 2006). But, educating all of these (future) customers is unattractive to companies since this requires high additional costs. A better option would be to develop a free tutorial or training which focuses on the problems consumers face due to their higher cognitive age. But, this solutions depends on whether consumers want to invest time in following a tutorial or completing a training. Also, businesses have to invest to create awareness among these consumers through the AIDA-model (Hassan, Nadzim, & Shiratuddin, 2015) for example.

The second possibility is promising for companies. The relationship between cognitive capability and TR indicates the importance of ensuring that technologies are well designed and easy to use (Czaja et al., 2006). Companies can invest into research that examines in what way their technology requires customers to use their cognitive capabilities. Then, products or services can be redesigned in a way that less cognitive capabilities and -assets are needed to understand and use it. For example, the interfaces can be designed so that minimal demands on working memory are placed and navigational aids can be provided (Czaja, Boot, Charness, & Rogers, 2019). Based upon the literature of Kasper (2018) it is also important that businesses have employees with higher (cognitive) ages. These employees better understand the needs of consumers with higher (cognitive) ages. This benefits the development of new products and services for those consumers in terms of fit which increase adoption.

From the point of view of an innovation manager it could be beneficial to segment the customers based upon their cognitive capabilities and -assets to create a more "simple" version of the product or service which suits their cognitive capabilities and assets. As a student of the master Innovation & Entrepreneurship I see an opportunity to start a consultancy company specialised in advising companies on how to adjust their technologies for consumers with higher cognitive age. In many cases businesses are not able to think "out of the box" because they are stuck in a pattern. A consultancy company would provide new insights to a company and create the opportunity to outsource the additional workload.

## **5.5 Limitations and further research**

Like other scientific work, this research has its limitations that result into suggestions for further research. As a start, the research is limited with regard to the data collection method. Because of the time limit, data collection through interviews was impossible. The offline conversations however provided reasoning on why someone felt optimistic, innovative,

discomfort or insecure. This would have been useful information, especially for setting implications on how to make consumers more technology ready.

Secondly, the research is limited in terms of generalizability by mostly retrieving respondents from suburban villages and because respondents had a high educational level on average. A true representation of respondents from industrialized cities and smaller villages and respondents' educational level could result into different research outcomes.

Another limitation is the focus on technology in general. For respondents it is hard to imagine technology in general, even though a definition was provided within the survey. During the offline conversation, in which consumers were thinking out loud, it appeared that they created an opinion based upon certain technological products or services. The frame of references can vary significantly between respondents. By aiming on certain technology, for example e-health technology, within future research these differences can be minimized and more accurate results can be obtained.

The research selected a cognitive approach to explain TR and is limited to cognitive age in regard to conclusions. Findings cannot be applied to chronological age. Future research could replicate the conducted analyses and use the data of this research. By comparing the research findings conclusions can be set from both point of views.

Another suggestion for future research is to investigate why certain dimensions of TR were only related to cognitive assets or to cognitive capabilities. The same accounts for the fact that some relationships were fully mediated where others were partially mediated. Also, the curvilinear relationship between cognitive age and TRI-score could be further examined.

Besides cognitive age and cognitive capability additional variables can be included in future research like self-efficacy and personality for example. Someone who is more confident could be less anxious to use new technologies (Czaja et al., 2006). Devaraj, Easley, and Crant (2008) found significant relationships between the Five-Factor model (personality) and Technology acceptance and use.

Last, the adoption of technology is explained through the TRI (Godoe & Johansen, 2012) which functioned as a lens to explain adoption. In further research the TAM could be added and combined to TRAM, which includes variables perceived ease of use and perceived usefulness (Lin et al., 2007). Another alternative model could be the unified UTAUT-model which combines multiple acceptance determinants for technology introductions (Venkatesh, Morris, Davis, & Davis, 2003).

## 6. References

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- Arthur, W. B. (2009). *The nature of technology: What it is and how it evolves*. Simon and Schuster.
- Babbie, E. R. (2013). *The Practice of Social Research*. Nelson education.
- Barak, B. & Schiffman, L.G. (1981). Cognitive age: a nonchronological age variable. *Advances in Consumer Research*, 8, 602-606.
- Bayo-Moriones, A., & Lera-López, F. (2007). A firm-level analysis of determinants of ICT adoption in Spain. *Technovation*, 27(6-7), 352-366.
- Blaschke, C. M., Freddolino, P. P., & Mullen, E. E. (2009). Ageing and technology: A review of the research literature. *British Journal of Social Work*, 39(4), 641-656.
- Boone, H. N., & Boone, D. A. (2012). Analyzing likert data. *Journal of extension*, 50(2), 1-5.
- Caison, A. L., Bulman, D., Pai, S. & Neville, D. (2009). Exploring the technology readiness of nursing and medical students at a Canadian University. *Journal of Interprofessional Care*, 22(3), 283 – 294.
- Cambridge University press. (2019). *Cambridge online dictionary*, Cambridge dictionary online. Retrieved at February 02, 2019, from the website [temoa.info](http://temoa.info)
- Cooper, J. (2006). The digital divide: The special case of gender. *Journal of Computer Assisted Learning*, 22(5), 320-334.
- Cui, G., Bao, W., Chan T. (2009). Consumers' adoption of new technology products: the role of coping strategies. *Journal of Consumer marketing*. 26 (2), 110-120.
- Czaja, S. J., Charness, N., Fisk, A. D., Hertzog, C., Nair, S. N., Rogers, W. A., & Sharit, J. (2006). Factors predicting the use of technology: findings from the Center for Research and

Education on Aging and Technology Enhancement (CREATE). *Psychology and aging*, 21(2), 333.

Czaja, S. J., Boot, W. R., Charness, N., & Rogers, W. A. (2019). *Designing for older adults: Principles and creative human factors approaches*. CRC press.

Davis, F.D. (1989). Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly*, 13, 319-340.

Devaraj, S., Easley, R. F., & Crant, J. M. (2008). Research note—how does personality matter? Relating the five-factor model to technology acceptance and use. *Information systems research*, 19(1), 93-105.

Dominguez-Rué, E. & Nierling L. (2016). *Aging and Technology : Perspectives from the Social Sciences (1)*. Transcript Verlag, Bielefeld.

Eastman, J. K. & Iyer, R. (2005). The impact of cognitive age on Internet use of the elderly: an introduction to the public policy implications. *International journal of consumer studies*, 29 (2), 125-136.

Frattoni, F., Bianchi, M., De Massis, A. & Sikimic, U. (2013). The Role of Early Adopters in the Diffusion of New Products: Differences between Platform and Nonplatform Innovations. *Economics and Industrial Engineering*, 31(3), 466-488.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. sage.

Godoe, P., & Johansen, T. S. (2012). Understanding adoption of new technologies: Technology readiness and technology acceptance as an integrated concept. *Journal of European Psychology students*, 3, 38-52.

Hassan, S., Nadzim, S. Z. A., & Shiratuddin, N. (2015). Strategic use of social media for small business based on the AIDA model. *Procedia-Social and Behavioral Sciences*, 172, 262-269.

Hair, J., Black, W. C., Babin, B. J. & Anderson, R. E. (2014). *Multivariate data analysis: A Global Perspective*, NJ: Pearson, New York 7<sup>th</sup> edition.

Harada, C. N., Natelson Love, M. C. & Triebel, K. (2014). Normal cognitive aging. *Clin Geriatr Med*, 29(04), 737-752.

Kasper, J. D. P. (2018). Perspectief hebben: Zicht op het welzijn van oudere consumenten. *Afscheidsrede*, 5-71.

Lin, C. H., Shih, H. Y., & Sher, P. J. (2007). Integrating technology readiness into technology acceptance: The TRAM model. *Psychology & Marketing*, 24(7), 641-657.

Murman, D. L. (2015). The impact of Age on Cognition. *Semin hear*, 36(03), 111-121.

Meuter, M. L., Ostrom, A. L., Bitner, M. J., & Roundtree, R. (2003). The influence of technology anxiety on consumer use and experiences with self-service technologies. *Journal of business research*, 56 (11), 899-906

Parasuraman, A. (2000), “Technology Readiness Index (TRI): A Multiple-item Scale to Measure Readiness to Embrace New Technologies,” *Journal of Service Research*, 307-320.

Parasuraman, A., & Colby, C. L. (2015). An updated and streamlined technology readiness index: TRI 2.0. *Journal of service research*, 18(1), 59-74.

Park, S., & Jayaraman, S. (2003). Enhancing the quality of life through wearable technology. *IEEE Engineering in medicine and biology magazine*, 22(3), 41-48.

Qualtrics XM software, Radboud University (2019). How to Determine the Correct Survey Sample Size. Geraadpleegd op 23 April 2019, van <https://www.qualtrics.com/experience-management/research/determine-sample-size/>

Rogers, E. M. (2003). *Diffusion of innovations*. The Free Press.

Rojas-Méndez, J. I., Parasuraman, A., & Papadopoulos, N. (2017). Demographics, attitudes, and technology readiness: A cross-cultural analysis and model validation. *Marketing Intelligence & Planning*, 35(1), 18-39.

Salthouse, T. A., Pink, J. E., & Tucker-Drob, E. M. (2008). Contextual analysis of fluid intelligence. *Intelligence*, 36(5), 464-486.

Sudman, S. (1998). Survey research and ethics. *ACR North American Advances*.

Tsikriktsis, N. (2004). A technology readiness-based taxonomy of customers: A replication and extension. *Journal of Service Research*, 7(1), 42-52.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478.

Zacher, L. (2017). *Technology, Society and Sustainability*. Cham: Springer.

## Appendix I Survey translation

To conduct the survey, the TRI 2.0 statements (Parasuraman & Colby, 2015) and additional questions are translated. This appendix elaborates on the translation and is completed with the help of an acquaintance and her brother who both lived several years abroad. First a basic translation was made by the author himself. Then adjustments were made grammatically and for word choices. Both made some small adjustments to accomplish decent translations. The results are presented below:

Original statement/question	Translation (English language experts)
New technologies contribute to a better quality of life.	Nieuwe technologieën dragen bij aan een betere kwaliteit van leven.
Technology gives me more freedom of mobility.	Technologie geeft mij meer bewegingsvrijheid.
Technology gives people more control over their daily lives.	Technologie geeft mensen meer controle over hun dagelijks leven.
Technology makes me more productive in my personal life.	Technologie maakt mij productiever in mijn privé leven.
Other people come to me for advice on new technologies.	Andere mensen komen naar mij toe voor advies over nieuwe technologieën.
In general, I am among the first of my circle of friends to acquire new technology when it appears.	Over het algemeen ben ik één van de eersten in mijn vriendenkring die zich een nieuwe technologie eigen maakt wanneer deze verschijnt.
I can usually figure out new high-tech products and services without help from others.	Ik kan meestal zonder hulp van anderen achterhalen hoe nieuwe technologische producten en diensten
I keep up with the latest technological developments in my areas of interest.	Ik blijf op de hoogte van de laatste technologische ontwikkelingen binnen mijn interessegebied.
When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.	Wanneer ik technische ondersteuning krijg van een leverancier van een technologisch product of dienst, dan heb ik soms het gevoel dat er gebruik van mijn onwetendheid wordt gemaakt door iemand die er meer vanaf weet dan ik.
Technical support lines are not helpful because they do not explain things in terms I understand.	Technische helpdesks zijn niet behulpzaam omdat zij dingen niet uitleggen in termen die ik begrijp.
Sometimes, I think that technology systems are not designed for use by ordinary people.	Soms denk ik dat technologische systemen niet zijn ontworpen om gebruikt te kunnen worden door de "gewone man of vrouw".
There is no such thing as a manual for a high-tech product or service that is written in plain language.	Er bestaat geen handleiding voor een technologisch product of dienst die geschreven is in begrijpelijke taal.

People are too dependent on technology to do things for them.	Mensen worden té afhankelijk van technologie om dingen voor ze te doen.
Too much technology distracts people to a point that is harmful.	Te veel technologie verwent mensen tot een punt waarop het schadelijk voor ze is in plaats van nuttig.
Technology lowers the quality of relationships by reducing personal interaction.	Technologie verlaagt de kwaliteit van relaties door het verminderen van persoonlijk contact.
I do not feel confident doing business with a place that can only be reached online.	Ik voel me niet vertrouwd bij het doen van zaken met iets of iemand die alleen online te bereiken is.
What is your age (in years)?	Wat is uw leeftijd (in jaren)?
I feel as though I am ... years old.	Ik voel me alsof ik ... jaar oud ben.
I look as though I am ... years old.	Ik zie eruit alsof ik ... jaar oud ben.
I do most things as though I am ... years old.	Ik doe de meeste dingen alsof ik ... jaar oud ben.
My interests are mostly those of a person who is ... years old.	Mijn interesses zijn vooral de interesses van een persoon die ... jaar oud is.
What is your sex?	Wat is uw geslacht?
What is your highest accomplished educational level (degree)?	Wat is je hoogst genoten opleiding (met diploma)?
Which occupational status is applicable to your situation?	Welke arbeidssituatie is op u van toepassing?
Is (was) your occupation engineering related (electrical, mechanical, software, I(C)T etc.) ? Indien u nog studeert: Zal uw toekomstige beroep techniek gerelateerd zijn?	Is of was je beroep techniek gerelateerd (elektrotechniek, werktuigbouwkunde, informatica, I(C)T, etc.)?
Learning how to use new technology takes a lot of mental effort.	Leren hoe je een nieuwe technologie moet gebruiken vergt mentaal veel inspanning van mij.
I find it easy to understand how a new technology works.	Ik vind het makkelijk om te begrijpen hoe een nieuwe technologie werkt.
Learning new technology does not require much time for me.	Het leren van een nieuwe technologie kost mij niet veel tijd.
Interacting with new technology is often difficult for me.	Omgaan met een nieuwe technologie is vaak moeilijk voor me.
Interacting with new technology requires a lot of my mental effort.	Omgaan met een nieuwe technologie vereist veel mentale inspanning van me.
I often become mentally confused when I use new technology.	Ik voel me vaak in verwarring gebracht als ik een nieuwe technologie gebruik.
I have knowledge of technology.	Ik heb verstand van technologie.
I am experienced in using technology.	Ik heb ervaring met het gebruiken van technologie.
I have acquired insight into technology during my life.	Ik heb inzicht verkregen in technologie tijdens mijn leven.
I have gained understanding of technology during my life.	Ik heb begrip voor technologie gekregen tijdens mijn leven.
I am skillfull in working with technology.	Ik ben behendig in het werken met technologie.

**Figure: translation overview of statements**

## **Appendix II Survey pre-test**

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Before the survey is sent towards possible respondents, a pre-test has been executed. It is important to make sure that the questions asked are understandable and clear. Another aspect is duration. When the questionnaire takes too long an increased chance of invalid answering occurs. Last, the question scales are checked by making sure all possible answers are included, given by the respondents. The pre-test has been conducted in the local rest home (Bruggerhof, Hunsel). A mix of gender, age and education was created. In total, 6 persons participated in the pre-test with an age of 54, 55, 70, 73, 77 and 78 years. The pre-test resulted into the following insights:

The respondents between 73-78 years found trouble in understanding the meaning of technology. Therefore the statements regarding technology were sometimes unclear. A typical answer was that they were living a rather “simple life” and are not that aware of technology. Also, the test respondents with higher ages (73-78) found difficulty in concentrating, reading and understanding statements because of ageing. However, the questionnaire did not take too much time in their opinion.

Regarding terminology, the term “eigen maken” mentioned in statement 6 was unclear. This is solved by adding the synonym “beheersen” within the statement. This also counted for the term “bewegingsvrijheid”. To make this term more clear the synonym “mobiliteit” was added in statement 2.

The term technology will be elaborated in the survey to create more understanding. This will improve the validity of the answers.

## Appendix III The survey

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Geachte lezer,

Mijn naam is Danny Vleeshouwers en ik studeer momenteel Innovation & Entrepreneurship aan de Radboud Universiteit in Nijmegen. Voor u bevindt zich de enquête die ik afneem ten behoeve van mijn afstudeeronderzoek dat begeleid wordt door prof. dr. H. Kasper. Voor het afronden van mijn Master voer ik een onderzoek uit naar de meningen over het gebruik van nieuwe technologieën door consumenten. Uw mening is daarbij erg belangrijk. Ik hoop dat u aan mijn onderzoek wilt deelnemen.

Het doel van de vragen is om uw opinie, als consument, over (nieuwe) technologie te bepalen. Daarnaast zullen nog enkele persoonskenmerken bevroegd worden. Ik wil u verzoeken om de vragen aandachtig door te lezen en naar waarheid in te vullen. De vragenlijst is gericht op consumenten met een leeftijd van 18+ jaar, neemt ongeveer 10 minuten in beslag, en is anoniem. Uw gegevens worden volgens de huidige privacy wetgeving verwerkt. In onderstaande link vindt u de betreffende enquête:

[http://fmru.az1.qualtrics.com/jfe/form/SV\\_0iiqVlwJGM6WiAR](http://fmru.az1.qualtrics.com/jfe/form/SV_0iiqVlwJGM6WiAR)

Indien er vragen zijn kunt u mij contacteren op het e-mailadres:

[d.vleeshouwers@student.ru.nl](mailto:d.vleeshouwers@student.ru.nl). Daarbij wil ik u verzoeken om deze enquête door te sturen naar uw vrienden, kennissen en familie. De vragenlijst kan herhaaldelijk ingevuld worden. Ik wil u nogmaals hartelijk bedanken voor uw tijd en moeite.

Met vriendelijke groet,

Danny Vleeshouwers

# Master thesis survey

---

Start of Block: Default Question Block

Dank u wel voor het deelnemen aan deze vragenlijst! Door middel van uw medewerking kom ik dichterbij het voltooiën van mijn onderzoek. In deze enquête wordt uw mening gevraagd over het gebruik van nieuwe technologieën. Eerst zullen een aantal persoonskenmerken gevraagd worden, daarna volgen een aantal stellingen over technologie. De enquête is anoniem en uw gegevens worden volgens de huidige privacy wetgeving verwerkt. De duur van de enquête is ongeveer 10 minuten.

Alvast bedankt voor uw tijd en moeite,

Danny Vleeshouwers

---

Wat is uw geslacht?

- Man
- Vrouw
- 

Wat is uw leeftijd (in jaren)?

\_\_\_\_\_

---

Ik voel me alsof ik ..... jaar oud ben.

\_\_\_\_\_

---

Ik zie eruit alsof ik ..... jaar oud ben.

---

Ik doe de meeste dingen alsof ik ..... jaar oud ben.

---

Mijn interesses zijn vooral de interesses van een persoon die ..... jaar oud is.

---

Wat is uw hoogst genoten opleiding (met diploma)?

- Geen onderwijs / basisonderwijs
- Vmbo-basis / kader, MBO 1 / LTS / LBO / VBO
- Vmbo-gemengd / theoretisch / MAVO / ULO / MULO
- MBO 2, 3 of 4 / MTS
- HAVO / VWO
- HBO-bachelor / WO- bachelor
- WO-doctoraal / WO-master / HBO-master

Welke arbeidssituatie is op u van toepassing?

- Gepensioneerd
  - Werkzaam in een betaalde baan
  - Werkzaam in een onbetaalde baan
  - Arbeidsongeschikt
  - Huisvrouw / huisman
  - Werkloos
  - Werk niet omdat ik onderwijs volg
- 

Is of was uw beroep techniek gerelateerd? (werktuigbouwkunde / elektrotechniek / informatica, (I)C(T) etc.) (Indien u nog studeert: Zal uw toekomstige beroep techniek gerelateerd zijn?)

- Ja
  - Nee
- 

Wilt u bij elke stelling aangeven in welke mate u het er eens of oneens mee bent? Een aantal stellingen gaat over technologie in het algemeen. Technologie is een 'breed' begrip. **In dit onderzoek wordt met 'technologie' verwezen naar allerlei vormen van techniek of innovatie, zowel digitaal als fysiek in de maakindustrie (voeding, duurzame consumptiegoederen, chemie etc.) of dienstensector (automatisering, etc.). Technologie is een praktische toepassing van kennis die leidt tot een bepaalde ontwikkeling. Denk hierbij aan het Internet of Things, big data, kunstmatige intelligentie, Blockchain, Virtual Reality, maar ook aan zelfrijdende auto's, automatische stofzuigers, elektrische fietsen, computers, mobiele telefoons, 3D-printers en ga zo maar door.**

---

Wilt u voor de volgende 16 stellingen aangeven in welke mate u het er mee eens of oneens bent?

	Sterk mee oneens	Oneens	Neutraal	Eens	Sterk mee eens
Nieuwe technologieën dragen bij aan een betere kwaliteit van leven.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technologie geeft mij meer bewegingsvrijheid (mobiliteit).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technologie geeft mensen meer controle over hun dagelijks leven.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technologie maakt mij productiever in mijn privé leven.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Andere mensen komen naar mij toe voor advies over nieuwe technologieën.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Over het algemeen ben ik één van de eersten in mijn vriendenkring die zich een nieuwe technologie eigen maakt (beheerst) wanneer deze verschijnt.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik kan meestal zonder hulp van anderen achterhalen hoe nieuwe technologische producten en diensten werken.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik blijf op de hoogte van de laatste technologische ontwikkelingen binnen mijn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

interessegebied.

Wanneer ik technische ondersteuning krijg van een leverancier van een technologisch product of dienst, dan heb ik soms het gevoel dat er gebruik van mijn onwetendheid wordt gemaakt door iemand die er meer vanaf weet dan ik.

Technische helpdesks zijn niet behulpzaam omdat zij dingen niet uitleggen in termen die ik begrijp.

Soms denk ik dat technologische systemen niet zijn ontworpen om gebruikt te worden door de "gewone man of vrouw".

Er bestaat geen handleiding voor een technologisch product of dienst die geschreven is in begrijpelijke taal.

Mensen worden té afhankelijk van technologie om dingen voor ze te doen.

Te veel technologie verwent mensen tot een punt waarop het schadelijk voor ze wordt in plaats

van nuttig.

Technologie  
verlaagt de  
kwaliteit van  
relaties door het  
verminderen van  
persoonlijk  
contact.

Ik voel me niet  
vertrouwd bij het  
doen van zaken  
met iets of  
iemand die alleen  
online te  
bereiken is.



Wilt u voor de volgende 11 stellingen aangeven in welke mate u het er mee eens of oneens bent?

	Sterk mee oneens	Oneens	Neutraal	Eens	Sterk mee eens
Leren hoe je een nieuwe technologie moet gebruiken vergt mentaal veel inspanning van mij.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik vind het makkelijk om te begrijpen hoe een nieuwe technologie werkt.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Het leren van een nieuwe technologie kost mij niet veel tijd.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Omgaan met een nieuwe technologie is vaak moeilijk voor me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Omgaan met een nieuwe technologie vereist veel mentale inspanning van mij.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik voel me vaak in verwarring gebracht als ik een nieuwe technologie gebruik.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik heb verstand van technologie.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik heb ervaring met het gebruiken van technologie.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik heb inzicht verkregen in technologie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

tijdens mijn leven.					
Ik heb begrip voor technologie gekregen tijdens mijn leven.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik ben behendig in het werken met technologie.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

Bedankt voor het deelnemen aan de enquête! Klik op de rode knop (rechtsonder) om de enquête af te ronden.

End of Block: Default Question Block

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## Appendix IV Measurement overview

Variables (Labels)	Original statement/question	Translation (English language experts)	Answer scale	Hypotheses
Optimism (OPT1, OPT2, OPT3, OPT4)	New technologies contribute to a better quality of life.	Nieuwe technologieën dragen bij aan een betere kwaliteit van leven.	Likert scale : 1 = sterk mee oneens 2 = oneens 3 = neutraal 4 = eens 5 = sterk mee eens.	H1, 5, 7 & 11
	Technology gives me more freedom of mobility.	Technologie geeft mij meer bewegingsvrijheid.		
	Technology gives people more control over their daily lives.	Technologie geeft mensen meer controle over hun dagelijks leven.		
	Technology makes me more productive in my personal life.	Technologie maakt mij productiever in mijn privé leven.		
Innovativeness (INN1, INN2, INN3, INN4)	Other people come to me for advice on new technologies.	Andere mensen komen naar mij toe voor advies over nieuwe	Likert scale : 1 = sterk mee oneens 2 = oneens 3 = neutraal 4 = eens 5 = sterk mee eens.	H2, 5, 8 & 11
	In general, I am among the first of my circle of friends to acquire new technology when it appears.	Over het algemeen ben ik één van de eersten in mijn vriendenkring die zich een nieuwe technologie eigen maakt wanneer deze verschijnt.		
	I can usually figure out new high-tech products and services without help from others.	Ik kan meestal zonder hulp van anderen achterhalen hoe nieuwe technologische producten en diensten werken.		
	I keep up with the latest technological developments in my areas of interest.	Ik blijf op de hoogte van de laatste technologische ontwikkelingen binnen mijn interessegebied.		
Discomfort (DIS1, DIS2, DIS3, DIS4)	When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.	Wanneer ik technische ondersteuning krijg van een leverancier van een technologisch product of dienst, dan heb ik soms het gevoel dat er gebruik van mijn onwetendheid wordt gemaakt door iemand die er meer vanaf weet dan ik.	Likert scale : 1 = sterk mee oneens 2 = oneens 3 = neutraal 4 = eens 5 = sterk mee eens.	H3, 5, 9 & 11
	Technical support lines are not helpful because they do not explain things in terms I understand.	Technische helpdesks zijn niet behulpzaam omdat zij dingen niet uitleggen in termen die ik begrijp.		
	Sometimes, I think that technology systems are not designed for use by ordinary people.	Soms denk ik dat technologische systemen niet zijn ontworpen om gebruikt te kunnen worden door de "gewone man of vrouw".		
	There is no such thing as a manual for a high-tech product or service that is written in plain language.	Er bestaat geen handleiding voor een technologisch product of dienst die geschreven is in begrijpelijke taal.		
Insecurity (INS1, INS2, INS3, INS4)	People are too dependent on technology to do things for them.	Mensen worden té afhankelijk van technologie om dingen voor ze te	Likert scale : 1 = sterk mee oneens 2 = oneens 3 = neutraal 4 = eens 5 = sterk mee eens.	H4, 5, 10 & 11
	Too much technology distracts people to a point that is harmful.	Te veel technologie verwent mensen tot een punt waarop het schadelijk voor ze is in plaats van nuttig.		
	Technology lowers the quality of relationships by reducing personal interaction.	Technologie verlaagt de kwaliteit van relaties door het verminderen van persoonlijk contact.		
	I do not feel confident doing business with a place that can only be reached online.	Ik voel me niet vertrouwd bij het doen van zaken met iets of iemand die alleen online te bereiken is.		

Chronological age (CA1)	What is your age (in years)?	Wat is uw leeftijd (in jaren)?	0 - 100	
Cognitive age (CA21, CA22, CA23, CA24)	I feel as though I am ... years old.	Ik voel me alsof ik ... jaar oud ben.	0 - 100	H1-6
	I look as though I am ... years old.	Ik zie eruit alsof ik ... jaar oud ben.		
	I do most things as though I am ... years old.	Ik doe de meeste dingen alsof ik ... jaar oud ben.		
	My interests are mostly those of a person who is ... years old.	Mijn interesses zijn vooral de interesses van een persoon die ... jaar oud is.		
Gender (GEN)	What is your sex?	Wat is uw geslacht?	man / vrouw	(-)
Educational level (EDU)	What is your highest accomplished educational level (degree)?	Wat is je hoogst genoten opleiding (met diploma)?	1 = geen onderwijs / basisonderwijs / cursus inburgering 2 = VMBO (kader of beroepsgerichte leerweg) / MBO 1 / LTS / LBO / VBO 3 = VMBO (theoretisch of gemengde leerweg) / MAVO / ULO / MULO 4 = MBO 2, 3 of 4 / MTS 5 = HAVO / VWO / HBS / MMS 6 = HBO- of WO- propedeuse / HBO-bachelor / WO-bachelor 7 = WO-doctoraal / WO-master / HBO-master	(-)
Occupation (OCC1, OCC2)	Which occupational status is applicable to your situation?	Welke arbeidssituatie is op u van toepassing?	1 = Gepensioneerd 2 = Werkzaam in een betaalde baan 3 = Werkzaam in een onbetaalde baan 4 = Arbeidsongeschikt 5 = Huisvrouw / huisman 6 = Werkloos 7 = Werk niet omdat ik onderwijs volg	(-)
	Is (was) your occupation engineering related (electrical, mechanical, software, I(C)T etc.) ? Indien u nog studeert: Zal uw toekomstige beroep techniek gerelateerd zijn?	Is of was je beroep techniek gerelateerd (elektrotechniek, werktuigbouwkunde, informatica, I(C)T, etc.)?	Ja / Nee	
Cognitive capabilities (CC1, CC2, CC3, CC4, CC5, CC6)	Learning how to use new technology takes a lot of mental effort.	Leren hoe je een nieuwe technologie moet gebruiken vergt mentaal veel inspanning van mij.	Likert scale : 1 = sterk mee oneens 2 = oneens 3 = neutraal 4 = eens 5 = sterk mee eens.	H7-11
	I find it easy to understand how a new technology works.	Ik vind het makkelijk om te begrijpen hoe een nieuwe technologie werkt.		
	Learning new technology does not require much time for me.	Het leren van een nieuwe technologie kost mij niet veel tijd.		
	Interacting with new technology is often difficult for me.	Omgaan met een nieuwe technologie is vaak moeilijk voor me.		
	Interacting with new technology requires a lot of my mental effort.	Omgaan met een nieuwe technologie vereist veel mentale inspanning van me.		
I often become mentally confused when I use new technology.	Ik voel me vaak in verwarring gebracht als ik een nieuwe technologie gebruik.			
Cognitive assets (CA1, CA2, CA3, CA4, CA5)	I have knowledge of technology.	Ik heb verstand van technologie.	Likert scale : 1 = sterk mee oneens 2 = oneens 3 = neutraal 4 = eens 5 = sterk mee eens.	
	I am experienced in using technology.	Ik heb ervaring met het gebruiken van technologie.		
	I have acquired insight into technology during my life.	Ik heb inzicht verkregen in technologie tijdens mijn leven.		
	I have gained understanding of technology during my life.	Ik heb begrip voor technologie gekregen tijdens mijn leven.		
	I am skillfull in working with technology.	Ik ben behendig in het werken met technologie.		

Figure: Survey items for each variable

## Appendix V Factor analysis procedure and results

The measurements of the TRI dimensions are analysed with a factor analysis. As a start the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (criteria:  $>0.5$ ) was 0,787 and therefore sufficient. Secondly, the Bartlett's test of sphericity (criteria: sign.  $<0.05$ ) was  $<0,001$  and therefore significant. Complying to both of these tests means that the data is suitable to perform a factor analysis. The extraction method principal axis factoring is used to determine the amount of factors (eigenvalue  $>1$  cut off) and to examine the loading of the items. The minimal required factor loading is 0,3 (Hair et al., 2014, p. 115) because the sample is  $>350$ . Four factors were determined with an eigenvalue  $>1$ , which explain 55,2% of the variance. The factor loadings were rotated by using the oblique method because some factor correlations ( $-0.407$ ) were  $>0.3$  (Hair et al., 2014). This resulted into the pattern matrix in the table below.

**Table: Pattern matrix TRI**

	Factor			
	Innovativeness	Insecurity	Discomfort	Optimism
INN2	<b>,799</b>			
INN1	<b>,695</b>			
INN3	<b>,658</b>		<b>-,278</b>	
INN4	<b>,607</b>			
INS2		<b>,972</b>		
INS1		<b>,569</b>		
INS3		<b>,396</b>		
DIS3			<b>,691</b>	
DIS2			<b>,612</b>	
DIS4			<b>,565</b>	
DIS1			<b>,493</b>	
<del>INS4</del>			<b>,228</b>	
OPT1				<b>,576</b>
OPT2				<b>,573</b>
OPT3				<b>,547</b>
OPT4				<b>,481</b>

Then discriminant and convergent validity is checked. Items with a factor loading value lower than 0.3, low communality ( $<0.2$ ) or cross loading have been removed to increase convergent and discriminant validity. All items, except the fourth item of Insecurity (INS4) about doing business online, had a sufficient factor loading. The communalities were high enough for all items except item 4 Insecurity. Also, the item (INS4) loads on the wrong factor. Therefore it is decided to delete item 4 insecurity. Then a second iteration was conducted. All criteria were

met. Again four factors were determined with an eigenvalue >1 which explain 57,7% of the variance.

Secondly the measurement of cognitive age is analysed. The data was suitable because Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (criteria: >0.5) was 0,877 and the Bartlett's test of sphericity (criteria: sign. <0.05) was <0,001. The extraction method principal axis factoring is used to determine the amount of factors (eigenvalue >1 cut off) and to examine the loading of the items. One factor was determined with an eigenvalue >1, which explains 90,4% of the variance. All factor loadings were >0.3, all communalities were >0.2 and there were no cross loadings, meaning that all items can be included for the measurement.

Third, the measurement of the variable cognitive capability (assets and capabilities) is checked. The KMO-measure of sampling adequacy (criteria: >0.5) was 0,926 and the Bartlett's test of sphericity (criteria: sign. <0.05) was <0,001. Again, the extraction method principal axis factoring was used. Two factors were determined (eigenvalue >1 cut off) which explain 68.3% of the variance. The factor loadings were rotated by using the oblique method because the factor correlation was 0.59 (criteria >0.3) (Hair et al., 2014). This resulted into the pattern matrix in the figure below.

	Factor	
	Capabilities	Assets
CC1	,861	
CC5	,839	
CC4	,820	
CC2	,797	
CC3	,744	
CC6	,638	
<del>CA1</del>	<del>,425</del>	<del>,424</del>
CA3		,881
CA4		,654
<del>CA2</del>		<del>,553</del>
<del>CA5</del>	<del>,408</del>	<del>,505</del>

	Factor	
	Capabilities	Assets
CC1	,863	
CC5	,824	
CC4	,824	
CC2	,812	
CC3	,730	
CC6	,653	
CA3		,792
CA4		,725

**Figure: Pattern matrixes - Cognitive capability**

The discriminant and convergent validity is checked. The communalities were high enough for all items. All items had a sufficient factor loading (criteria >0.3). Item 1 cognitive assets (CA1) and item 5 cognitive assets (CA5) were removed because of cross loadings (see figure). Then a second iteration was conducted without item 1 and 5. Still, not all criteria were met. Now, item 2 cognitive assets (CA2) shows a cross loading and is therefore deleted (see figure). In the third iteration all criteria are met and two factors were determined with an

eigenvalue >1 which explain 72.5% of the variance. As mentioned in the measurements (3.2.2) the scales of cognitive capabilities and assets are new. Enough items comply to the factory analysis criteria to create two separate variables which. represent cognitive capability.

By deleting previously mentioned items the construct validity of the measurements is increased. After completing the factor analysis the reliability of item scales was measured with the Cronbach's alpha. The Cronbach's alpha-values are presented in the figure below for TRI variables, cognitive age and cognitive capability (assets and capabilities) and indicate the internal consistency. For every item it is determined how well they represent the related variable (homogeneity).

Optimism (0,650)	Cronbach's Alpha if Item Deleted	Innovativeness (0,795)	Cronbach's Alpha if Item Deleted	Discomfort (0,696)	Cronbach's Alpha if Item Deleted	Insecurity (0,681)	Cronbach's Alpha if Item Deleted
OPT1	,552	INN1	,742	DIS1	,680	INS1	,593
OPT2	,589	INN2	,717	DIS2	,615	INS2	,437
OPT3	,602	INN3	,759	DIS3	,584	INS3	,713
OPT4	,586	INN4	,757	DIS4	,640		
Cognitive age (0,964)	Cronbach's Alpha if Item Deleted	Cognitive capabilities (0,911)	Cronbach's Alpha if Item Deleted	Cognitive assets (0,737)	Cronbach's Alpha if Item Deleted		
AGE21	,948	CC1	,886	CA3	NA		
AGE22	,951	CC2	,892	CA4	NA		
AGE23	,945	CC3	,909				
AGE24	,964	CC4	,888				
		CC5	,893				
		CC6	,901				

**Figure: Cronbach's Alpha values**

The Cronbach's alpha are as follows: optimism – 0.650, innovativeness – 0.795, discomfort – 0.696, insecurity – 0.681, cognitive age – 0.964, cognitive capabilities – 0.911 and cognitive assets – 0.737. All values exceed the criteria of 0.6 and no items can be deleted that increase the value with 0.05 or more (Hair et al., 2014). This indicates reliable measurement scales.

## Appendix VI Descriptive results

	Age C.1	Age C.2	Age C.3	Age C.4	Opt. 1	Opt. 2	Opt. 3	Opt. 4
N Valid	400	400	400	400	400	400	400	400
Missing	0	0	0	0	0	0	0	0
Mean	35,86	38,11	35,69	35,82	3,94	3,89	3,59	3,37
Std. Deviation	14,360	15,972	14,611	13,642	,745	,732	,833	,922

	Inn. 1	Inn. 2	Inn. 3	Inn. 4	Dis 1.	Dis 2.	Dis 3.	Dis 4.
N Valid	400	400	400	400	400	400	400	400
Missing	0	0	0	0	0	0	0	0
Mean	2,73	2,59	3,35	3,45	3,18	3,20	3,07	3,31
Std. Deviation	1,082	1,039	1,079	,943	,877	,945	,995	,923

	Ins. 1	Ins. 2	Ins. 3	Ins. 4	Cog. C. 1	Cog. C. 2	Cog. C. 3	Cog. C. 4
N Valid	400	400	400	400	400	400	400	400
Missing	0	0	0	0	0	0	0	0
Mean	2,36	2,52	2,34	2,72	3,28	3,34	3,23	3,45
Std. Deviation	,907	,934	,988	1,048	,982	,912	,974	,935

	Cog. C.5	Cog. C.6	Cog. A.1	Cog. A.2	Cog. A.3	Cog. A.4	Cog. A.5	Age
N Valid	400	400	400	400	400	400	400	400
Missing	0	0	0	0	0	0	0	0
Mean	3,32	3,42	3,08	3,56	3,77	3,80	3,46	41,27
Std. Deviation	,938	,930	,959	,827	,745	,673	,843	18,169

Gender	Frequency	Percent	Cumulative Percent
Valid 1 Man	216	54,0	54,0
2 Vrouw	184	46,0	100,0
Total	400	100,0	

Engineerin related occ.	Frequency	Percent	Cumulative Percent
Valid 1 Ja	104	26,0	26,0
2 Nee	296	74,0	100,0
Total	400	100,0	

Educational level	Freq.	Perc.	Cum. Percent
Valid 1 Geen onderwijs / basisonderwijs	5	1,3	1,3
2 Vmbo-basis / kader, MBO 1 / LTS / LBO / VBO	34	8,5	9,8
3 Vmbo-gemengd / theoretisch / MAVO / ULO / MULO	30	7,5	17,3
4 MBO 2, 3 of 4 / MTS	116	29,0	46,3
5 HAVO / VWO	50	12,5	58,8
6 HBO-bachelor / WO- bachelor	124	31,0	89,8
7 WO-doctoraal / WO-master / HBO-master	41	10,3	100,0
Total	400	100,0	

Occupation		Frequency	Percent	Cumulative Percent
Valid	1 Gepensioneerd	48	12,0	12,0
	2 Werkzaam in een betaalde baan	282	70,5	82,5
	3 Werkzaam in een onbetaalde baan	2	,5	83,0
	4 Arbeidsongeschikt	8	2,0	85,0
	5 Huisvrouw / huisman	7	1,8	86,8
	6 Werkloos	5	1,3	88,0
	7 Werk niet omdat ik onderwijs volg	48	12,0	100,0
Total		400	100,0	

## Appendix VII Regression assumptions

The distribution of variables has been analysed before (section 3.2.4), it appeared that not all variables are normally distributed. But, the violation of this assumptions does not mean the regression cannot be performed. Because of the robustness of the regression analysis it is allowed to perform the analysis, even when the assumption is violated (Hair et al., 2014).

Regression requires data to be metric. This means there is a rank order, distances between answers have to be equal and have a numerical meaning (Babbie, 2013). Age is an example of a metric variable. Therefore variables age and cognitive age are suitable. The TRI dimensions are measured with a Likert scale. Likert scale data is analysed at the interval measurement scale (Boone & Boone, 2012). This because a mean score is often calculated from the items, like in this case a TRI-score.

Another assumption is the linear relationship between the dependent variable and every independent variable. This should be the case because regression analysis is not able to take non-linear relationships into account: that would lead to a model with a bad fit. This assumption is checked by including polynomial terms. When these terms are significant non-linear relationships are present. To check the assumption variable age and cognitive age need to be centred by subtracting the mean of each score. Then the polynomial terms are added (quadratic and cubic). The relationships are checked between age, cognitive age and the total TRI-score and dimensions separately. The results show linear relationships for each relationship except between cognitive age and the TRI-score variable, see table below.

**Table: Linear analysis results**

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3,102	,046		68,077	,000
Age_centre	,005	,006	,204	,870	,385
Age_centre^2	,000	,000	-,152	-1,053	,293
Age_centre^3	2,308E-06	,000	,062	,270	,787
Cog. Age_centre	-,005	,007	-,165	-,791	,430
Cog. Age_centre^2	,000	,000	,233	1,318	,188
Cog. Age_centre^3	-2,446E-05	,000	-,433	-2,102	,036

a. Dependent Variable: TRI\_SCORE

Cognitive age shows a curvilinear relationship with the TRI-score variable (criteria  $p < 0,05$ ). Therefore, instead of the original variable cognitive age, the polynomial term has to be used within the (multiple) regression analysis.

As expected, there is severe multicollinearity between the variables age and cognitive age. This means that there is a correlation between the independent variables. To get an efficient estimation a high correlation is not allowed within the regression analysis (Hair et al., 2014). The diagnostics are presented in the table below.

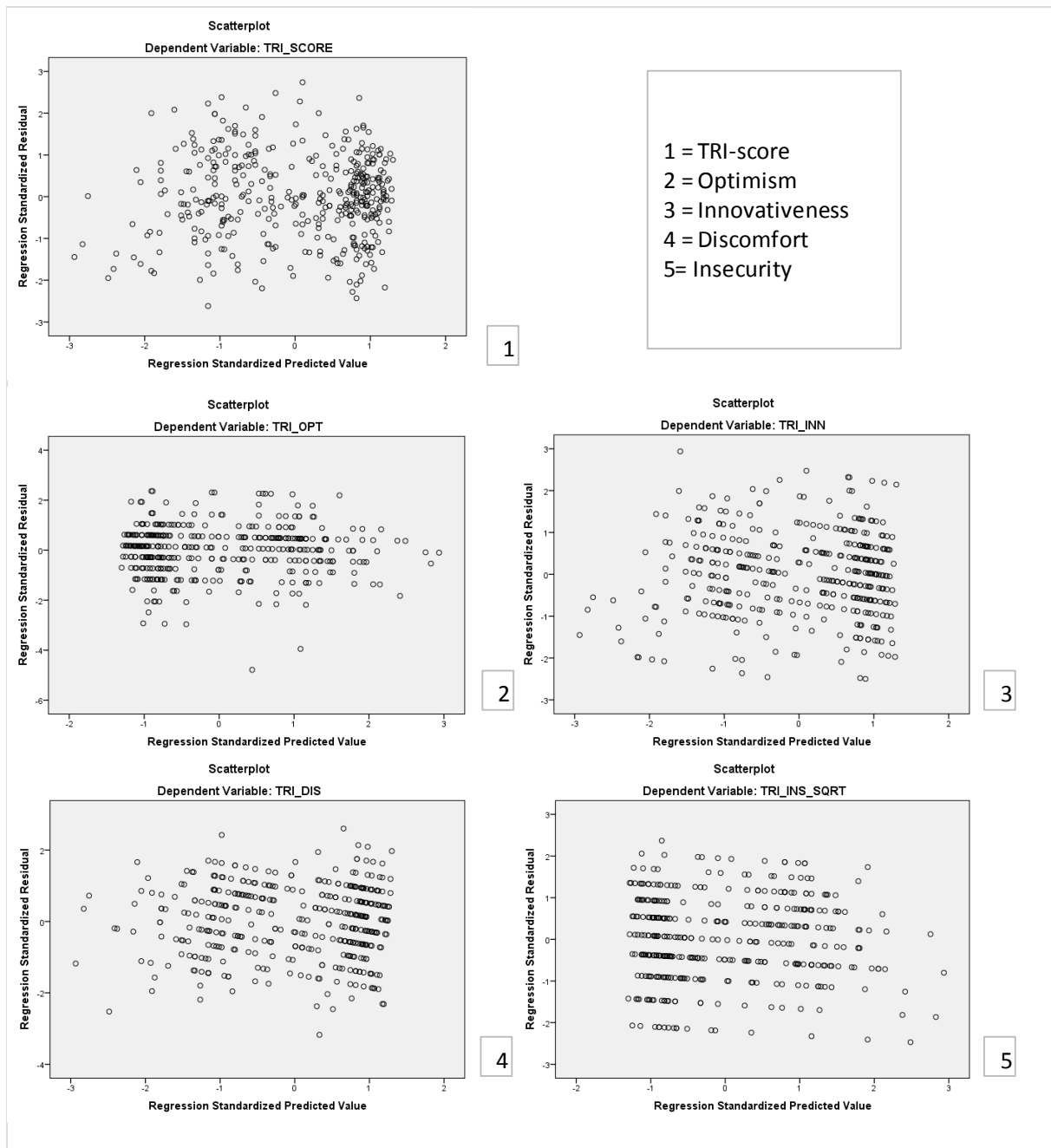
**Table: Multicollinearity diagnostics**

		Collinearity Statistics	
		Tolerance	VIF
Age		,119	<b>8,383</b>
Cog. Age		,119	<b>8,383</b>

The collinearity tolerances are not allowed to be smaller than 0,2 (Hair et al., 2014). In this case the values are 0,119 and therefore the assumption is not met. This indicates that the independent variables cannot be included both within the regression analysis. In section 5.2 the analysis shows that cognitive age is a stronger predictor than actual age.

The last assumption checks homoscedasticity. Based upon the ZRESID (y-axle) and ZPRED (x-axle) the regression standardized residual values are visualized and investigated for the dependent variables. The research includes five dependent variables: TRI-score, optimism, innovativeness, discomfort and insecurity. For each variable plots of residues were created, see appendix VI. As independent variable, cognitive age is used because this variable shows a higher fit with the dependent variables in comparison to actual age (see section 5.2). There is homoscedasticity when there is no pattern recognised within the scatterplot. In this case a small sign of bias is detected in plot 3 and 4 but does not seem significant. The spread of residuals seems regular and therefore homoscedasticity is found for all dependent variables.

## Appendix VIII Residuals plots



## Appendix IX Regression analysis

After complying to the assumptions the regression analysis is conducted. For hypothesis 1-6 the analysis results will be elaborated. In the figure below the regression analysis results are presented.

Relationship Cognitive age - Optimism			Unstandardized Coefficients		Standardized Coefficients	Sig.
			B	Std. Error	Beta	
R <sup>2</sup> = 0,004	F = 1,785	Constant	3,597	,079		,000
	p = 0,182	Cognitive age	,003	,002	,067	,182
Relationship Cognitive age - Innovativeness			Unstandardized Coefficients		Standardized Coefficients	Sig.
			B	Std. Error	Beta	
R <sup>2</sup> = 0,070	F = 30,042	Constant	3,593	,110		,000
	p = 0,000	Cognitive age	-,016	,003	-,265	,000
Relationship Cognitive age - Discomfort			Unstandardized Coefficients		Standardized Coefficients	Sig.
			B	Std. Error	Beta	
R <sup>2</sup> = 0,121	F = 54,878	Constant	3,805	,089		,000
	p = 0,000	Cognitive age	-,017	,002	-,348	,000
Relationship Cognitive age - Insecurity (SQRT)			Unstandardized Coefficients		Standardized Coefficients	Sig.
			B	Std. Error	Beta	
R <sup>2</sup> = 0,011	F = 4,569	Constant	1,464	,034		,000
	p = 0,033	Cognitive age	,002	,001	,107	,033
Relationship Cognitive age_centre^3 - TRI-score			Unstandardized Coefficients		Standardized Coefficients	Sig.
			B	Std. Error	Beta	
R <sup>2</sup> = 0,074	F = 10,560	Constant	3,099	,036		,000
	p = 0,000	Cog. Age_centre	,001	,003	,042	,687
		Cog. Age_centre^2	,000	,000	-,075	,187
		Cog. Age_centre^3	-2,019E-05	,000	-,281	,007
Relationship Cognitive age - Cognitive capabilities^2			Unstandardized Coefficients		Standardized Coefficients	Sig.
			B	Std. Error	Beta	
R <sup>2</sup> = 0,227	F = 116,865	Constant	17,981	,614		,000
	p = 0,000	Cognitive age	-,170	,016	-,476	,000
Relationship Cognitive age - Cognitive assets			Unstandardized Coefficients		Standardized Coefficients	Sig.
			B	Std. Error	Beta	
R <sup>2</sup> = 0,041	F = 16,824	Constant	4,114	,087		,000
	p = 0,000	Cognitive age	-,009	,002	-,201	,000

Remark: the variables insecurity (SQRT), cognitive age\_centre^3 and cognitive capabilities^2 refer to the transformed variables in regard to assumption violation (regression)

Figure: Simple regression results

Hypothesis 1 - 4 examines the relationship between cognitive age and TRI dimensions : optimism, innovativeness, discomfort and insecurity. In order to examine these relationships a regression analysis is executed for each individual relationship.

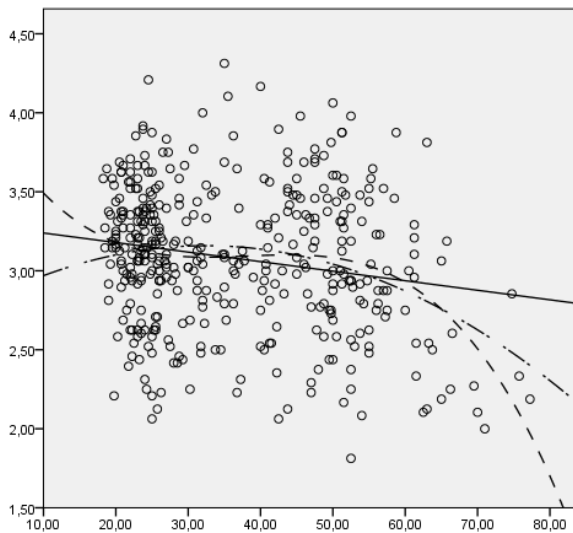
For optimism the analysis shows that the model is not useful ( $F(1,398) = 1,785 \mid p = 0,182$ ) because it is not significant. This means that no significant relationship is found between cognitive age and optimism. Therefore H1 is rejected, people's optimism towards technology does not change with the increase of cognitive age.

The second hypothesis is about the relationship between cognitive age and innovativeness. The model is significant ( $F(1, 398) = 30,042 \mid p < 0,01$ ). The model fit is weak ( $R^2 = 0,07$ ), it explains 7% of the variance. Cognitive age shows a negative relationship with innovativeness ( $B = -0,016 \mid p < 0,01$ ). This means that the increase of cognitive age results into a decrease of the innovativeness of consumers, therefore H2 is confirmed.

Hypothesis 3 sets the relationship between discomfort and cognitive age. According to the F-statistics the regression model is significant ( $F(1, 398) = 54,878 \mid p < 0,01$ ). The model fit is weak ( $R^2 = 0,121$ ). The model explains 12,1% of the variance. The regression coefficient shows that the relationship between cognitive age and discomfort is negative ( $B = -0,017 \mid p < 0,01$ ). But, the variable discomfort is reversed and therefore the relationship is actually positive. The increase of cognitive age increases feeling discomfort towards technology. This means that hypothesis 3 is confirmed.

For insecurity the analysis shows that the regression model is significant ( $F(1, 398) = 4,569 \mid p < 0,05$ ). The model fit is weak ( $R^2 = 0,011$ ), 1,1% of the variance is explained by the regression model. cognitive age shows a positive relationship with insecurity ( $B = 0,002 \mid p < 0,05$ ). Like discomfort, this variable is reversed. Therefore the relationship is actually negative, an increase of cognitive age decreases the feeling of insecurity. This is in contrast with hypothesis 4 which implies a positive relationship. Based upon this result, hypothesis 4 is rejected.

Besides the separate TRI dimensions it also interesting to examine the influence of cognitive age on the total TRI-score. This relationship is hypothesized with H5 in the conceptual model. The regression model is significant ( $F(3, 396) = 10,560 \mid p < 0,01$ ). The model fit is weak ( $R^2 = 0,074$ ), 7,4% of the variance is explained by the regression model. Cognitive age is a significant predictor of the TRI-score. In this case the regression coefficients (B) cannot be interpreted as before because of the polynomial term involved. Looking at the regression curve estimation the cubic model is presented in the figure. The figure shows that the TRI-



**Figure: Curve estimation polynomial terms – TRI-score**

score declines from the age of 18-28. Then, the TRI-score stays constant until the age of 48 is reached. After the age of 48 the TRI starts declining again. Therefore hypothesis 5 is partially confirmed.

Hypothesis 6 sets the relationship between cognitive age and cognitive capabilities and assets. The regression model is significant for both capabilities ( $F(1, 398) = 116,865 \mid p < 0,01$ ) as well as assets ( $F(1, 398) = 16,824 \mid p < 0,01$ ). The model fit is weak for capabilities ( $R^2 = 0,227$ ) and assets ( $R^2 = 0,041$ ), it explains 22,7% and 4,1% of the variance. Cognitive age shows a negative relationship with capabilities ( $B = -0,170 \mid p < 0,01$ ) and assets ( $B = -0,009 \mid p < 0,01$ ). This means that the increase of cognitive age results into a decrease of cognitive capabilities and assets, therefore H6 is confirmed.

## Appendix X ANOVA analysis

The ANOVA is conducted in addition to the simple regression analysis. In this analysis the exact differences between groups on the TRI-score and dimensions will be determined.

**Table: ANOVA analysis educational level**

Independent	Dependent	F	Sig.
Educational level	TRI-score	5,989	,000
	Optimism	1,498	,177
	Innovativeness	6,710	,000
	Discomfort	7,132	,000
	Insecurity	1,455	,192

average feeling of discomfort differs significantly for certain educational levels.

For *educational level* significant mean differences are found (see table). As a start the average TRI-score differs for certain educational levels ( $p < 0,01$ ). Secondly, the average innovativeness differs for educational levels ( $p < 0,01$ ). Last, the

**Table: ANOVA analysis gender**

Independent	Dependent	F	Sig.
Gender	TRI-score	27,649	,000
	Optimism	10,377	,001
	Innovativeness	66,317	,000
	Discomfort	0,070	,791
	Insecurity	3,356	,068

males and females ( $p < 0,01$ ). The same accounts for being innovative  $p < 0,01$ ).

For *gender* significant mean differences were found between males and females (see table). The average TRI-scores differs significantly for gender type ( $p < 0,01$ ). Secondly the optimism towards technology differs significantly between

**Table: ANOVA analysis occupation**

Independent	Dependent	F	Sig.
Occupation	TRI-score	25,920	,000
	Optimism	7,380	,007
	Innovativeness	62,163	,000
	Discomfort	0,854	,356
	Insecurity	0,794	,374

same accounts for the feeling of optimism, significant mean differences are found ( $p < 0,01$ ). Last, the average innovativeness differs for gender type ( $p < 0,01$ ).

For *occupation* significant mean differences were found for respondents with an engineering related job. As a start the average TRI-score differs significantly between respondents with or without an engineering related job ( $p < 0,01$ ). The

The group differences for each independent variable and dependent variable are described into detail in the figures below.

Educational level - Innovativeness	N	Mean	Std. Deviation	Significant at (*) 0,05 level						
				1	2	3	4	5	6	7
1 Geen onderwijs / basisonderwijs	5	2,00	1,06						*	*
2 Vmbo-basis / kader, MBO 1 / LTS / LBO / VBO	34	2,61	0,83						*	*
3 Vmbo-gemengd / theoretisch / MAVO / ULO / MULO	30	2,66	0,66						*	*
4 MBO 2, 3 of 4 / MTS	116	3,02	0,73							
5 HAVO / VWO	50	2,91	0,86							
6 HBO-bachelor / WO- bachelor	124	3,24	0,82	*	*	*				
7 WO-doctoraal / WO-master / HBO-master	41	3,30	0,73	*	*	*				

Educational level - Discomfort	N	Mean	Std. Deviation	Significant at (*) 0,05 level						
				1	2	3	4	5	6	7
1 Geen onderwijs / basisonderwijs	5	2,45	0,45						*	
2 Vmbo-basis / kader, MBO 1 / LTS / LBO / VBO	34	2,84	0,56						*	*
3 Vmbo-gemengd / theoretisch / MAVO / ULO / MULO	30	2,91	0,60						*	
4 MBO 2, 3 of 4 / MTS	116	3,08	0,69						*	
5 HAVO / VWO	50	3,26	0,60							
6 HBO-bachelor / WO- bachelor	124	3,41	0,66	*	*	*	*			
7 WO-doctoraal / WO-master / HBO-master	41	3,36	0,67		*					

Educational level - TRI-score	N	Mean	Std. Deviation	Significant at (*) 0,05 level						
				1	2	3	4	5	6	7
1 Geen onderwijs / basisonderwijs	5	2,48	0,45					*	*	*
2 Vmbo-basis / kader, MBO 1 / LTS / LBO / VBO	34	2,88	0,49						*	*
3 Vmbo-gemengd / theoretisch / MAVO / ULO / MULO	30	2,95	0,43							
4 MBO 2, 3 of 4 / MTS	116	3,01	0,42						*	
5 HAVO / VWO	50	3,11	0,42	*						
6 HBO-bachelor / WO- bachelor	124	3,20	0,47	*	*		*			
7 WO-doctoraal / WO-master / HBO-master	41	3,21	0,36	*	*					

Figure: ANOVA results for educational level

Gender - Optimism	N	Mean	Std. Deviation	Significant at (*) 0,05 level
1 Male	216	3,78	0,56	*
2 Female	184	3,60	0,57	

Gender - Innovativeness	N	Mean	Std. Deviation	Significant at (*) 0,05 level
1 Male	216	3,31	0,76	*
2 Female	184	2,69	0,76	

Gender - TRI-score	N	Mean	Std. Deviation	Significant at (*) 0,05 level
1 Male	216	3,19	0,44	*
2 Female	184	2,95	0,44	

**Figure: ANOVA results for gender**

Occupation - Optimism	N	Mean	Std. Deviation	Significant at (*) 0,05 level
1 Engineering related job	104	3,82	0,56	*
2 No engineering related job	296	3,65	0,56	

Occupation - Innovativeness	N	Mean	Std. Deviation	Significant at (*) 0,05 level
1 Engineering related job	104	3,53	0,69	*
2 No engineering related job	296	2,85	0,78	

Occupation - TRI-score	N	Mean	Std. Deviation	Significant at (*) 0,05 level
1 Engineering related job	104	3,27	0,45	*
2 No engineering related job	296	3,01	0,44	

**Figure: ANOVA results for occupation**

## Appendix XI Multiple regression procedure and results

For all dependent variables a multiple regression is executed which includes variables cognitive age, educational level, gender, occupation, cognitive capabilities and cognitive assets. All conducted multiple regression models apart from insecurity were useful. Also no sign of multicollinearity, non-linearity and heteroscedasticity was found (regression assumptions). The multiple regression results are presented in the figure below.

adj. R <sup>2</sup> = 0,063    F = 5,503    p < 0,01		Unstandardized Coefficients		Standardized Coefficients	Sig.
		B	Std. Error	Beta	
Optimism	(Constant)	2,780	,280		,000
	Cognitive age	,006	,002	,149	,009
	Cognitive capabilities^2	,003	,007	,028	,652
	Cognitive assets	,133	,050	,148	,008
	Gender_male	,110	,061	,097	,071
	Educational level	,044	,021	,115	,035
	Occupation_engineering	,064	,071	,050	,368

Remark: the variable cognitive capabilities^2 refers to the transformed variable in regard to assumption violation (regression)

adj. R <sup>2</sup> = 0,488    F = 64,394    p < 0,01		Unstandardized Coefficients		Standardized Coefficients	Sig.
		B	Std. Error	Beta	
Innovativeness	(Constant)	1,277	,298		,000
	Cognitive age	-,001	,002	-,014	,736
	Cognitive capabilities^2	,065	,008	,394	,000
	Cognitive assets	,314	,053	,243	,000
	Gender_male	,323	,065	,198	,000
	Educational level	,023	,022	,041	,303
	Occupation_engineering	,258	,076	,139	,001

Remark: the variable cognitive capabilities^2 refers to the transformed variable in regard to assumption violation (regression)

adj. R <sup>2</sup> = 0,258    F = 24,116    p < 0,01		Unstandardized Coefficients		Standardized Coefficients	Sig.
		B	Std. Error	Beta	
Discomfort	(Constant)	2,276	,297		,000
	Cognitive age	-,006	,002	-,125	,013
	Cognitive capabilities^2	,047	,008	,347	,000
	Cognitive assets	,103	,053	,096	,053
	Gender_male	-,149	,065	-,110	,022
	Educational level	,052	,022	,115	,018
	Occupation_engineering	-,011	,076	-,007	,881

Remark: the variable cognitive capabilities^2 refers to the transformed variable in regard to assumption violation (regression)

adj. R <sup>2</sup> = 0,009    F = 1,585    p = 0,150		Unstandardized Coefficients		Standardized Coefficients	Sig.
		B	Std. Error	Beta	
Insecurity (SQRT)	(Constant)	1,342	,123		,000
	Cognitive age	,002	,001	,140	,017
	Cognitive capabilities <sup>2</sup>	,003	,003	,055	,389
	Cognitive assets	,011	,022	,028	,631
	Gender_male	,039	,027	,080	,150
	Educational level	,000	,009	,002	,978
	Occupation_engineering	-,004	,031	-,008	,893

Remark: the variables cognitive capabilities<sup>2</sup> and insecurity (SQRT) refer to the transformed variables in regard to assumption violation (regression)

adj. R <sup>2</sup> = 0,319    F = 24,375    p < 0,01		Unstandardized Coefficients		Standardized Coefficients	Sig.
		B	Std. Error	Beta	
TRI-score	(Constant)	1,996	,128		,000
	Cog. age_centre	,008	,003	,253	,007
	Cog. age_centre <sup>2</sup>	-5,734E-05	,000	-,023	,636
	Cog. age_centre <sup>3</sup>	-1,795E-05	,000	-,250	,005
	Cognitive capabilities <sup>2</sup>	,030	,005	,334	,000
	Cognitive assets	,145	,034	,202	,000
	Gender_male	,105	,042	,116	,012
	Educational level	,027	,014	,090	,056
	Occupation_engineering	,063	,049	,061	,195

Remark: the variables cognitive capabilities<sup>2</sup> and Cog. age\_centre<sup>(2^3)</sup> refer to the transformed variable in regard to assumption violation (regression) and the polynomial term

**Figure: multiple regression analysis results**

The multiple regression model for optimism is significant ( $p < 0,01$ ) and explains 7,8% of the variance. The results show a positive significant relationship between cognitive age and optimism ( $B = 0,006 \mid p < 0,01$ ). The increase of cognitive age increases optimism for consumers. Also, a positive significant relationship is found between cognitive assets and optimism ( $B = 0,133 \mid p < 0,01$ ). This means that an increase of cognitive assets results into an increase of optimism. Last, a positive significant relationship is found between educational level and optimism ( $B = 0,044 \mid p < 0,05$ ). This indicates that the higher the educational level of consumers the higher the level of optimism towards technology. Cognitive age functions as the most important predictor of optimism ( $\beta = 0,149$ ).

For innovativeness the model appears to be significant ( $p < 0,01$ ) and explains 49,6% of the variance. The results show a significant positive relationship between cognitive capabilities and innovativeness ( $B = 0,065 \mid p < 0,01$ ). An increase of cognitive capabilities of consumers results into a higher degree of innovativeness. Also, a significant positive

relationship is found between cognitive assets and innovativeness ( $B = 0,314 \mid p < 0,01$ ). This indicates that when cognitive assets of consumers increase their innovativeness also increases. The results show that males appear to be more innovative ( $B = 0,323 \mid p < 0,01$ ). Last, consumers with an engineering related job are more innovative than those without ( $B = 0,258 \mid p < 0,05$ ). Cognitive capabilities functions as the most important predictor of innovativeness ( $\beta = 0,394$ ).

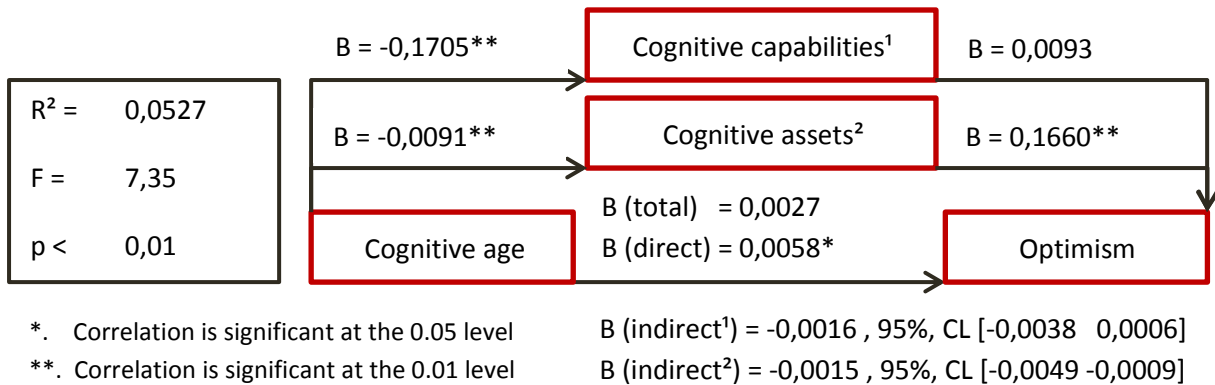
The multiple regression model for discomfort is significant ( $p < 0,01$ ) and explains 26,9% of the variance. Negative B-values are actually positive and the other way around because discomfort is reversed. Based upon the results a significant positive relationship is found between cognitive age and discomfort ( $B = 0,006 \mid p < 0,05$ ). This indicates that when consumers' cognitive age increases their feeling of discomfort also increases. Also, a significant negative relationship is determined between cognitive capabilities and discomfort ( $B = -0,047 \mid p < 0,01$ ). The increase of cognitive capabilities of consumers results into a decrease of discomfort. The results show that males experience more discomfort than females ( $B = 0,149 \mid p < 0,05$ ). Last, a significant negative relationship is found between educational level and discomfort ( $B = -0,052 \mid p < 0,05$ ). This indicates that when the educational level of consumers increase the feeling of discomfort decreases. Cognitive capabilities appears to be the most important predictor of discomfort ( $\beta = 0,347$ ).

For insecurity the multiple regression model appears to be non-significant ( $p = 0,150$ ).

The multiple regression model for the TRI-score is significant ( $p < 0,01$ ) and explains 33,3% of the variance. The results show a significant positive relationship between cognitive age and TRI-score ( $B = -1,79E-05 \mid p < 0,01$ ). Both the original variable as well as the polynomial term appear to be significant. Also, a significant positive relationship is found between cognitive capabilities and TRI-score ( $B = 0,030 \mid p < 0,01$ ). The increase of cognitive capabilities of consumers results into a decrease of TRI-score. The same accounts for cognitive assets, a significant positive relationship is determined ( $B = 0,145 \mid p < 0,01$ ). The increase of cognitive assets of consumers increases their TRI-score. Last, males have a significant higher TRI-score in comparison to females ( $B = 0,105 \mid p < 0,05$ ). The most important predictor of TRI-score is cognitive capabilities ( $\beta = 0,334$ ).

## Appendix XII Mediation results

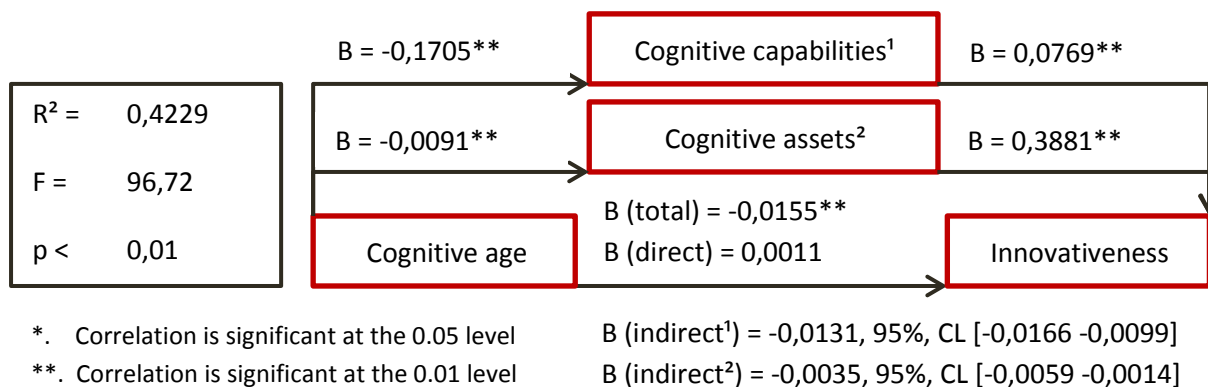
The relationship structure of the mediation analysis for optimism and corresponding results are presented in the figure below.



**Figure: Mediation analysis optimism**

The mediation model explains 5,3% of the variance in innovativeness and is significant ( $p < 0,01$ ). A non-significant relationship between cognitive age and optimism is determined ( $B(\text{total}) = 0,0027 \mid p = 0,1823$ ) when the mediators are not included. When including the mediators the direct relationship between cognitive age and optimism becomes significant ( $B(\text{direct}) = 0,0058^*$ ). In total, 34,8% of the original effect is accounted to cognitive capabilities and assets. There is a significant indirect negative effect of cognitive age on optimism through cognitive assets ( $B = -0,0015 \mid [-0,0049 \ -0,0009]$ ) but not through cognitive capabilities ( $B = -0,0016 \mid [-0,0038 \ -0,0006]$ ). The relationship is as follows: an increase of cognitive age decreases cognitive assets resulting into lower optimism. The significance of the direct relationship between cognitive age and optimism indicates a partial mediation effect.

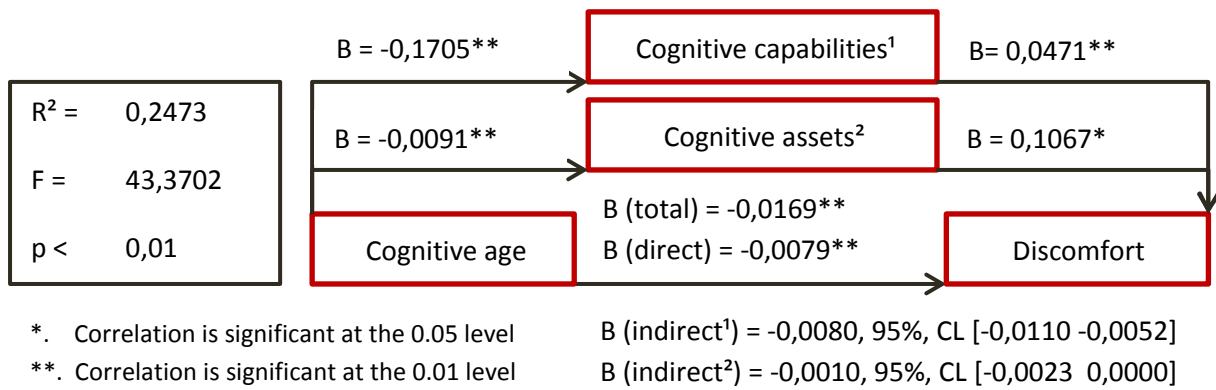
The relationship structure of the mediation analysis for innovativeness and corresponding results are presented in the figure below.



**Figure: Mediation analysis innovativeness**

The mediation model explains 42,3% of the variance in innovativeness and is significant ( $p < 0,01$ ). A significant negative relationship between cognitive age and innovativeness is determined ( $B \text{ (total)} = -0,0155^{**}$ ) when the mediators are not included. When including the mediators the direct relationship between cognitive age and innovativeness becomes non-significant ( $B \text{ (direct)} = 0,0011 \mid p = 0,6597$ ). In total, 93,8% of the original effect is accounted to cognitive capabilities and assets. There is a significant indirect negative effect of cognitive age on innovativeness through cognitive capabilities ( $B = -0,0131 \mid [-0,0059 - 0,0014]$ ) and cognitive assets ( $B = -0,0035 \mid [-0,0166 -0,0099]$ ). The relationship is as follows: an increase of cognitive age decreases cognitive capabilities and cognitive assets resulting into lower consumer innovativeness. The non-significance of the direct relationship between cognitive age and innovativeness indicates a full mediation effect.

The relationship structure of the mediation analysis for discomfort and corresponding results are presented in the figure below. The direction of the relationships with discomfort need to be interpreted the opposite way because discomfort is a reversed variable.



**Figure: Mediation analysis Discomfort**

The mediation model explains 24,73% of the variance in discomfort and is significant ( $p < 0,01$ ). A significant positive relationship between cognitive age and discomfort(reversed) is determined ( $B \text{ (total)} = -0,0169^{**}$ ) when the mediators are not included. When including the mediators the direct relationship between cognitive age and discomfort is still significant ( $B \text{ (direct)} = -0,0079 \mid p < 0,01$ ). In total, 53,3% of the original effect is accounted to cognitive capabilities and assets. There is a significant indirect positive effect of cognitive age on discomfort(reversed) through cognitive capabilities ( $B = -0,0080 \mid [-0,0110 -0,0053]$ ) but not through cognitive assets ( $B = -0,0010 \mid [-0,0023 0,0000]$ ). Only cognitive capabilities functions as a significant mediator and the relationship is as follows: the increase of cognitive age leads to a decrease of cognitive capabilities and an increase of discomfort. The direct relationship between cognitive age and discomfort is significant, there is a partial mediation effect.

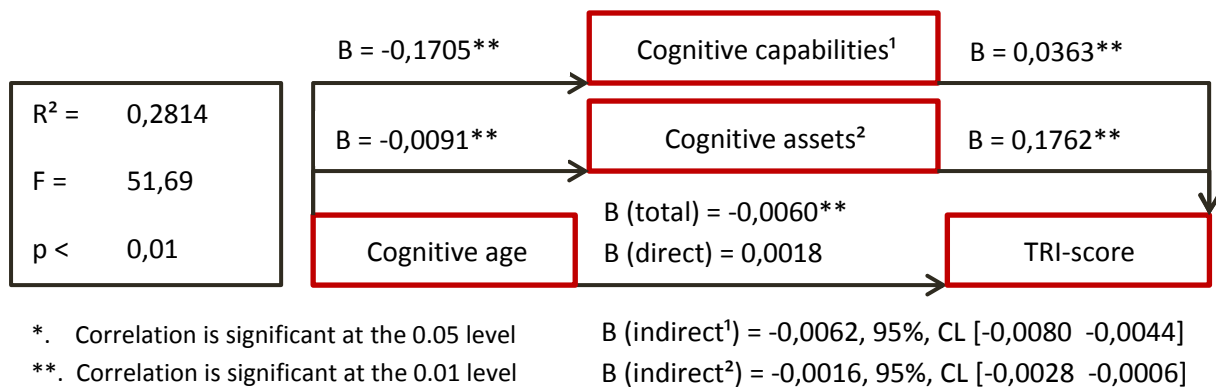
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For insecurity the mediation model appeared to be non-significant ( $p = 0,0657$ ). This is due to the fact that no significant relationship is found between cognitive assets and insecurity ( $p = 0,5372$ ) and neither between cognitive capabilities and insecurity ( $p = 0,2510$ ). These analysis results are presented in the figure below.

Model Summary							
	R	R-sq	MSE	F	df1	df2	p
	,1342	,0180	,0582	2,4204	3,0000	396,0000	,0657
Model							
	coeff	se	t	p	LLCI	ULCI	
constant	1,3483	,0893	15,1067	,0000	1,1729	1,5238	
AGE_COGN	,0026	,0010	2,5987	,0097	,0006	,0045	
CA_TOT	,0131	,0213	,6176	,5372	-,0287	,0549	
CC_TOT_2	,0034	,0030	1,1497	,2510	-,0024	,0093	

**Figure: Hayes's PROCESS results mediation analysis insecurity**

The relationship structure of the mediation analysis for discomfort and corresponding results are presented in the figure below. Because the difference in explanatory power is minimal between cognitive age and cognitive age<sup>3</sup> (difference R<sup>2</sup> = 0,0006) the original variable cognitive age is used as predictor. With a non-linear relationship the direction (positive/negative) of coefficients and effects cannot be interpreted correctly.



**Figure: Mediation analysis TRI-score**

The mediation model explains 28,1% of the variance in TRI-score and is significant (p < 0,01). A significant negative relationship between cognitive age and TRI-score is determined (B (total) = -0,0060\*\*) when the mediators are not included. When including the mediators the direct relationship between cognitive age and TRI-score becomes non-significant (B (direct) = 0,0018 | p = 0,2665). In total, 81,3% of the original effect is accounted to cognitive capabilities and assets. There is a significant indirect negative effect of cognitive age on TRI-

score through cognitive capabilities ( $B = -0,0062$  |  $[-0,0080 -0,0044]$ ) and cognitive assets ( $B = -0,0016$  |  $[-0,0028 -0,0006]$ ). The relationship is as follows: an increase of cognitive age decreases cognitive capabilities and cognitive assets resulting into a decline of TRI-score until the cognitive age of 28 is reached, a constant TRI-score until the cognitive age of 48 is reached and a declining TRI-score after the cognitive age of 48. The direct relationship between cognitive age and discomfort is not significant, there is a full mediation effect.