Biometrics as a security feature compared to non-biometrics

Differences in choice preference between interest-based subgroups

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ABSTRACT

This study has aimed at trying to uncover a relationship between self-perceived interest into technology and security on one hand, and choice preference with regard to the use of biometric systems as a security feature in our daily life on the other hand. Data has been collected through a literature study and later on through a survey, which has been distributed among many different groups of people living within the Netherlands. By testing the results of this survey through a principal component analysis and multiple different ANOVA tests in SPSS, it has been shown that there is no evidence for a statistically significant relationship between the two aforementioned independent variables and the dependent variable. Nonetheless, it has been indicated in this research that there may be some form of interaction between the variables, in which the alleged effect of security is overshadowed by other factors. Moreover, the effect of the variables price and usability on choice preference seems to be much more significant than the effect of the security variable, but the effect of the latter variable should not be excluded because of this difference, since including the security variable does show to be influential with regard to the choice preferences observed in the survey. Therefore, this research has been very useful from an explorative point of view, but the results have the be delved out deeper to really get an understanding of how the interaction between all these variables is established.

FOREWORD

The basis for this research has originated in my interest into the dynamic world of security, especially with regard to digital security. It has been written to fulfil the graduation requirements of the Master Crisis and Security Management at the faculty of Governance and Global Affairs at Leiden University. I was engaged in this research from February to June 2020.

With a wide variety of subjects to choose from, this research has aimed at uncovering the relationship between self-perceived interest and choice preferences. However, I could not have performed this research completely by myself. Therefore, I would like to thank my supervisor Dr. J. Shires for his help and guidance during the process, with this thesis as a result. Furthermore I would like to thank the second reader, Dr. T. van Steen, for his feedback during the process as well. Lastly, I would like to thank the respondents to the survey, without whom I would have had no data to research.

I hope you enjoy the reading of this thesis.

Tom van den Dungen

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1. INTRODUCTION

Our daily lives are increasingly taking place on the internet, due to increased internet access as well as the rise in smartphone ownership around the world (Odlyzko, 2003; Poushter, 2016). However, this internet expansion does not come without a risk. Since people feel the need to keep the content on their phones private or at least secure, different forms of doing so have been introduced. Up until a few years ago, the most common form of authentication in phones is the use of a text or numerical password, which poses security-risks with regard to simplification of passwords as well as the threat of it being discovered during a data breach (Agrawal & Patidar, 2014). Both of these can lead to complicated and unwanted situations, especially if the same passwords are used for multiple accounts on different platforms. Nowadays, there is a shift visible from the use old text passwords towards phones which work with biometric sensors, more specifically facial or finger print recognition.

1.1 SHIFT OF SECURITY

This shift has been facilitated by a combination of different societal factors, of which the main two factors regard to the increasing amount of personal/sensitive data on phones, as well as the technological advantages which make this implementation possible (Wang & Liu, 2011). These factors together do not comprehensively explain the shift towards using biometrics in phones, however they can be seen as underlying factors which helped both the implementation as well as the adaptation of this new form of security. According to Meng, Wong, Furnell & Zhou (2015), biometrics provide a higher level of security than any type of card, chip or password since they do not rely on something that you have or know, but rather they rely on something that you are. This means that this new form of identification cannot be shared or forgotten, and is also much harder to duplicate than a regular card or chip, thus making it the perfect key for personal authentication and identification. Even though this new form of security may seem very different from using the old passwords, the main difference between them is not in the process of identification or authentication itself, but rather in the level of security of the underlying process of matching the input pattern to the database.

1.2 HOW DOES IT WORK

To better understand why biometric systems are so much more secure, it is important to know how a phone equipped with a biometric sensor decides whether or not it will unlock itself when asked to by the operator. This process is described by Wang & Liu (2011), who first identify a database in which the accepted patterns for candidates are being stored. On the other side of the comparison, the phone equipped with a biometric sensor will read the data and send it to a characteristic extraction unit. The output of this unit is then compared to the database with accepted patterns to see if they are a match, and if so, the phone will be unlocked. However, according to Prabhaker, Pankanti & Jain (2003) this process may slightly differ when talking about different forms of use, namely enrolment, verification, and identification. Enrolment focusses on extracting biometric data to be saved in the system database, so that next time it can be compared to this saved pattern. In verification the data read by the biometric sensor will have to match a single, specific pattern in the database, whereas with identification the data read by the sensor can be matched to multiple different profiles of people registered in its database. The difference between these processes will be further touched upon in chapter 2.1.

1.3 RESEARCH OBJECTIVE

This research has aimed at uncovering how perceived expertise influences the differences in perception with regard to security of both biometric and non-biometric systems, so that further research and development regarding the further implementation and refinement of biometric systems in phones may be converged according to what society perceives as desired and what not. While there are many different types of biometric security systems (Jain, Nandakumar & Nagar, 2008; Prabhaker, Pankanti & Jain, 2003), the general focus here is on the type that is implemented most in our daily life, namely fingerprint recognition. This type can be defined as corporate, which are focussed on the private market. The other two categories of biometric systems are governmental and judicial, which respectively focus on use of biometrics by the government as well as the use of these systems in tracing and catching criminals. The difference between these different types will be explained more elaborately in chapter 2.1, but this research has focused mainly on the perception of biometrics with regard to corporate use rather than governmental or judicial. Furthermore, this research has focused solely on the use of fingerprint scanners as biometric systems and thus not facial recognition or other forms of biometrics. This is done because fingerprints are widely used nowadays, with implementation ranging from phones to the criminal justice system. It is therefore likely that this is one of the more of the well-known types of biometrics and thus people will be more familiar with it, which in turn leads to better understanding of the questions in the survey, and consequently to more informed answers. Therefore, fingerprint scanners are chosen as a representative for biometric security systems as a whole.

By eventually dividing the public into different groups – based on their own view on their expertise of these techniques and their corresponding threats and possibilities – it is possible to make a comparison between the different interest-based subgroups. This splitting of respondents into groups has been done based on their relative score to each other, which thus implies that the line of demarcation is set in the middle of the group when ranking their own perceived expertise and interest from low to high. Since the value of experts theory focusses on engaging and involving experts to find a valuable forecast, there is a high level of trust placed upon these experts and that they do the right thing. Even though experts are often seen as the people who know most about their particular expertise, this may not always be so straight forward. Combining this with Armstrong's (1980) seer-sucker theory – which entails that a little bit of knowledge is as valuable as being an expert on a subject – helps to see whether or not the general public in this situation shows a divide in perception between self-proclaimed experts and people with little insight into the same subjects. Thus, it can test if the potential divide between perceptions in society can be related to the level of knowledge of an individual. These two theories, the value of experts theory and the seer-sucker theory, will be further elaborated on in chapter 2.2 and 2.3 respectively.

1.4 ACADEMIC RELEVANCE

Currently, many different security techniques have been developed that use biometric systems. However, no standards with respect to these techniques have really been developed (Trikos et al., 2019), thus leaving a gap in knowledge with respect to what the future may hold. However, before this gap is addressed, it is important to know whether people do actually want this shift from traditional security measures to biometric systems to happen. Scientific literature has only just touched upon the perception of biometric security techniques in the past years, and if a standard has to be developed, it first calls for a comparison between the perceptions of biometric and non-biometric security systems. This would help the people involved in developing the standards with creating an overview of how this shift towards biometrics is perceived by the public, as well as possibly better define the important factors when it comes to implementing biometrics in the daily life of our society.

1.5 SOCIETAL RELEVANCE

It has already been touched on lightly before, but biometric systems are already widely used in different settings, from facial and fingerprint scanners in phones, as well as identification of criminals through the use of fingerprint scanners. Even regular companies and amusement parks like Disney World in Florida jump on the bandwagon, as they offer guests or employees the option to use their fingerprint for identification, and consequently as form of payment.

Besides, with the introduction and implementation of the General Data Protection Regulation (GDPR) in respectively 2016 and 2018, a debate regarding privacy of personal information had been sparked. This debate about the trade-off between security and privacy is something that is also present with the storage and processing of biometric data. This data is very personal and is the key to other private data, thus it should be securely protected. Especially now that our phones quickly contain increasingly more sensitive and personal data, it is of utmost importance that securing this is not only done thorough, but also within a reasonable amount of time.

1.6 RESEARCH QUESTION

As mentioned before, this research has aimed at trying to uncover differences in choice preference between the general public and self-proclaimed experts from within this general public with regard to the use of biometric systems – fingerprint scanners in particular – as a security provider in our daily life compared to non-biometric systems. Since the research focused on the choice preference of different subgroups within the population, there need to be underlying phenomena which would explain the differences between the groups. Therefore, the underlying interest with regard to security and technology are used here to try and identify how these factors influence the reciprocal differences in risk perception. Following this, the research question has been formulated as follows:

"To what extent does the choice preference towards the use of biometric systems as a security feature in our daily life differ between interest-based subgroups in the general population?"

This paper will not try to uncover what the exact level of interest is on which this alleged difference in perception occurs, but rather on finding *if* there is a difference between subgroups with a different average level of interest on the subject of technology or security. Also, it has been analysed whether the self-perceived risk perception of the respondents could explain (part of) this relationship between interest levels and choice preference. If it proves to be necessary, further research may look into the exact and coherent causal relationship which underlies the forming of the risk perception and its relation to respondents' choice preferences.

1.7 STRUCTURE

As stated above, this research has started with the application of biometrics, which will be uncovered through a literature study. By starting off with a literature review, a clear overview of the situation as well as terms used can be drafted up, something which could also benefit the next chapters. It also helps with the conceptualization of specific terms in the next chapter, which help with providing clarity later on in the analysis. The second chapter will elaborate on this literature review by setting up a theoretical framework for the analysis as well as drafting up hypothesis for the outcome. Two theories, the value of experts theory and the seer-sucker theory will be introduced to try and clarify the difference that most likely will be visible between the groups after the analysis. Following the second chapter, the final chapter will regard how the different subgroups – based on their self-proclaimed interest related to both the security and technology field – perceive possible threats related to widespread biometrics implementation. This chapter has been derived from the results of the survey, with support from literature wherever may be necessary. These perceptions are in turn acquired through a questionnaire in the form of a survey among people living in the Netherlands. The survey was then analysed in SPSS, so that an aggregated opinion can be generated for each subgroup, and can thus the results with respect to the choice preference can be compared between different groups.

2. BODY OF KNOWLEDGE

Early literature about biometrics suggests that from the beginning, a lot of potential has been seen in biometric systems as a security feature. These biometric systems – also abbreviated to biometrics – entail an independent system which can check if the input coming from a biometric sensor matches the saved and approved pattern in the internal or online database. Lawton (1998) has shown that from 1992 to 1999, the monetary value gained through the sale of biometric systems to private actors has increased almost tenfold, which was mainly due to growing demand, decreasing costs and increasing accuracy of biometric systems. This development as well as the underlying factors were already predicted by Sherman (1992), but he added that process of developing operational standards was of high significance as well. Standards which are still lacking almost thirty years later (Wilkinson, 2018) and thus leave space for vulnerabilities which can be exploited (Frustaci, Pace, Aloi & Fortino, 2018). Since public opinion influences the process of policy making significantly (Burstein, 2003), researching public opinion with regard to biometrics as a security feature could help this process of developing operational standards gain momentum. This perception of biometrics has been researched sporadically throughout the last decades (Bhagavatula et al., 2015; Furnell & Evangelatos, 2007; Moody, 2004), however with the increased development and implementation of biometric systems in the last few years, opinions and risk perceptions in the general public may have changed. According to Nepomuceno, Laroche & Richard (2014), increased knowledge regarding the technology of products can compensate for the concerns with respect to its perceived level of security. Consequently, they argue that increased knowledge helps reducing the perceived threat when buying a product, since there are less unknowns and thus it can be visualized more clearly.

2.1 TYPES OF BIOMETRICS

Within the field of biometrics, different types of systems can be identified on multiple levels. The first of these levels regards to the type of environment the system is used in, which can differ between governmental, corporate or judicial. Governmental refers to the systems being used by the government in the broadest sense, which is directly opposite of the corporate use, in which the systems are used by private actors. Finally, judicial refers to the systems being used in the tracing and identifying of criminals or criminal acts. For this research the focus will solely be on corporate use of biometric systems. The second level on which these biometric systems can be divided is that of how it works, namely physiological or behavioural (Sherman, 1992). Physiological biometric systems work with human characteristics that do not change but may be influenced by behaviour, whereas behavioural systems work through the measurement of individual action rather than characteristics. Since this research focusses on fingerprint recognition, it only entails physiological biometric systems. The third level to divide biometrics systems on is that of what they are used for, not to be confused with in which environment they are used. This final level can divided into three different processes, namely enrolment, verification, and identification. The enrolment process focusses on capturing and extracting the features through the biometric sensor so that they can be saved for comparison during the other two processes. These processes, verification and identification, work through comparing the scanned image from the biometric sensor to data which is saved in the system – or online – database. The major difference between these two processes is that during the verification process the system can only match the scan to a single possible correct pattern, whereas the identification process can compare this scan and match it to one of multiple different saved and approved patterns (Jain, Nandakumar & Nagar, 2008; Prabhaker, Pankanti & Jain, 2003).

2.2 VALUE OF EXPERTS

According to Abraham, Saulquin & Soparnot (2011), the value of experts is not set in stone but can differ based on intrinsic and contributive factors, but they do argue that the most vital assets are related to knowledge. Consequently, they visualize that experts are one of the main drivers for success when it comes to future company performance, which in turn indicates that experts have a higher value in business forecasting than non-experts. Whereas the usefulness of experts also depends on their working environment, their intrinsic values – the knowledge that these experts hold individually – is the main driver for forecasting or judging. This is also argued by Pinnock (2006), who elaborates on this by saying that different opinions about quality of a product are based on the individual areas of expertise, but situational factors should not be excluded. To conclude, it is argued that the value of experts is higher than that of non-experts, especially when it comes to forecasting and generating value.

2.3 SEER-SUCKER THEORY

In general, people rely heavily on experts when it comes to assessing change because they are thought to effectively utilize information and thus predict the future better. However, Armstrong (1980) argues that these experts are no better in assessing change than the general population and that all you need is a minimal level of expertise, a theory which he called the “seer-sucker theory”. Almost forty years later, this is all still relevant according to Sjöberg (2008), who found that the general population of Sweden were better at predicting political change compared to political scientists and journalists, groups who would normally be seen as experts in this field. Almost a decade later Hong, Hu, Wang, Fan & Xu (2016) identify the same thing in the financial sector, where recommendations from the public outperform those of experts as well as the public "able to outperforming S&P500 companies in terms of both overall returns and risk-adjusted returns" (Ready-Campbell et al., as cited in Hong et al, 2016). Even Armstrong himself addressed the theory again in 2012, arguing that the seer-sucker theory is still as relevant as in 1980 and that this has been proven over and over again in the intermediate time. Even though this theory focusses on knowledge rather than interest, Rotgans & Schmidt (2017) argue that it is widely assumed that interest guides the acquisition of knowledge. They even argue that individuals with a higher level of interest acquire knowledge with regard to this area of interest quicker than their peers who do not share this high level of interest for the subject. Therefore, the seer-sucker theory can also be based on interest rather than knowledge, since interest presumably precedence knowledge.

2.4 ADAPTATION OF NEW TECHNOLOGIES

Even though not much literature is available on how the general public perceives the implementation of and adapts to the biometrics as a security feature, it is still possible to focus on technology adaptation in general and relate this to biometrics. One of the possibilities to do so is using a "technology acceptance model (TAM) to analyse acceptability" (Yang as cited in Kim, Kim & Kim, 2019, p. 2). In this same paper Kim, Kim & Kim (2019) conclude that the main drivers for technology acceptance are perceived usefulness, general technology acceptance, and privacy concerns. This implies that convenience and security are the main focus areas with regard to increasing biometric acceptance among society. Something which is confirmed by Al Solami (2018), who argues that the main drivers for biometric adaptation are computability of technology, difficulty of use, and relative advantage.

This research has focused mainly on how the technical interest influences choice preference, as well as focussing on the technology acceptance through measuring interest into technology and its security. These two factors together – identified as technical and security interest – are used to try and find a difference between interest-based subgroups in society.

2.5 HYPOTHESES

It is expected that the choice preference of people is influenced by the amount of interest they have into technology and security. This means that the groups consisting of self-proclaimed experts would score different as a group than the less interested and thus less informed respondents, as indicated by the value of experts theory described in chapter 2.2. If no difference can be found between the groups – especially that part of the public which has some interest into the combination of technology and security would presumably come in close range with the expectations of the self-proclaimed experts – this could be due to the seer-sucker theory as defined in chapter 2.3, but this is not expected however.

Since two different independent variables are tested to see if they influence the dependent variable, multiple hypotheses are drafted up. The null hypothesis is shown below:

***H_0**:* *Both perceived technological interest and interest into safety and security as well as their interdependent interaction will not have a significant effect on choice preference towards the use of biometric systems as a security feature in our daily life*

To be able to overthrow this null hypothesis, or parts of it, different hypotheses have to be drafted up to visualize the expected difference in choice preference caused by these technological and security factors. With these two independent variables two hypotheses have been drafted up, however there is one extra hypothesis drafted up for the potential influence of the interaction effect between the two independent variables. These three alternative hypotheses are shown below:

***H_1**:* *Perceived technological interest will have a significant effect on choice preference towards the use of biometric systems as a security feature in our daily life*

***H_2**:* *Perceived interest into safety and security will have a significant effect on choice preference towards the use of biometric systems as a security feature in our daily life*

***H_3**:* *The interaction between perceived technological interest and interest in safety and security will have a significant effect on choice preference towards the use of biometric systems as a security feature in our daily life*

Each of the different alternative hypotheses has been statistically analysed, so that it can consequently be argued if the null hypothesis fits best with the findings of the research or if (parts of) this null hypothesis has to be overthrown and (some of the) alternative hypotheses have to be accepted. Potential differences are explained through either the value of experts theory or the seer-sucker theory, whereas they both argue in an opposite direction. Eventually it has been possible to form four different groups based on the potential ranking with regard to the independent variables, their level of perceived interest of technology (ranging between high/low), and their perceived interest in safety and security (also ranging between high/low).

It was expected that both perceived technological interest as well as perceived interest in safety and security will have a significant influence on choice preference. Meaning that it was expected that higher levels of these two independent variables will contribute to change in their choice preference, which would lead to both H_1 and H_2 being accepted, as parts of the null hypothesis are overthrown. For H_3 it was expected that this interaction may strengthen the effect of the individual factors, whereas the interaction itself is not expected to significantly influence the outcome. These findings may also be due to differences in risk perception between the interest-based subgroups, therefore the relation between perceived risk perception and the choice preference of respondents has also been analysed to see if this could (further) explain the outcome, or that it may be the sole factor for influencing choice preferences.

As is concluded later on in this research based upon the results from the survey, none of the alternative hypotheses are proved to be statistically significant, thus meaning that only the null-hypothesis is accepted. This could potentially be the consequence of the overshadowing by other variables, however it can nonetheless be said that the null-hypothesis cannot be overthrown based upon the significance levels that are found in this research.

2.6 CONCEPTUALIZATION

The term cyber security has been used often and in many different settings, but in this research the term refers to securing the online environment in which people engage in. Thus meaning that cyber security focusses on reducing threats in this online environment to a minimum, making it a safe(r) space for everyone to walk around in.

To be able to compare the perceptions regarding biometrics, it is important to define how the performance of these biometric systems can be measured. Performance can be measured in a percentage of how often the system finds the correct match compared to when it finds a false match or no match, even though the user is registered in the database (Philips, Martin, Wilson & Przybocki, 2000). They define the proportion of these errors respectively as false-alarm rate and false-reject rate, measuring them as a percentage of the total amount of entries. Even though this research has not focused on analysing the performance of the biometrics itself, it is important to understand that the definition of performance may differ between different groups in the general public. Even though the general public may not define it explicitly like a percentage, according to *the Oxford Dictionary* (2020) performance is associated with how good or bad something works, where high performance is naturally preferred. This high performance is consistent with the percentage defined earlier, since a high percentage would lead to high performance and vice versa.

The term general public and public opinion both refer to the (opinion of the) same group, which refers to the habitants of the country the Netherlands. Even though smartphones seem to be reaching a younger audience every day, the general public in this research will be limited to people aged fifteen and older.

3. METHODOLOGY

The main important indicators are the perceived interest levels of both the self-claimed experts and the less-interest part of the general public. These perceptions have been tested with regard to both technology and security, but their individual self-perceived risk perception has also been tested. Before starting, it is important to thoroughly understand how these perceptions are measured precisely in this research.

First, a literature study has been done to identify and aggregate different points of view on biometrics as a security feature, as well as looking into technology acceptance and other theories which may explain the potential causation between interest and choice preference. Since the use and developments of biometrics have increased significantly throughout the years (Thakur & Vyas, 2019), the literature has mainly been from the last ten years to try and create a more recent view off the subject. This is useful so that old theories – which are proven to no longer be applicable – are not taken into account anymore, and therefore not compared to the more recent view of the survey. Eventually a proper general view of aforementioned literature was drafted up, so that this general view can be compared to the different opinions of the public.

3.1 TWO-WAY ANOVA TEST

To be able to find and visualize a difference between the interest-based subgroups, a two-way ANOVA test has been executed. This is because a two-way ANOVA test can show the effect of two different independent variables – technological interest and interest into safety and security in this research – on the same dependent variable. Furthermore, it can even look for an interaction between the independent variables to see if this can explain the correlation between both the independent as well as the dependent variables (Assaad, Hou, Zhou, Carroll & Wu, 2015; Fujikoshi, 1993).

Consequently, this test has aimed at trying to uncover a difference between three or more groups within the independent variable, with respect to a single dependent variable (the outcome). The independent variables in this case have been the level of interest with regard to both security and technology in general, whereas the dependent variable is the choice preference of the respondents that can be derived from the results of the survey. As said before in paragraph 1.4, the groups have been split based on their relative score compared to other respondents. Since this split has happened in the middle of the relative ranking of scores, there has been a low-scoring and a high-scoring group for both the independent variables, thus leading to a total of four different interest-based groups, with the high-scoring groups embodying the so-called experts.

Since a one-way ANOVA test can only be executed with a single independent variable, interest with respect to both technology and security would have to be aggregated for this test to work. It could also be run twice for each independent variable, but this would lack the option of testing for the interaction effect between these two. Therefore, a two-way ANOVA has been performed, so that both independent variables can be tested separately, to see how these individual factors influence the choice preference of people, and that it can be tested whether the alleged correlation may be due to the interaction between these two factors, or that it may even be due to the differences in perceived risk perception between the respondents themselves.

3.2 SURVEY DESIGN

In the survey, multiple questions have been asked in which answers were to be given on a five or seven-point Likert scale, meaning that these values can therefore be analysed as a regular dataset. By assigning numbers to each answer it is possible to rank these answers on an interval scale, which means that the results can be aggregated and then analysed so that a clear average can be obtained regarding public opinion. Some of the question have focused on the level of interest the respondents feel like they have themselves when it comes to (biometric) technology and security, so that it can be determined in what group – as defined in paragraph 3.1 – they should be placed. Other questions have in turn focused more in depth on the subject, by making people reply to or choose between different situations and configurations. Some of these questions consisted of different options for the respondents to choose which option they preferred, where every alternative has been made up of a different set of characteristics, thus performing so-called conjoint analysis. Demographics with respect to each entry have also been collected in the survey, but these were aggregated so that anonymity of the participants has been and will be guaranteed. This anonymity is further ensured by not saving information that may lead to the respondent, such as IP addresses that are linked to each entry.

The data which has been collected was analysed using the statistics software SPSS, a program made for complex statistical data analysis which also has the tools to perform the analysis of the survey in this research, namely the so-called "Bayesian two-way ANOVA" (IBM, n.d.-a) test. By aggregating single entries, the average as well as the standard deviation can be obtained, through which something useful can be said about the opinion of the people in the sample. If the demographics in this sample were to match the demographics in the Dutch population, which is highly unlikely but can be tested in SPSS, (some of) this opinion from the sample can be generalized to the general public. However, it is highly likely that this survey will not be a representative group of people living in the Netherlands due to a survey sample bias. The survey has been distributed among my personal network, thus leading to a convenience sample in which some groups of the population will be overrepresented and others will be underrepresented. Nonetheless, this research is still useful in finding out how at least a part of the population thinks, which may pose new insights compared to the expert opinion which is already used heavily in policy making (Rich, 2005). Furthermore, it may also give insights into the choice preference of specific groups which are properly represented in the survey, one of which will most likely be students or people between the age of 20 and 30. It could even be possible to try and extrapolate the results of the survey to the general population, but only if the distribution of the population in the survey is recoded so that it fits the national demographics.

3.3 SURVEY QUESTIONS

As touched upon in the previous paragraph, different types of questions have been used in the questionnaire. The survey started off with a set of questions regarding the demographics of the respondent. This was then followed by the second category of questions which have consisted of seven questions regarding a comparison between two different phones, where a choice was to be made regarding which phone the respondent would prefer to buy. The final category of questions related to the level of interest the participants have with regard to the subject technology and security, moreover their self-proclaimed interest, since it would have been infeasible to research the participants expertise independently. The questions in this last section have tried to uncover a broad view of their perceived interest by focussing not just on the subjects themselves, but also on the many different challenges which surround technology, safety and security. Also, their perceived interest about the developments and implications regarding these subjects has been tested. Together, these questions have contributed to a broader image of the choice preference of individuals than when the only questions that were included in the survey regard the subjects itself, and not the surroundings issues and challenges as well as the processes themselves. The final category in this last part of the survey has also entailed question with regard to the risk perception of the respondents, so that its effect on the choice preference could be analysed as well. However, the main focus has been on the relation between the independent variables and the dependent variable, without the interference of the potential underlying explanation for this potential causation.

The different categories of questions are chosen so that the preferences that were selected by the respondents could be analysed with respect to their perceived interest of both technology and security. The questions with regard to self-perceived risk perception are included so that its effect on choice preferences could be analysed to see if this could explain or refute the relationship between interest and choice preference. These results could then be analysed based on the demographics of the participants, so that more potential differences between subgroups can be visualized. How the survey questions are built up can be found in Appendix A: Survey Design and the full survey in itself can be found in Appendix B: Sample Survey.

Besides the demographics and the questions regarding the configurations, the perceived interest questions have been measured on either a five or seven point Likert scale, so that they can be related to words ranging from “completely disagree”, to “neutral” and finally “completely agree”, filled with degradations of these statements until either five or seven different answer possibilities have been defined. The possibilities for the answer have differed slightly to fit the question more clearly, meaning that words as “agree” could have been replaced by words such as “satisfied” or “sufficient”.

Some examples of questions with regard to the interest of participants are listed below:

- *How would you rank your interest when it comes to biometrics/technology in general? (i.e. have you heard of the term and do you know what it means?)*
- *How familiar are you with biometric systems and their implications? (i.e. can you name different types of uses/currently implications?)*
- *How satisfied are you with your own knowledge with regard to technology and its security? (one being the lowest and seven being the highest)*

The survey has entailed more questions regarding the perceived interest of the respondents, so that a more elaborate view can be visualized. Questions related to testing perceived interest or knowledge about technology can also be found in Hosseini & Kamal (2012), which serves as a basis for some of the survey questions. These questions are selected so that a broad image could have been created with respect to the underlying interest, instead of focussing solely on biometric technology.

Finally, an example for questions in which a decision was to be made between different configurations is shown below:

- *Which of the two options below are you more likely to pick if you were to buy a new phone? (consider all non-mentioned characteristics are equal between the two options)*

Option 1
€ 400
Fingerprint scanner
High usability

Option 2
€ 300
Simple PIN lock
Moderate usability

These characteristics have been changed so that different configurations could be made, and thus different preferences were to be given. All respondents in the survey have nonetheless received the exact same survey, but with multiple questions about comparisons between different configurations. A further elaboration on how the complete survey design has been built up can be found in Appendix A: Survey Design. By aggregating the results, it has been made possible to analyse which of the factors is of most importance when picking a specific configuration. However, it is important that an unbiased and unambiguous set of options was presented, so that it did not influence the outcome through suggestive formulation of questions. Another possible configuration has been shown below, which together with the first one may show if people prefer a fingerprint scanner over a simple PIN lock, even though it does cost significantly more.

Option 1
€ 300
Simple PIN lock
High usability

Option 2
€ 400
Fingerprint scanner
Moderate usability

In the survey itself characteristics were differed more than in this example, so that a more elaborate view could be drafted up. To do this in the most effective way possible, a fractional factorial design has been drafted up. These type of fractional designs are experimental designs which do not entail every single possible comparison, but consist of a precisely chosen subset of all possibilities. Therefore, the survey has been less repetitive and more efficient while limiting the trade-off with regard to losing critical information (Gunst & Mason, 2009).

It has also been possible to change the order of the questions so that there is no prejudice with regard to the subject. By shifting the questions with regard to security and biometrics to the end and the questions regarding different configurations to the front, there is no bias in the respondents regarding what the survey wants to test. This contributes to an unbiased survey and therefore to a more representative result of this research.

3.4 SURVEY DISTRIBUTION

As mentioned before, the survey has mainly been distributed among my personal network within the Netherlands. Besides knowing the consequences of this form of convenience sampling, it is also important to understand how the survey has been distributed and filled in. To be able to reach a sample size big enough in the limited time available, the survey has been distributed and conducted online. By making it available online, it was relatively easy to distribute the survey to my network through online platforms or social media accounts. This has reduced the time needed to try and reach multiple respondents, especially in a time where people are in quarantine at home due to the COVID-19 pandemic.

Another benefit of conducting the survey through an online platform is that the data can often be directly exported to SPSS. This has decreased – or completely erase – the time needed for the recoding of the data before it could be analysed. Consequently, there was more time to both conduct the survey and find more respondents, as well as there being more time for the data to be analysed. This has eventually even led to the execution of another analysis for control within this research, so that the results from the original analysis could be checked.

3.5 LIMITATIONS

In every research there is a potential for limitations which can influence the outcome or the generalizability of the research, which is no different for this research. The main risk here did not lie in finding general information regarding biometrics or marketing, there is enough literature available, but it can be found in not collecting enough data through the survey. If not enough respondents were found, the risk is that the research could not have been generalized to the public. It would have also been possible that the distribution of respondents does not match the distribution in the public, meaning that it could be generalized less easy. Nevertheless, it would then still have been possible to generalize the findings from this research to a particular group in society or at least give an insight into possible opinions and considerations.

Another limitation was the fact that people have ranked their own level of interest when it comes to biometric systems and technology in the survey, thus perceived interest instead of objective interest or knowledge is measured. If this self-reported data is not correct or invalid, the correlation that would have potentially been found in this research may not be in place in the real world. This is because false entries could have led to this information being wrongly classified, and thus influenced the potential observed relationship which is derived from the survey (Hellerstedt, Smith, Shew & Resnick, 2000). According to Nunes et al., (2011) and Rock, Ireland, Resnick & McNeely (2005), there is a correlation between perceived knowledge and objective knowledge, but there are also discrepancies visible between the two types of knowledge. This would mean that what people say does not always reflect what they are or what they know, which could potentially have influenced the outcome of this research, especially if this was not only the case with perceived knowledge but also perceived interest.

Finally, there could have been a systematic discrepancy between the people who fill out the survey and the people who do not. It could have been possible that people who fill out the survey are already more interested in safety, security and technology compared to the people who do not fill it out, therefore it could have led to a somewhat biased conclusion of this research.

3.6 IMPLICATIONS

Besides having used the differences in perception as a base for setting up a standard regarding implementation of biometric systems, it has also been interesting to see what people do with their perception. It could have very well been possible that some people do more with their perception than others, which could be explained to some extent through the seer-sucker theory. Therefore, having included questions with regard to the use and implication of biometrics in the survey could have helped identifying how people manage their perceptions and how they implement these with regard to their choices.

The relationship between the risk perceptions and the choice preference could also have been compared to other areas of interest to see if the same potential correlation occurs as well. If so, it may have been possible to generalize these findings and draft up a general theory for the relationship between perceived interest and choice preference with regard to technology and its security.

4. SURVEY DEMOGRAPHICS

This chapter will elaborate on the results of survey and what was noticed in the process as the survey was distributed among respondents and analysed, as well as the minimal sample size needed for this research to be generalizable.

4.1 SAMPLE SIZE

Acquiring the right minimal amount of respondents to fill in the survey was of utmost importance when trying to generalize the findings to the population. For this research the population consisted of the inhabitants of the Netherlands, which are approximately 17.5 million people according to the latest published dataset at the time of writing by Statistics Netherlands (CBS, 2020). Another factor which influenced the sample size was the desired confidence interval, which has been set at 95% in this research, just like most other statistical analysis. The final factor which contributed to the sample size of the survey is the error margin, which has been set at 10% in this research. This percentage is often set lower at 5%, which would have increased the amount of respondents needed to be able to generalize the findings to the Dutch population. However because of convenience sampling the respondents were not selected randomly, which already influenced the way this research could have eventually been generalized to the entire Dutch population. Combined with the fact that this has been an exploratory research which should be followed by more precise research into the underlying interactions and interdependent effects, an error margin of 10% was still precise enough to properly identify the general trends and correlations in the observed dataset.

These three factors (population of 17.5 million, 95% confidence interval, 10% error margin) combined decided the minimally needed sample size to be able to generalize it to the population. Based upon the three aforementioned factors, it is indicated that a minimum of 97 respondents was needed for the survey to be able to generalize the findings to the entire population under these conditions. This number was based on the formula for sample sizes, as visualized below:

$$Sample\ size = \frac{\frac{z^2 * p\ (1-p)}{e^2}}{1 + \frac{z^2 * p\ (1-p)}{e^2 N}}$$

Where z is the z-score and can be derived from the desired confidence interval, in this case the corresponding z-score for the two-sided 95% confidence interval is 1.96; p is the likely sample proportion and consistent at 50% based on the division between the two interest-based subgroups, it should be filled in as decimal and thus is entered as 0.50 in the formula; e is the error margin filled in as a decimal, thus as 0.10; finally the N is the population over which the results are supposed to be generalized and thus 17.500.000 in this research, which is based on the dataset from Statistics Netherlands (CBS, 2020). Below, the formula can be found again but this time filled in with the aforementioned values that have been used in this research, and thus the final answer of this equation represents the minimum amount of respondents that was needed for this research to be generalized.

$$Sample\ size = \frac{\frac{1.96^2 * 0.50\ (1-0.50)}{0.10^2}}{1 + \frac{1.96^2 * 0.50\ (1-0.50)}{0.10^2 * 17500000}} = 96.04 \rightarrow 97$$

Since the result of the sample size formula indicates the minimal amount of respondents needed, 96.04 will be rounded up to 97, because it is simply not possible to have partial respondents and 96 would have been too low with the given factors in this research.

With a total of 112 respondents, the sample size did match the criteria for size set above. The correctness of the sample size is also supported by Israel (1992), who shows that with the same parameters as described earlier in this paragraph, the sample size should be a minimum of 100 people. One of the consequences of having not enough respondents would be a decrease in power, which would lead to a higher probability of rejecting the null hypothesis when it in fact is true (VanVoorhis & Morgan, 2007).

4.2 GENERAL OBSERVATIONS

When looking at the demographics from the survey, it can be seen that the expectation from chapter 3.2 with regard to a convenience sample is correct. Most of the respondents (approximately 75%) are between the age of 15 and 29, and have either finished high school (approximately 30%), have a bachelor degree (approximately 35%) or have already completed a master's degree (approximately 17%). This is in line with what was expected before the distribution of the survey, since my personal network mostly consists of current bachelor and master students, and people who have just recently finished a master's degree. Another thing which supports this theory is that almost 45% of the respondents has filled in that their annual household income is less that €25.000, while the GDP per capita in the Netherlands was more than €38.000 in 2017 (CBS, 2019). Combined with the general high level of education between the respondents, this could mean that the respondents are still mainly occupied with their studies, rather than them already being employed full time and thus earning a decent salary.

5. TECHNIQUES USED

As described in the chapter 3.1, a two-way ANOVA test has been performed to see if the independent variables influenced the dependent variable according to the hypotheses, or if there may have been another explanation for this expected causation. To find out how people saw their own level of interest into technology, security and general risk perception, multiple questions have been asked with regard to each aforementioned subject. However, for the analysis the questions have to be aggregated into a single variable, so that the two-way ANOVA could have been conducted with the variables "technological interest" and "interest into security". To make sure that the questions with regard to the same variable could have been aggregated, it was important to find out if these questions actually measure the same type of things. This was done through the principal component analysis (not to be confused with factor analysis, which may look the same but works differently), which is a built-in data reduction technique in SPSS.

5.1 PRINCIPAL COMPONENT ANALYSIS

The execution of the principal component analysis (PCA) is done with the goal of reducing the indicators needed to explain – most of – the information that can be found in a raw dataset. Consequently, the higher amount of indicators, the higher the level of information that can be described with these factors, assuming that it regards the same dataset. Therefore, this test will be used to see how many and which factors SPSS extracts as indicators from the data. Furthermore, this test will also be used to find other important values and coefficients in the data, especially with regard to testing whether the assumptions for the ANOVA tests and the PCA are met. First of these tests is KMO and Bartlett's test of sphericity, which tests if the variables in the research are independent of each other.

Within the PCA itself, the choice has been made to rotate the solution that is found, so that the data can be reduced even further. This rotation is done through an oblique technique integrated in SPSS, which assumes mutual dependency between the variables, which differs from the other types of "max-rotations" in SPSS that do not assume this mutual dependency.

5.2 TWO-WAY ANOVA TEST

After performing the PCA, the data could now be analysed through the two-way ANOVA test to see if the factors extracted from part three of the survey are indeed the motivation behind the choices the respondents made between the configurations in the second part of the survey. In this two-way ANOVA, it can be visualized which coefficients and corresponding relationships are statistically significant, which indicate the composition of aforementioned motivation from the respondents. Before or within the two-way ANOVA test, two different tests have to be performed to see if the data meets all the criteria for it to be analysed in this manner. First of these two tests is the chi-square test of independence, which measured if the data is fairly distributed and if it is a balanced design. This value for this test should be as close to zero as possible (Kent State

University, 2020). The second test is Levene's test of Equality, which focusses more on equal variances within the group. Ideally this value is bigger than $\alpha = 0.05$ so that the assumption of equal variances will not be rejected (Van den Berg, 2019). If these tests were both passed, then the statistically significant relationships that are found through the two-way ANOVA could potentially be generalized to the public. If these tests were not passed, the two-way ANOVA has been based upon wrong premises and assumptions, which in turn would have led to the transformation of the dataset or the usage of different tests, so that potential relationships found could be generalized to the general public.

Another benefit of using this two-way ANOVA test, is that not only the general relationship between choice preference in general and both independent variables regarding self-perceived interest can be tested, but that these potential causal relationships could be addressed and analysed individually. This has led to more insight into the underlying process of the correlation between the dependent and independent variables, since it has been specified and it elaborated on in more detail.

6. RESULTS

This chapter will focus on the execution and results of the aforementioned tests in SPSS, as well as the complications and assumptions made based on the results. Before starting the analysis itself, it was important to see if this dataset is fit for the desired analysis, thus if there was a potential underlying factor which causes variance in the data as well as finding out if the variables in the data are related to each other. The first part has been done through the Kaiser-Meyer-Olkin Measure of Sampling Adequacy and the second one has been done by performing the Bartlett's test of sphericity. The results of both tests can be seen in Table 1 below.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.852
Bartlett's Test of Sphericity	Approx. Chi-Square	526.028
	df	105
	Sig.	.000

Table 1: KMO and Bartlett's test

As visible in the table above, the result for the KMO test is 0.852, which indicates that performing a factor analysis or principal component analysis may be useful for the data. The closer the value is to 1.000 the better, whereas a minimum of 0.600 is desired (UCLA, 2020a). The second test would indicate whether or not there is dependency between the variables, which is confirmed with the significance level of 0.000, since this should be lower than $\alpha = 0.05$ to confirm the mutual dependency (IBM, n.d.-b).

6.1 PRINCIPAL COMPONENT ANALYSIS

The goal of the PCA was to reduce the amount of factors needed to explain the results, while at the same time trying to minimalize the amount of accuracy lost in the process (IBM, 2018). The expectation would have been that the first five questions of the survey could be reduced to a single factor, as well as the second five questions and the final five as well. In the ideal situation this would have therefore led to three aggregated factors based on the fifteen question from part three of the survey. However, after performing the PCA as described in chapter 5.1, a different result came about. SPSS identified four factors, which may not have been a big problem in itself, but the distribution over the questions was also different from the expected and ideal situation. Even though SPSS identified four factors based on their eigenvalue, it was also possible to force the program to identify three factors instead of four, but this often means that the model is less precise overall. The full correlation matrix as SPSS output can be found in Appendix C: Correlation Matrix, but the result have been summarized in this chapter. As mentioned before in chapter 3.3, the question in the third part of the survey were supposed to be centralized around three different subjects; technological interest, interest in security, and individual risk perception. This was done so that the results from the questions regarding each subject could have been aggregated to form a score for each corresponding variable, which would have led to three independent variables. To make sure that the scores from the questions regarding each variable could be aggregated, the interdependent correlations were to be checked, where a higher correlation between questions about the same subject is desired so that these questions can be aggregated under the same umbrella variable (UCLA, 2020b).

6.1.1 TECHNOLOGY

The first five questions of part three of the survey were supposed to uncover the technological interest that the respondents perceive they have, thus it would have been logical to expect a first factor technology where at least the first five questions would load high on, as well as a high mutual correlation between these five sub-questions. However, the mutual correlations are lower than expected, which decreases the ease at which these aforementioned sub-questions can be aggregated into a single variable. These correlations are all approximately between 0.500 and 0.700, values which indicate that roughly half to three-quarter of the results of the first five questions of part three are based around the same subject, and thus the answers correlate mutually. Even though these values are not as close to 1 as may have been expected, it still shows that that there is a central subject in these questions, which supports the idea that the first variable "technological interest" exists in the model. However, there are also other questions under different subjects in the survey which also correlate highly with questions from within these first five questions regarding technological interest. For example the correlation between Q1.1 and Q2.2 (0.599) or between Q1.2 and Q2.3 (0.598), which may indicate that the umbrella variable with regard to technological interest is of a wider influence than expected before the execution of the survey. The correlations between the first five questions interdependently as well as the other high correlating factors from these first five question with regard to others outside of the subject, are all significant as well with each of them having a significance-tail (p-value) of approximately 0.000, which is lower than $\alpha = 0.05$ and thus the possibility of it being a fluke can be scratched.

6.1.2 SAFETY AND SESCURITY

The second umbrella variable under which questions were asked was their perceived interest into security in general, which would therefore most likely be the second identifiable factor. By checking the mutual correlations between the questions corresponding to this subject it is visualized that this umbrella variable does not entail a high level of correlation such as the first one in chapter 6.1.1 does. Even though all correlations are positive and between 0.200 and 0.500 approximately, this does not show a high level of either mutual dependencies or interdependent interactions. Especially if we compare these values to the correlations between Q1.1 and Q2.2 (0.599) or between Q1.2 and Q2.3 (0.598) as identified in the previous chapter 6.1.1 to the mutual correlations between the questions with regard to the second umbrella variable, it is visualized that some of the questions which were related to the second umbrella variable security interest may have better been fitted to the first variable with respect to technological interest. However, even though the mutual correlations may not be extremely high, there is still a pattern visible that all of these questions at least entailed the same subject up to a certain level. Just as is the case with the correlations underneath the first umbrella variable, all of these correlations for this second umbrella variable are also significant. With a few exceptions of 0.028, 0.003 and 0.001, all other p-values are calculated to be approximately 0.000, and thus lower than the standard significance level of $\alpha = 0.05$ which is maintained in this research as well.

6.1.3 RISK PERCEPTION

The final category of questions on the survey was with respect to the general risk perception of the respondents, which may have been used to explain the choice preference of respondents if their measured perceived technological interest and interest into security did not explain the observed effect to a satisfactory level. Since these questions may have entailed a broader subject which can be viewed from many different angles, the correlations here were expected to be lower and less consistent than within the other two umbrella variables as mentioned in paragraph 6.1.1 and 6.1.2. This can also be seen in the correlation matrix, which shows correlations with much lower values – ranging from approximately 0.000 to 0.250 – than before, as well as both positive and negative correlations between questions from the same part. The latter indicates that some of these questions (the ones with negative mutual correlations) even measure the opposite from each other, however this could also be explained due to positive and negative formulation of questions. Even though it has been tried to formulate the questions in the same manner, this may not have been done completely accurately. Especially one of the questions pops out when looking at the Q3 section in the correlation matrix, namely question Q3.4 which asked people how likely it was for them to engage in risky behaviour. This questions correlates negatively with first three questions of Q3 (-0.138, -0.072 and -0.081 respectively) and slightly positive with the last one (0.117), indicating that this question measures the opposite from – most of – the other questions. This is a reasonable assumption since the first three questions focused more on their skills and awareness with respect to risky behaviour and this Q3.4 asked these same people how often they would engage in this type of behaviour, knowing that they have just shown how they prepare and try to prevent this behaviour from happening. The fact that it correlated positively with the Q3.5 is also logical, since this question has aimed at comparing their behaviour to others, where a higher likelihood of engaging in risky behaviour most likely correlates with a higher likelihood of being the victim of this type of behaviour. However, in the end most of these aforementioned correlations underneath the risk perception umbrella variable were to be omitted, since the significance levels are almost all higher than the $\alpha = 0.05$ that was set for this research, thus meaning that it cannot be excluded that the correlations in this chapter are based entirely on coincidences. The only two significant correlations are between Q3.1 and Q3.3, and between Q3.2 and Q3.3, with p-levels of 0.008 and 0.005 respectively, which are both lower than $\alpha = 0.05$. Because of all aforementioned reasons, the umbrella variable risk perception will be discarded completely from this research and therefore not be analysed any further from paragraph 6.3 and onwards. There was no way to correctly aggregate the results due to the low correlations mutually, which could in turn have led to finding a causal relationship in this research which was then based on wrong information and would thus not exists in the real world. The questions with regard to this umbrella variable, questions 11 through 15 from part three of the survey, will also be discarded and the results hereof will be left for what they are.

6.1.4 EXTRACTED FACTORS

Identifying the amount of factors needed to describe the results in the data as efficient as possible could have been done in different ways. The default setting in SPSS is to include each factor with an eigenvalue larger than one, which means that this factor explains more variance than the variance caused by its own effect, thus this single factor can be used to explain a part of the variance caused by other factors and therefore helps reducing the amount of factors needed in the model. Another option was to force SPSS to extract a set amount of factors, in which SPSS will maximize the amount of data explained with the amount of factors set at the start of the analysis. By looking at the component matrix (see Appendix F: Component Matrix) it could be seen which questions load best on which extracted factor, thus giving an approximation of how the variance within the dataset could be explained.

When running the principal component analysis in SPSS with the default settings (eigenvalues > 1 for extraction), a total of four different factors are identified which explain approximately 60% of the variance in the model. This means that the rest of the results in the dataset can only be explained by introducing more factors, which would mean a total of fifteen factors if 100% of the variance is to be explained through these factors, as can be seen in Appendix E: Total Variance Explained. However, since this research has been based on three different previously identified potential factors to explain the choice preferences seen by the respondents, this analysis was ran with the settings so that just three factors were extracted. When looking at Appendix E: Total

Variance Explained, it is visualized that the only difference between these two results is the fact that SPSS has left the fourth factor out of the model in the second total variance table, which corresponds to the factor extraction with just three factors. This means that the model with three extracted factors would perform a little less than a four factor model when it comes to explaining a percentage of the total variance, but it can also be seen that the percentage of the total variance that is explained with each added individual factor decreases significantly. This is also the case for the third factor, which explains significantly less of the total variance compared to the second factor (7.7% compared to 11.5%). If we identify the first two factors as technological interest and interest into security, it is visible that these two factors could explain almost half of the total variance (45.6%) within the dataset of the respondents. To support this claim, it is important to look at the component matrix (see Appendix F: Component Matrix), which show that the first factor does indeed load very heavily on the questions with regard to technology (between approximately 0.650 and 0.830), thus indicating that technology does indeed explain a big part of the total variance in the model. However, the second factor does load more heavily on question from the risk perception part (between approximately 0.260 and 0.650) compared to the security questions (between approximately 0.080 and 0.480), which would indicate that the second factor should be sought more in the area of risk perception than general interest in security. The latter is also the case for the potential extra third factor to explain the total amount of variance, since this factor also loads more heavily on question related to a third umbrella variable (between approximately 0.170 and 0.810) rather than on questions related to security interest (between approximately 0.030 and 0.340).

6.2 TWO-WAY ANOVA TEST

As described in paragraph 5.2, the two-way ANOVA test was preceded by another test, namely the chi-square test of independence. This was done to test whether or not the two independent variables – technological interest and interest into security – are really independent of each other or if there was some interaction between the two, which could potentially influence the outcome of the analysis. To perform this test, the questions with regard to both the aforementioned independent variables, as well as the ones with regard to risk perception in general, were to be aggregated to form a single variable from these multiple questions. Only once this was done, then it was possible to perform the chi-square and other following tests, otherwise there would be an overload of variables in the analysis.

There are also some assumptions regarding the data which must be met to be able to perform the ANOVA tests, which may influence the generalizability of the outcome. First of these assumptions is the fact that the data should have been distributed normally, thus according to the normality principle. Secondly, it should have been checked to see if the homogeneity of variances hypothesis has been violated, through for example the Levene's test. Finally, the cases were to be independent from each other, which was also the most serious assumption and should therefore be met before the other two (Laerd Statistics, 2018). If the first two assumptions were not met, this may not have been a big problem, since ANOVA tests are considered strong against non-normal distributed data, as well as there being options to perform the ANOVA test when the second assumption was to be violated, which is elaborated on in paragraph 6.2.2. If – some of – these assumptions were not met, this could influence the generalizability of the research, as well as it could have possibly influenced the strength of correlations or change correlations between factors all together.

6.2.1 AGGREGATING UMBRELLA VARIABLES

Aggregating questions from the survey into the desired independent variables depends on the interdependent correlations as described in paragraphs 6.1.1, 6.1.2 and 6.1.3. The first paragraph entails the mutual correlations within the question with regard to technological interest, and as seen in paragraph 6.1.1 these correlations are relatively high (between approximately 0.500 and 0.700) as well as each of them being statistically significant, meaning that these questions can rather easily be aggregated into a single umbrella variable. Since all the questions with regard to this first subject were asked on a 7-point Likert scale which went from low to high in the same way for every question, aggregating these questions consisted simply of summing up the answers on each individual question, followed by dividing this number by the amount of questions that were aggregated. This means that the answers for question 1.1 through 1.5 from the third part of the survey were added together and then divided by 5 to form an average score for the new variable "Technological interest". This is visualized in the equation below, with N being the amount of questions that are aggregated and Q_i embodying these questions:

$$Score\ "technological\ interest"\ = \frac{\sum_{i=o}^{N}(Qi)}{N}$$

This score was aggregated in the same way for the other two umbrella variables, interest into security and general risk perception, however the correlations and significance levels differ for these two aforementioned variables. First off, the correlations for the questions related to interest into security are lower than as seen with the questions regarding technological interest, but it still shows some degree of correlation between the questions, namely between approximately 0.300 and 0.400. Even though these values may not be very high, all of them are statistically significant, which implies that the correlation found between them is really there. Since the aim of this research is more exploratory than descriptive, these questions will be aggregated into a single variable as well, even though this may increase the amount of errors as well as decrease the overall reliability (Beal & Dawson, 2007). Thus the same formula from technological interest can be used for aggregating interest into security questions into one umbrella variable, as is shown below:

$$Score \text{ "}interest\ into\ security\text{" } = \frac{\sum_{i=o}^{N}(Qi)}{N}$$

For the final umbrella variable, general risk perception, aggregating the different questions into a single variable proved to be even harder. This was because the interdependent correlations between the questions with regard to this subject are rather low (between approximately 0.100 and 0.250), both negative and positive, and finally only a few of them are actually statistically significant (between Q1 and Q3: 0.008; between Q2 and Q3: 0.005). This means that even though there were some correlation between the answers to the questions with regard to the self-perceived general risk perception, this is not enough to really argue for the aggregation of these different answers. Especially question 3.4 and 3.5 have relatively low correlations, as they barely every score over 0.100 when it comes to correlation with other questions in the same category. Since the first three questions correlate somewhat, it can be said that these questions really focus on self-perceived risk perception, whereas question 3.4 may focus more on willingness to engage rather than perception, and question 3.5 may be more in line with how people feel their position in society is, rather than what their risk perception is compared to others. This implies that it would perhaps be possible to still form an umbrella variable with regard to self-perceived risk perception, but this would then most likely be based on only the first three questions with regard to this subject, rather than it being based on all five of the questions. Therefore, this umbrella variable will not be included in this research any further beyond this point, as touched upon before in paragraph 6.1.3.

In SPSS this aggregating and averaging of variables can be done through the “Compute Variable” option, where a new variable can be calculated from the data of other variables in the dataset. In the submenu an equation could be drafted up on how this new variable should base its value on the results of the other variables. It was done through aggregating the value of the other variables on which the umbrella variable were based and then divided by the amount of variables that are aggregated, before the umbrella variable was rounded up to round numbers, thus the distribution of these new umbrella variables matched the distribution of the underlying variables as a Likert-scale. This was done so that the aggregated variables can be used in the two-way ANOVA to find out whether or not these aforementioned variables influenced the choice preferences from the respondents in the survey, which cannot be done if the questions were used individually rather than as aggregated umbrella variable.

6.2.2 OBSERVED CORRELATION

After preparing the data as well as testing whether or not the data fits this form of testing, the two-way ANOVA was executed in SPSS, as described in paragraph 5.2. This has been done with the new umbrella variables that are created in chapter 6.2.1, combined with the data that was collected in the second part of the survey, where respondents had to give their preference for either of the two options. Table 2 below shows how often each of the two options was picked in the survey, based on a total of 105 correct and completely filled in surveys. First it shows the absolute amount of people that picked a certain choice within a specific question, which is then followed by the percentage of the total respondents that has picked this same option. Finally, both sides also include a column to see what has been varied between the two configurations, which is elaborated on in Appendix A: Survey Design. Thus, the variables that are mentioned in this last column are the once that are differed between the options, if and which variables are not mentioned in this box can be assumed to be equal between the two options.

	First choice			*Second choice*		
Question	*Amount*	*Percentage*	*What is varied?*	*Amount*	*Percentage*	*What is varied?*
Q2.1	66	62,9	Low priced, pin secured	39	37,1	High priced, fingerprint secured
Q2.2	48	45,7	High priced, fingerprint secured, moderate usability	57	54,3	Low priced, pin secured, high usability
Q2.3	63	60,0	Low priced, pin secured	42	40,0	High priced, fingerprint secured
Q2.4	73	69,5	Pin secured, high usability	32	30,5	Fingerprint secured, moderate usability
Q2.5	91	86,7	Fingerprint secured, high usability	14	13,3	Pin secured, moderate usability

Q2.6	38	36,2	Low priced, moderate usability	67	63,8	High priced, high usability
Q2.7	94	89,5	Low priced, high usability	11	10,5	High priced, moderate usability

Table 2: Choice preferences per comparison in the survey and what was varied

These choice preferences with regard to implementing biometric system as security feature show that the consideration people make was not the same in every situation, whereas in some comparisons there seems to be a much more obvious choice than in other comparisons, something which can be expected in situations where people have to make multiple choices. This is also supported by the difference in the mean and standard deviation per question, as can be seen in Appendix G: Descriptives & Means. However, table 2 also helps to show that the type of security system used (PIN and fingerprint scanner) did not influence the choice preference as much as was expected. Whenever the price of the product was varied, it can be seen that in four of the five cases the cheapest option was picked most. The only moment when this is not the case is in Q2.6, where it can be seen than people are willing to pay more for their phone if the corresponding usability is higher as well. The differences between the configurations in question Q2.6 does not entail the security, which is consistent between the two, thus indicating that the reason the respondents go for the more expensive phone is – at least in this situation – mainly based on the level of usability. To see whether or not biometric systems as a security feature influence the choice preference at all compared to a PIN secured system, the results of Q2.4 and Q2.5 are compared. For these questions the price was equal between the options, thus leaving security and usability as only influential factors for the observed choice preference. Table 2 shows that in Q2.4 almost 70% of the respondents chose the phone with high usability and a PIN secured system, but in Q2.5 almost 87% of people chose the phone with high usability and a biometric secured system, even though the only difference between these two is the switch from PIN to biometrics as security feature. This indicates that even though price and usability seem to be the main drivers for the observed choice preference of the respondents in the survey, the security variable also contributes to the choice people make, but this effect is mostly overshadowed by how important people seem to find price and usability. Thus, the effect of the variables price and usability seems to be much more significant than the effect of the security variable, but the effect of the latter should not be excluded because of this difference, since including the security variable does show to be influential with regard to the choice preferences observed in the survey. This effect of security may be present as this questions shows, but the individual effect cannot be measured due to overshadowing by other variables. Thus, it indicates a relationship or correlation, but it cannot be said if this is statistically significant enough to accept any alternative hypotheses with regard to choice preference in this research, but its effect is still present nonetheless.

Since aggregating the choice preferences themselves was practically impossible without loss of information, the two-way ANOVA test will be ran seven times, once for each question with regard to choice preference. Each of these seven analysis has been visualized below in Table 3, in which not only the significance levels of the independent variables and their interaction will be displayed, but also the outcome to the chi-square and Levene's test of equal variances will be shown for the corresponding analysis. Both of these tests have been performed under the assumption that the model is based on both the independent variables – technological interest and interest in security – as well as their interaction effect. The following results are a summary from the entire analysis, but this full analysis can be found in Appendix H: Levene's test of equal variances, Appendix I: Two-way ANOVA, and Appendix J: Chi-square test.

Question	Test		Significance	Outcome	Conclusion two-way ANOVA	Welch one-way ANOVA	Conclusion significance
Q1	Chi-square	*Technological interest*	0.196	Accept H_0	> No Relationship		
		Security interest	0.149	Accept H_0			
	Levene's test		0.000	No homogeneity of variances	> Transform data		
	Two-way ANOVA	*Technological interest*	0.854			0.200	> Not significant
		Security interest	0.103			0.151	> Not significant
		Interaction effect	0.239			Not possible	> Not significant in two-way ANOVA, not possible in one-way ANOVA
Q2	Chi-square	*Technological interest*	0.699	Accept H_0	> No Relationship		
		Security interest	0.623	Accept H_0			
	Levene's test		0.908	Homogeneity of variances accepted			
	Two-way ANOVA	*Technological interest*	0.785				> Not significant
		Security interest	0.632				> Not significant
		Interaction effect	0.201				> Not significant
Q3	Chi-square	*Technological interest*	0.514	Accept H_0	> No Relationship		
		Security interest	0.385	Accept H_0			
	Levene's test		0.000	No homogeneity of variances	> Transform data		
	Two-way ANOVA	*Technological interest*	0.855			0.528	> Not significant
		Security interest	0.163			0.397	> Not significant
		Interaction effect	0.049			Not possible	> Only significant coefficient (in two-way ANOVA)

Q4	**Chi-square**	*Technological interest*	0.126	Accept H_0	> No Relationship		
		Security interest	0.637	Accept H_0			
	Levene's test		0.000	No homogeneity of variances	> Transform data		
	Two-way ANOVA	*Technological interest*	0.142			0.126	> Not significant
		Security interest	0.751			0.651	> Not significant
		Interaction effect	0.780			Not possible	> Not significant in two-way ANOVA, not possible in one-way ANOVA
Q5	**Chi-square**	*Technological interest*	0.901	Accept H_0	> No Relationship		
		Security interest	0.777	Accept H_0			
	Levene's test		0.000	No homogeneity of variances	> Transform data		
	Two-way ANOVA	*Technological interest*	0.863			0.908	> Not significant
		Security interest	0.827			0.789	> Not significant
		Interaction effect	0.521			Not possible	> Not significant in two-way ANOVA, not possible in one-way ANOVA
Q6	**Chi-square**	*Technological interest*	0.898	Accept H_0	> No Relationship		
		Security interest	0.389	Accept H_0			
	Levene's test		0.104	Homogeneity of variances accepted			
	Two-way ANOVA	*Technological interest*	0.843				> Not significant
		Security interest	0.188				> Not significant
		Interaction effect	0.461				> Not significant
Q7	**Chi-square**	*Technological interest*	0.644	Accept H_0	> No Relationship		
		Security interest	0.618	Accept H_0			
	Levene's test		0.000	No homogeneity of variances	> Transform data		
	Two-way ANOVA	*Technological interest*	0.586			0.658	> Not significant
		Security interest	0.831			0.632	> Not significant
		Interaction effect	0.628			Not possible	> Not significant in two-way ANOVA, not possible in one-way ANOVA

Table 3: Chi-square, Levene's test and two-way ANOVA specified per choice preference question

6.2.3 ASSUMPTION OF EQUAL VARIANCES

As is visualized in Table 3 above, in five out of the seven questions the Levene's test of equal variances was significant at p = 0.000. As described before in paragraph 5.2, the ideal value for this test would have been $\alpha > 0.05$, so that the assumption of equal variances was not to be rejected (Van den Berg, 2019), as this is one of the assumptions needed to perform a two-way ANOVA test correctly. Table 3 in paragraph 6.2.2 shows that these criteria have not been met for Q1, Q3, Q4, Q5 and Q7, and thus the data was to be transformed or another type of ANOVA test was to be performed. Therefore, since this criteria has not been met in five of the questions, a Welch one-way ANOVA has been performed to at least get an understanding of the individual effects of the independent variables on the choice preference of respondents, and to see if these results differed from the results of the aforementioned two-way ANOVA. This Welch one-way ANOVA is designed to test the same as the regular one-way ANOVA – thus the influence of a single dependent variable on a single independent variable – but does this without the assumption of equal variances between groups (Welch, 1951). Therefore, this test is ideal in the situation when the Levene's test is significant, so that individual effects of the independent variables on the dependent variable can still be calculated and thus even compared to the results of the two-way ANOVA with wrong premises to see if there were any differences. Unfortunately, these Welch one-way ANOVA tests were not able to check for the interaction effect between the independent variables mutually on the outcome, and thus provide a less complete view of how choice preference was influenced by technological interest and interest into security. This test can performed in SPSS under the "Analyze" tab, followed by the "Compare Means" and then once again followed by the "One-way ANOVA" option. To make sure the Welch one-way ANOVA was performed and not the ordinary one-way ANOVA, "Welch" had to be turned on within the "Options" tab. It has also been possible to turn on the "Homogeneity of variance test" in this menu, to see if this assumption could be assumed correctly when looking at the effect of a single independent variable on the dependent variable, however since the Welch one-way ANOVA is used because the homogeneity of variances could not be assumed in the two-way ANOVA, turning on this "Homogeneity of variance test" for the Welch one-way ANOVA would have been unnecessary and thus overkill. The results of these Welch one-way ANOVA tests are also included in Table 3, so that the results can easily be compared to the results of the two-way ANOVA as well as each other.

6.2.4 CHI-SQUARE TEST OF INDEPENDENCE

Another test that was performed, and from which the results can be seen in Table 3 in paragraph 6.2.2, is the chi-square test of independence. This test has aimed at uncovering a potential relationship/association between the multiple factorial variables in the model, thus trying to identify whether or not these variables are really independent or that they were already mutually related (Kent State University, 2020). In this research it is visualized that the chi-square value for each question with regard to choice preference has not been statistically significant, thus indicating that there was no relationship between the variables technological interest and interest into security. Therefore, the third assumption of the ANOVA test – which has been mentioned in paragraph 6.2 – has been met and the variables that were used to try and explain the choice preferences are mutually independent. The null-hypothesis that was described as no relationship between the variables can thus be accepted.

6.2.5 RESULTS TWO-WAY ANOVA

Both table 3 in paragraph 6.2.2 and Appendix I: Two-way ANOVA show the outcome of the multiple two-way ANOVA tests that were performed in this research. The aim of these tests was to see if the independent variables – technological interest and interest into security – are statistically significant when it comes to influencing the respondents' choice preference observed in the survey. The two-way ANOVA also tested to see if the interaction between the independent variables is statistically significant, or that this had no influence on the outcome. If the p-values of the two-way ANOVA tests were below $\alpha = 0.05$, they would have been statistically significant and then it could be said that (one of) the independent variables did significantly influence the outcome of the corresponding choice preference by the respondent. As visualized in Table 3 and described in paragraph 6.2.3, there is no homogeneity of variances in most cases, which thus resulted in an execution of the two-way ANOVA test based on false assumptions. Therefore, these questions have also been analysed through a Welch one-way ANOVA, as described in paragraph 6.2.3, resulting in new significance levels for each of the alleged correlations between the individual choice preferences and the perceived technological interest and interest into security. Comparing these results per question shows that for most cases there was not much of a difference between the significance results of the two-way ANOVA and the Welch one-way ANOVA, with some exceptions where there may have been a slight difference between these results. However, there was no situation visible where the Welch one-way ANOVA comes to a different result with respect to overthrowing or sticking to the null-hypothesis, and vice versa. This means that even though the assumptions of the two-way ANOVA may have been violated, the results did not differ in the sense that the same conclusion were derived from this analysis as well as from the analysis that was used to check this outcome, the Welch one-way ANOVA.

Table 3 shows that there is not a single outcome which was statistically significant in the end. The only p-value derived from an ANOVA which was below $\alpha = 0.05$ is the interaction effect between the independent variables in Q3, but since there was no homogeneity of variances – the corresponding Levene's test of equal variances is significant at $p = 0.000$ – this test has been based on wrong premises. When analysing this alleged correlation with the Welch one-way ANOVA to see if the results differed, the interaction effect could not be checked since a one-way ANOVA is not built for this kind of analysis. Thus in the end, there was not a single statistically significant relationship found between individual choice preference from respondents and their self-perceived technological interest and interest into security. This does not means that there is not relationship between these independent variables and choice preference, but it has not been found in this research, which could indicate that the potential relationship differs significantly from the hypotheses drafted up in the beginning of this research.

6.3 HYPOTHESES

In paragraph 2.5 a null-hypothesis and three alternative hypotheses have been drawn up to check if the results of this research matches the expectations that were held beforehand. This total of four hypotheses is visualized below:

***H_0**:* *Both perceived technological interest and interest into safety and security as well as their interdependent interaction will not have a significant effect on choice preference towards the use of biometric systems as a security feature in our daily life*

***H_1**:* *Perceived technological interest will have a significant effect on choice preference towards the use of biometric systems as a security feature in our daily life*

***H_2**:* *Perceived interest into safety and security will have a significant effect on choice towards the use of biometric systems as a security feature in our daily life*

***H_3**:* *The interaction between perceived technological interest and interest in safety and security will have a significant effect on choice preference towards the use of biometric systems as a security feature in our daily life*

Based upon the results from the previous chapter 6.2 that there are no statistically significant p-values for all the potential correlations between self-perceived interest and individual choice preferences as measured in the survey, there is no other option but to accept to null-hypothesis. No evidence has been found in this research that would have indicated that either one of the alternative hypotheses should be accepted. This does not immediately mean that there is no causal relationship between these independent and dependent variables, because it could also be possible that this potential causal relationship was overshadowed by the individual effect of both price and usability on choice preference, as it was tested in the second part of the survey. It could be that these two variables are ranked as more important by the respondents than overall security, which in turn would lead to the aforementioned process of overshadowing. This potential explanation for not finding any significant values will be further elaborated on in the discussion.

6.4 ANOVA TEST FOR CONTROL

Since the two-way ANOVA test from chapter 6.2 did not provide the results that were expected, another ANOVA test has been executed to see if this could help explain why no causal relationship has been found at first. This new ANOVA test has been ran based a different aggregation of individual factors, meaning that the aforementioned umbrella variables with regard to both technological interest and interest into security were differed to see if this influences the outcome. As is visible in Appendix C: Correlation Matrix, some results based on single question may have correlated highly with both the umbrella variable with regard to technology as well as the one of security, which could have blurred the effect of the factor on either of the variables individually. An example of this is the first question from the first part, Q1.1, which correlates highly with the other questions in the first part (0.607, 0.702, 0.519 and 0.536), but also correlates highly with questions Q2.2 and Q2.3, namely 0.599 and 0.527 respectively. This could indicate that this question did not measure the pure effect underneath the technology umbrella variable, and shall therefore be left out of the aggregation. By continuing to evaluate the correlations like this, all double-loading factors were excluded, so that the individual effect on the umbrella variables could be tried to uncover. This has led to two different umbrella variables, the first one with respect to technological interest and was based on the results of questions Q1.2, Q1.3, Q1.4 and Q1.5, and the second umbrella variable with respect to interest into security has been based on the results of questions Q2.1, Q2.4 and Q2.5.

6.4.1 RESULTS CONTROL ANOVA

The aggregation as described above in chapter 6.4 could potentially change the outcome of this research if both the chi-square and Levene’s test of equal variances are passed, and significant correlations were found consequently. As can be seen in table 4, there is again only one single statistically significant coefficient found, namely one for the relationship between self-perceived interest into security and the first choice preference as presented in the survey. However, none of the Levene’s test of equal variances are passed, indicating that the variances in the data were not equally distributed. Therefore, a Welch one-way ANOVA is performed again, as is previously described in paragraph 6.2.3. All of these tests and other important results are shown summarized below in table 4, but can be found more elaborately in Appendix H: Levene's test of equal variances, Appendix I: Two-way ANOVA, and Appendix J: Chi-square test.

Question	**Test**		**Significance**	**Outcome**	**Conclusion two-way ANOVA**	**Welch One-way ANOVA**	**Conclusion significance**
Q1	**Chi-square**	*Technological interest*	0.097	Accept H_0	> No Relationship		
		Security interest	0.020	Accept H_1	> Relationship found		
	Levene's test		0.000	No homogeneity of variances	> Transform data		
	Two-way ANOVA	*Technological interest*	0.481			0.096	> Not significant
		Security interest	0.083			0.018	> Only significant coefficient (in Welch ANOVA)
		Interaction effect	0.625			Not possible	> Not significant in two-way ANOVA, not possible in one-way ANOVA
Q2	**Chi-square**	*Technological interest*	0.870	Accept H_0	> No Relationship		
		Security interest	0.548	Accept H_0			
	Levene's test		0.000	No homogeneity of variances	> Transform data		
	Two-way ANOVA	*Technological interest*	0.448			0.878	> Not significant
		Security interest	0.358			0.562	> Not significant
		Interaction effect	0.067			Not possible	> Not significant in two-way ANOVA, not possible in one-way ANOVA
Q3	**Chi-square**	*Technological interest*	0.107	Accept H_0	> No Relationship		
		Security interest	0.394	Accept H_0			
	Levene's test		0.003	No homogeneity of variances	> Transform data		
	Two-way ANOVA	*Technological interest*	0.348			0.107	> Not significant
		Security interest	0.637			0.405	> Not significant
		Interaction effect	0.481			Not possible	> Not significant in two-way ANOVA, not possible in one-way ANOVA
Q4	**Chi-square**	*Technological interest*	0.394	Accept H_0	> No Relationship		
		Security interest	0.102	Accept H_0			
	Levene's test		0.000	No homogeneity of variances	> Transform data		
	Two-way ANOVA	*Technological interest*	0.462			0.406	> Not significant
		Security interest	0.167			0.102	> Not significant
		Interaction effect	0.759			Not possible	> Not significant in two-way ANOVA, not possible in one-way ANOVA
Q5	**Chi-square**	*Technological interest*	0.876	Accept H_0	> No Relationship		
		Security interest	0.835	Accept H_0			
	Levene's test		0.002	No homogeneity of variances	> Transform data		
	Two-way ANOVA	*Technological interest*	0.816			0.885	> Not significant
		Security interest	0.925			0.844	> Not significant
		Interaction effect	0.870			Not possible	> Not significant in two-way ANOVA, not possible in one-way ANOVA

Q6	**Chi-square**	*Technological interest*	0.471	Accept H_0	> No Relationship		
		Security interest	0.260	Accept H_0			
	Levene's test		0.000	No homogeneity of variances	> Transform data		
	Two-way ANOVA	*Technological interest*	0.698			0.484	> Not significant
		Security interest	0.318			0.267	> Not significant
		Interaction effect	0.416			Not possible	> Not significant in two-way ANOVA, not possible in one-way ANOVA
Q7	**Chi-square**	*Technological interest*	0.506	Accept H_0	> No Relationship		
		Security interest	0.544	Accept H_0			
	Levene's test		0.004	No homogeneity of variances	> Transform data		
	Two-way ANOVA	*Technological interest*	0.890			0.519	> Not significant
		Security interest	0.794			0.558	> Not significant
		Interaction effect	0.935			Not possible	> Not significant in two-way ANOVA, not possible in one-way ANOVA

Table 4: Chi-square, Levene's test and two-way ANOVA specified per choice preference question after different aggregation

Only for the first question Q1 a statistically significant coefficient is found, which is found in the Welch one-way ANOVA with respect to the same relationship that has a statistically significant chi-square value, indicating that there is a relationship present. This would then be between the umbrella variable with respect to self-perceived interest into security, and the choice preference of respondents with respect to the first configuration presented in the survey. Because of the fact that Levene's test of equal variances was not passed for this question, the Welch one-way ANOVA had to be performed that consequently led to this statistically significant relationship, since the result of the two-way ANOVA was not statistically significant. However, all other values in table 4 above are shown to be not statistically significant, thus indicating that the null-hypothesis was correct and shall not be overthrown for most cases.

6.4.2 CONSEQUENCES FOR HYPOTHESES

As previously addressed in paragraph 6.2.5 and 6.3, the outcome of this research depends on whether or not the null-hypothesis will be overthrown and thus alternative hypotheses are accepted, or that the null-hypothesis itself will be accepted. In chapter 6.3 it has been concluded that there was no other option except for the latter, accepting the null-hypothesis that both interest into security and technological interest did not significantly influence choice preference in the survey. However, with the new results from chapter 6.4.1, this conclusion had to be checked and potentially revised. Since table 4 shows that there is a single statistically significant relationship, it could be argued that the null-hypothesis should not be accepted, but that the second alternative hypothesis with respect to security (H_2) is at least partially true. Nonetheless, based upon this single statistically significant coefficient from all potential seven that could be statistically significant, deriving the aforementioned conclusion from this single observation may be too optimistic. Even though this single statistically significant relationship does indicate a relationship – to some extent – between choice preference and self-perceived interest into security, it does not overthrow the conclusion derived earlier on in paragraph 6.3, but it can be seen as a noteworthy case which needs to researcher further.

6.4.3 COMPARISON BETWEEN ANOVA TESTS

The results found in this chapter were based on the second aggregation in which the double-loading factors were not included, so that the results found in paragraph 6.2.5 could be checked to see if there were any discrepancies. By comparing the results from the different ANOVA tests and both table 3 and 4, it can be seen that there is only one difference between the results of the different aggregations, which is the statistically significant relationship found in the control ANOVA between interest into security and the results of the first choice preference configuration presented in the survey. Besides this aforementioned single statistically significant correlation, nothing has been found that indicates a more widespread correlation between self-perceived interest into technology and security on one hand, and the choice preference with regard to the use of biometric systems as a security feature as shown by the respondents on the other hand.

6.5 INFLUENCE BIOMETRICS

As talked about before in paragraph 6.2.2, the difference between biometric systems and PIN secured systems was not the most influential factor when looking at the observed choice preferences made by the respondents. As this research has aimed at trying to find out how self-perceived interest into technology and security may influence the choice for biometric systems, the result that biometric system do not influence observed choice preference as much as previously hypothesized could indicate that biometric systems are seen as not important in society. However, this would be too short-sighted, since the fact that its effect is overshadowed does not mean that it is not of influence. It could very well be possible that when respondents are not confronted with price and usability, that they would focus more on the biometric part itself, which in turn could lead to different results. Therefore, it cannot be said that the influence of biometric systems is not of any importance, but it should rather be delved into more deeply to find out how the effect biometric systems compares to the other variables in more detail.

7. DISCUSSION

This chapter will further elaborate on the assumptions that are done and crossed during this research, which may impact the generalizability or the power of the outcome of this research.

7.1 CONSEQUENCES AGGREGATION

Aggregating results from different data sources may lead to problems if these data sources do not measure the exact same thing, as was the case when aggregating the Likert-scales from the survey. The correlations that are visualized in Appendix C: Correlation Matrix show that there is low correlation between some questions, which usually indicates that these questions do not measure the same thing and thus cannot be aggregated. For the first variable, technological interest, this was not really the case as most correlations were around 0.700. However, for interest into security the correlations were much lower, but the corresponding questions were still aggregated into a single umbrella variable. Consequence of this aggregation could be that this umbrella variable did not consist of what it is expected to entail, which in turn would have led to the possibility that no correlation was to be found, simply because there was a mismatch between what the umbrella variable is and what it is expected to be.

When aggregating the umbrella variables for the second time, more attention has been paid to correlation outside of their original groups as well. Then, the analysis was performed identically as the original one. This second analysis has resulted in a single statistically significant coefficient, indicating that the way the umbrella variables were aggregated may have impacted the outcome of this research. It is suggested that future research looks further into the aggregation of the umbrella variables, as well as these variables themselves, to see if this potentially blurred the alleged relationship in this research.

7.2 EXPECTATIONS

As described in paragraph 2.5, it was expected that there would be some relationship between self-perceived interest and choice preference of respondents to the survey. However, barely any evidence has been found for this potential relationship in this research, which may feel unnatural since logical reasoning could indicate that people who are more interested into technology and security would most likely have a different perspective – and potentially a different choice preference – on the use of technology and security based on their expertise.

The demographics of the survey were in line with what was expected beforehand, as described in paragraph 4.2, which confirms the convenience sampling idea from paragraph 3.2. Even though almost no causal relationship between the independent variables and the dependent variables has been found in this research, the generalizability of this conclusion is still influenced by the fact that the sampling has not been done completely at random. Therefore, it cannot be said definitively that this causal relationship does not exist at all in the general population, but it is an indication for this to say at least. Especially within the group of respondents that was overrepresented in this research, namely students or recent graduates, this research could be useful to indicate how the perceived interest into technology and security relates to their choice preference when implementing these interests in their daily life.

7.3 RISK PERCEPTION

Besides the fact that there is no relationship found between the independent variables and the dependent variable, no relationship between the umbrella variables with regard to each other have been found either. During this research it was thought that risk perception could perhaps influence the dependent variable through an underlying, not yet identified, mechanism. However, since the correlations found for the question with regard to the risk perception umbrella variable were extremely low, as can be seen in Appendix C: Correlation Matrix, the choice has been made to not include this variable in the overall analysis of choice preference. Therefore, it could not be tested if this variable could potentially explain the underlying effects on the choice preferences as showed by the respondents, which could not be explained through the other umbrella variables. To see if this risk perception can explain the difference within the choice preference as shown by the respondents, further research should aim specifically at uncovering this potential relationship. Results from these research projects could potentially confirm or deny the relationship that is suggested in this research, and therefore also influence the power of the results from this research.

8. CONCLUSION

This research has aimed at trying to uncover a potential relationship between self-perceived interest in both technology and security, and individual choice preference on the other hand. The research question that has been formulated in paragraph 1.6 was as follows:

“To what extent does the choice preference towards the use of biometric systems as a security feature in our daily life differ between interest-based subgroups in the general population?”

Even though this is no simple yes or no question, a relatively simple answer to this question can be given after executing this research, namely that practically no difference with respect to choice preferences has been found. This means that no evidence or data from this research suggests that the preference with regard to biometric systems as a security feature in our daily life differs between interest-based subgroups within the general population of the Netherlands.

Consequently, the value of experts theory is not applicable in this situation, as this theory assumes that a difference between the interest-based subgroups was to be found, which would have been true if the null-hypothesis was overthrown. On the other hand the seer-sucker theory is applicable in this situation, since it assumed that there would be no difference between the interest-based subgroups, which is confirmed by the acceptance of the null-hypothesis. Nonetheless, because of the fact that the results of this research are overshadowed by other variables, it may also be argued that none of these theories are applicable, since the individual effect of self-perceived interest was not isolated and can therefore not be tested.

Based upon the technology acceptance model (TAM) it was expected that convenience and security were the main drivers behind technology acceptance among society. However, this research indicates that security is not as important as was expected, but it does confirm the importance of perceived convenience with regard to technology acceptance. Furthermore, the effect of the variables price and usability seems to be much more significant than the effect of the security variable, but the effect of the latter should not be excluded because of this difference, since including the security variable does show to be influential with regard to the choice preferences observed in the survey.

Only when differentiating the way the umbrella variables were aggregated, a single statistically significant correlation was found in the ANOVA. This correlation suggests that there might be a relationship between self-perceived interest into security and choice preference, but this indication has to be researched further to be able to make any definitive conclusions about whether or not this relationship exists in society. Therefore, further research should try to isolate the effect between self-perceived interest in technology and security on one hand, and choice preference with regard to implementing biometric systems as a security feature on the other hand. By identifying and isolating this effect, it can be research how this relationship and its underlying processes influence the perception of the general population in the Netherlands and eventually worldwide.

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APPENDIX A: SURVEY DESIGN

To find out how the different factors in the configurations influence the perception of people regarding the level of security – or lack of risk – of their phone, multiple comparisons are shown to the respondent for them to give their preference. The configurations consist of some changeable settings with regard to price, security and usability, other characteristics will be assumed equal between the configurations. Price, security and usability have deliberately been picked since this research is about security, and therefore automatically about issues surrounding this subject, which are often around costs or efficiency and effectivity. Consequently, these three factors have been chosen to differ between the configurations, so that the choice preference of the respondent is in line with what is searched for in this research. These comparisons are not a full factorial design, but they do represent every level of every variable the same amount of times through the comparisons. Table 1 below shows how these comparisons are drafted up. Every field of the table shows two different letters, which refer to both options for the corresponding variable, with the first letter corresponding to option one and the second letter corresponding to option two. Thus, each column represents a full comparison between two different configurations, based on price, security and usability. Below the table is shown which letter represents which option.

Table 1: Overview of questions regarding configuration preferences

	Q1		**Q2**		**Q3**		**Q4**		**Q5**		**Q6**		**Q7**	
Price	P_A	P_B	P_A	P_B	P_A	P_B	P_B	P_B	P_A	P_A	P_A	P_B	P_A	P_B
Security	S_A	S_B	S_B	S_A	S_A	S_B	S_A	S_B	S_B	S_A	S_A	S_A	S_B	S_B
Usability	U_A	U_A	U_A	U_B	U_B	U_B	U_B	U_A	U_B	U_A	U_A	U_B	U_B	U_A

For the first variable "price", two different entries can be seen. The first one, P_A, refers to the price of €300 and the second one, P_B, refers to the price of €400. For the second variable "security", two different entries can be seen as well. The first one, S_A, refers to the use of a PIN/passcode and the second one, S_B, refers to the use of a fingerprint scanner. Finally, it can be observed that for the last variable "usability" there are also two levels. The first one, U_A, refers to a moderate level of usability (defined as a combination between effectiveness, efficiency and satisfaction in a user context (ISO, 2018)) and the second one, U_B, refers to a higher level of usability.

APPENDIX B: SAMPLE SURVEY

This survey aims at uncovering choice preferences and the underlying mechanisms that form these choices.

It will consist of three different parts, focusing respectively on demographics, choice preferences and perceived interest. The type of questions will be elaborated on further at the start of each part of the survey, which will take no more than ten minutes to fill in completely.

Thank you in advance for filling out the survey and contributing to my master's thesis!

PART I: DEMOGRAPHICS

The first part of this survey will focus on questions related to your background. The answers of these questions will be anonymised so that it cannot be traced who gave which answer.

Q1*: What gender do you identify as?*

A: Male

B: Female

C: Other

D: Prefer not to answer

Q2*: What is your age?*

A: 0-14 years old

B: 15-29 years old

C: 30-44 years old

D: 45-59 years old

E: 60+ years old

F: Prefer not to answer

Q3*: What is your highest degree of education that you have completed?*

A: Some high school

B: High school

C: Higher vocational education (HBO)

D: Bachelor’s degree

E: Master's degree

F: Ph.D. or higher

G: Prefer not to answer

Q4*: What is your annual household income?*

A: Less than €25.000

B: €25.000 - €49.999

C: €50.000 - €99.999

D: More than €100.000

E: Prefer not to answer

PART II: PREFERENCES

The following part consists of different configurations between which a choice has to be made regarding the phone (option) you would prefer to buy. Some specifications are differed throughout the questions, the characteristics that are not mentioned can be assumed to be equal between the different options.

N.B. (1) The variable usability refers to a combination of effectiveness and efficiency of the product.

(2) The fingerprint scanner is an addition to the PIN, not a replacement.

(3) The price is based on a standard network agreement, and thus is exclusive of the extras.

Q1*: Which of the following options would you prefer when you have to buy a new phone?*

Option 1
€ 300
PIN/password
Moderate usability

Option 2
€ 400
Fingerprint scanner
Moderate usability

***Q2**: Which of the following options would you prefer when you have to buy a new phone?*

Option 1
€ 300
Fingerprint scanner
Moderate usability

Option 2
€ 400
PIN/password
High usability

***Q3**: Which of the following options would you prefer when you have to buy a new phone?*

Option 1
€ 300
PIN/password
High usability

Option 2
€ 400
Fingerprint scanner
High usability

***Q4**: Which of the following options would you prefer when you have to buy a new phone?*

Option 1
€ 400
PIN/password
High usability

Option 2
€ 400
Fingerprint scanner
Moderate usability

***Q5**: Which of the following options would you prefer when you have to buy a new phone?*

Option 1
€ 300
Fingerprint scanner
High usability

Option 2
€ 300
PIN/password
Moderate usability

***Q6**: Which of the following options would you prefer when you have to buy a new phone?*

Option 1
€ 300
PIN/password
Moderate usability

Option 2
€ 400
PIN/password
High usability

***Q7**: Which of the following options would you prefer when you have to buy a new phone?*

Option 1
€ 300
Fingerprint scanner
High usability

Option 2
€ 400
Fingerprint scanner
Moderate usability

PART III: PERCEIVED INTEREST

This last part of the survey will try to uncover your perceived interest when it comes to both technology and security, as well as your general risk perception. The results of this part will be used to analyse the choices you made in the previous section of the survey.

Please assign the following statements a score from one to seven, where one represents the lowest possible score and seven the highest.

TECHNOLOGY

***Q1**: How would you rank your interest when it comes to technology and its security in general? (i.e. have you heard of the term and do you know what it means?)*

***Q2**: How much do you keep up with the latest developments in technology? (i.e. block chain, AI, IoT)*

***Q3**: If you have any technical problems in your daily life, how likely are you to fix these problems yourself? (one being never and seven being always)*

Q4: *To what extent do are you familiar with the legal, ethical, cultural and societal challenges regarding technology and its development?*

Q5: *How satisfied are you with your own knowledge with regard to technology? (one meaning completely dissatisfied and seven meaning completely satisfied)*

SECURITY

Q6: *How would you rank your interest in safety and security skills in general? (i.e. do you know how to act in different emergencies, are you prepared for potential threats?)*

Q7: *To what extent are standard security practices and their implications integrated into your daily life? (i.e. do you change your PIN regularly, check your bank transactions online, create backups)*

Q8: *To what extent do you keep up with new developments with regard to safety and security practices? (i.e. new software, hardware or information related to increasing security)*

Q9: *How often are the choices you make in your daily life influenced by your choice to try to increase or maintain your financial security? (one being never and seven being always)*

Q10: *How would you rate your own level of knowledge when it comes to security in general? (one meaning completely dissatisfied and seven meaning completely satisfied)*

RISK PERCEPTION

Q11: *In general, how much control do you feel you have over potential risks to yourself? (i.e. accidents, sickness, unemployment)*

Q12: *To what extent is the way you perceive risks based entirely on factual information, rather than emotional experience? (one being purely emotional and seven being entirely factual)*

Q13: *How likely are you to change your risk perception when confronted with new evidence, assuming the information is correct? (one being very unlikely and seven being highly likely)*

Q14: *How likely are you to engage in behaviour that is risky? (based on your own definition of risky behaviour)*

Q15: *Compared to others, how much more likely do you feel to be impacted by potential global threats? (i.e. pandemic, climate change, terrorism; one meaning less likely, four meaning equal and seven meaning more likely)*

APPENDIX C: CORRELATION MATRIX

	Q1.1	Q1.2	Q1.3	Q1.4	Q1.5	Q2.1	Q2.2	Q2.3	Q2.4	Q2.5	Q3.1	Q3.2	Q3.3	Q3.4	Q3.5
Q1.1	1,000	0,607	0,702	0,519	0,536	0,488	0,599	0,527	0,251	0,376	0,013	0,182	0,159	0,261	0,162
Q1.2	0,607	1,000	0,536	0,548	0,491	0,392	0,488	0,598	0,143	0,362	0,058	0,130	-0,046	0,308	0,095
Q1.3	0,702	0,536	1,000	0,583	0,578	0,467	0,420	0,478	0,188	0,337	-0,106	0,137	0,038	0,407	0,038
Q1.4	0,519	0,548	0,583	1,000	0,460	0,218	0,242	0,460	0,134	0,351	-0,071	-0,011	-0,027	0,271	0,015
Q1.5	0,536	0,491	0,578	0,460	1,000	0,473	0,439	0,500	0,229	0,505	0,088	0,053	0,041	0,294	0,029
Q2.1	0,488	0,392	0,467	0,218	0,473	1,000	0,392	0,372	0,360	0,290	0,054	0,248	0,189	0,135	0,058
Q2.2	0,599	0,488	0,420	0,242	0,439	0,392	1,000	0,514	0,344	0,340	-0,015	0,255	0,069	0,243	0,213
Q2.3	0,527	0,598	0,478	0,460	0,500	0,372	0,514	1,000	0,264	0,485	0,019	0,100	0,010	0,403	0,116
Q2.4	0,251	0,143	0,188	0,134	0,229	0,360	0,344	0,264	1,000	0,187	-0,053	0,262	0,182	-0,037	0,106
Q2.5	0,376	0,362	0,337	0,351	0,505	0,290	0,340	0,485	0,187	1,000	0,078	0,040	0,032	0,223	0,025
Q3.1	0,013	0,058	-0,106	-0,071	0,088	0,054	-0,015	0,019	-0,053	0,078	1,000	0,036	0,233	-0,138	0,076
Q3.2	0,182	0,130	0,137	-0,011	0,053	0,248	0,255	0,100	0,262	0,040	0,036	1,000	0,248	-0,072	0,119
Q3.3	0,159	-0,046	0,038	-0,027	0,041	0,189	0,069	0,010	0,182	0,032	0,233	0,248	1,000	-0,081	0,090
Q3.4	0,261	0,308	0,407	0,271	0,294	0,135	0,243	0,403	-0,037	0,223	-0,138	-0,072	-0,081	1,000	0,117
Q3.5	0,162	0,095	0,038	0,015	0,029	0,058	0,213	0,116	0,106	0,025	0,076	0,119	0,090	0,117	1,000

APPENDIX D: SIGNIFICANCE MATRIX

	Q1.1	Q1.2	Q1.3	Q1.4	Q1.5	Q2.1	Q2.2	Q2.3	Q2.4	Q2.5	Q3.1	Q3.2	Q3.3	Q3.4	Q3.5
Q1.1		0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,005	0,000	0,449	0,031	0,052	0,004	0,050
Q1.2	0,000		0,000	0,000	0,000	0,000	0,000	0,000	0,072	0,000	0,278	0,093	0,321	0,001	0,168
Q1.3	0,000	0,000		0,000	0,000	0,000	0,000	0,000	0,027	0,000	0,140	0,082	0,351	0,000	0,351
Q1.4	0,000	0,000	0,000		0,000	0,013	0,006	0,000	0,087	0,000	0,237	0,455	0,394	0,003	0,440
Q1.5	0,000	0,000	0,000	0,000		0,000	0,000	0,000	0,009	0,000	0,187	0,294	0,340	0,001	0,383
Q2.1	0,000	0,000	0,000	0,013	0,000		0,000	0,000	0,000	0,001	0,291	0,005	0,026	0,085	0,278
Q2.2	0,000	0,000	0,000	0,006	0,000	0,000		0,000	0,000	0,000	0,439	0,004	0,242	0,006	0,015
Q2.3	0,000	0,000	0,000	0,000	0,000	0,000	0,000		0,003	0,000	0,425	0,154	0,460	0,000	0,119
Q2.4	0,005	0,072	0,027	0,087	0,009	0,000	0,000	0,003		0,028	0,296	0,004	0,031	0,352	0,140
Q2.5	0,000	0,000	0,000	0,000	0,000	0,001	0,000	0,000	0,028		0,216	0,343	0,373	0,011	0,401
Q3.1	0,449	0,278	0,140	0,237	0,187	0,291	0,439	0,425	0,296	0,216		0,357	0,008	0,081	0,221
Q3.2	0,031	0,093	0,082	0,455	0,294	0,005	0,004	0,154	0,004	0,343	0,357		0,005	0,234	0,113
Q3.3	0,052	0,321	0,351	0,394	0,340	0,026	0,242	0,460	0,031	0,373	0,008	0,005		0,207	0,182
Q3.4	0,004	0,001	0,000	0,003	0,001	0,085	0,006	0,000	0,352	0,011	0,081	0,234	0,207		0,118
Q3.5	0,050	0,168	0,351	0,440	0,383	0,278	0,015	0,119	0,140	0,401	0,221	0,113	0,182	0,118	

APPENDIX E: TOTAL VARIANCE EXPLAINED

1. <u>Based on eigenvalue > 1</u>

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	5.120	34.134	34.134	5.120	34.134	34.134	4.925
2	1.722	11.482	45.615	1.722	11.482	45.615	2.097
3	1.149	7.657	53.273	1.149	7.657	53.273	1.349
4	1.070	7.131	60.404	1.070	7.131	60.404	1.353
5	.884	5.893	66.297				
6	.786	5.238	71.535				
7	.735	4.899	76.433				
8	.682	4.549	80.982				
9	.596	3.971	84.954				
10	.570	3.801	88.755				
11	.475	3.167	91.922				
12	.376	2.508	94.430				
13	.331	2.207	96.637				
14	.291	1.941	98.579				
15	.213	1.421	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

2. <u>Based on a set amount of factors (3)</u>

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	5.120	34.134	34.134	5.120	34.134	34.134	4.912
2	1.722	11.482	45.615	1.722	11.482	45.615	2.285
3	1.149	7.657	53.273	1.149	7.657	53.273	1.361
4	1.070	7.131	60.404				
5	.884	5.893	66.297				
6	.786	5.238	71.535				
7	.735	4.899	76.433				
8	.682	4.549	80.982				
9	.596	3.971	84.954				
10	.570	3.801	88.755				
11	.475	3.167	91.922				
12	.376	2.508	94.430				
13	.331	2.207	96.637				
14	.291	1.941	98.579				
15	.213	1.421	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

APPENDIX F: COMPONENT MATRIX

Component matrix with four extracted factors

Component Matrix[a]

	Component			
	1	2	3	4
Q1.1	.826	.063	-.014	.016
Q1.2	.762	-.145	.081	.071
Q1.3	.788	-.163	-.079	-.116
Q1.4	.651	-.324	.082	-.117
Q1.5	.752	-.077	.218	-.139
Q2.1	.627	.317	-.025	-.235
Q2.2	.696	.196	-.206	.168
Q2.3	.763	-.108	.036	.113
Q2.4	.384	.478	-.336	-.237
Q2.5	.592	-.077	.283	-.081
Q3.1	.009	.357	.808	.206
Q3.2	.228	.615	-.293	-.039
Q3.3	.107	.646	.251	-.018
Q3.4	.447	-.427	-.118	.355
Q3.5	.166	.261	-.166	.830

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

Component matrix with three extracted factors

Component Matrix[a]

	Component		
	1	2	3
Q1.1	.826	.063	-.014
Q1.2	.762	-.145	.081
Q1.3	.788	-.163	-.079
Q1.4	.651	-.324	.082
Q1.5	.752	-.077	.218
Q2.1	.627	.317	-.025
Q2.2	.696	.196	-.206
Q2.3	.763	-.108	.036
Q2.4	.384	.478	-.336
Q2.5	.592	-.077	.283
Q3.1	.009	.357	.808
Q3.2	.228	.615	-.293
Q3.3	.107	.646	.251
Q3.4	.447	-.427	-.118
Q3.5	.166	.261	-.166

Extraction Method: Principal Component Analysis.

a. 3 components extracted.

APPENDIX G: DESCRIPTIVES & MEANS

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Q1	105	1	2	1.37	.486
Q2	105	1	2	1.54	.501
Q3.	105	1	2	1.40	.492
Q4	105	1	2	1.30	.463
Q5	105	1	2	1.13	.342
Q6	105	1	2	1.64	.483
Q7	105	1	2	1.10	.308
Valid N (listwise)	105				

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Q1 * Technological_Interest	105	95.5%	5	4.5%	110	100.0%
Q2 * Technological_Interest	105	95.5%	5	4.5%	110	100.0%
Q3 * Technological_Interest	105	95.5%	5	4.5%	110	100.0%
Q4 * Technological_Interest	105	95.5%	5	4.5%	110	100.0%
Q5 * Technological_Interest	105	95.5%	5	4.5%	110	100.0%
Q6 * Technological_Interest	105	95.5%	5	4.5%	110	100.0%
Q7 * Technological_Interest	105	95.5%	5	4.5%	110	100.0%
Q1 * Security_Interest	105	95.5%	5	4.5%	110	100.0%
Q2 * Security_Interest	105	95.5%	5	4.5%	110	100.0%
Q3 * Security_Interest	105	95.5%	5	4.5%	110	100.0%
Q4 * Security_Interest	105	95.5%	5	4.5%	110	100.0%
Q5 * Security_Interest	105	95.5%	5	4.5%	110	100.0%
Q6 * Security_Interest	105	95.5%	5	4.5%	110	100.0%
Q7 * Security_Interest	105	95.5%	5	4.5%	110	100.0%

APPENDIX H: LEVENE'S TEST OF EQUAL VARIANCES

First aggregation

		Levene Statistic	df1	df2	Sig.
Q1. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	20.078	14	85	.000
	Based on Median	.968	14	85	.493
	Based on Median and with adjusted df	.968	14	66.552	.495
	Based on trimmed mean	16.175	14	85	.000
Q2. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	.531	14	85	.908
	Based on Median	.272	14	85	.996
	Based on Median and with adjusted df	.272	14	72.277	.995
	Based on trimmed mean	.531	14	85	.908
Q3. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	7.029	14	85	.000
	Based on Median	.943	14	85	.517
	Based on Median and with adjusted df	.943	14	68.006	.519
	Based on trimmed mean	5.971	14	85	.000
Q4. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	4.376	14	85	.000
	Based on Median	.595	14	85	.862
	Based on Median and with adjusted df	.595	14	71.996	.861
	Based on trimmed mean	3.734	14	85	.000
Q5. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	5.848	14	85	.000
	Based on Median	.893	14	85	.568
	Based on Median and with adjusted df	.893	14	51.660	.570
	Based on trimmed mean	4.482	14	85	.000
Q6. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	1.572	14	85	.104
	Based on Median	.385	14	85	.976
	Based on Median and with adjusted df	.385	14	76.687	.976
	Based on trimmed mean	1.421	14	85	.161
Q7. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	3.869	14	85	.000
	Based on Median	.931	14	85	.529
	Based on Median and with adjusted df	.931	14	47.834	.533
	Based on trimmed mean	2.998	14	85	.001

Second aggregation

Levene's Test of Equality of Error Variances[a]

		Levene Statistic	df1	df2	Sig.
Q1. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	39.664	15	85	.000
	Based on Median	1.199	15	85	.288
	Based on Median and with adjusted df	1.199	15	58.794	.298
	Based on trimmed mean	31.926	15	85	.000
Q2. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	6.813	15	85	.000
	Based on Median	.596	15	85	.870
	Based on Median and with adjusted df	.596	15	65.934	.868
	Based on trimmed mean	5.465	15	85	.000
Q3. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	2.567	15	85	.003
	Based on Median	.460	15	85	.954
	Based on Median and with adjusted df	.460	15	76.498	.953
	Based on trimmed mean	2.252	15	85	.010
Q4. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	8.829	15	85	.000
	Based on Median	.654	15	85	.821
	Based on Median and with adjusted df	.654	15	70.766	.820
	Based on trimmed mean	7.000	15	85	.000
Q5. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	2.658	15	85	.002
	Based on Median	.560	15	85	.897
	Based on Median and with adjusted df	.560	15	61.748	.894
	Based on trimmed mean	1.962	15	85	.028
Q6. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	5.676	15	85	.000
	Based on Median	.699	15	85	.778
	Based on Median and with adjusted df	.699	15	68.988	.776
	Based on trimmed mean	4.813	15	85	.000
Q7. Which of the following options would you prefer when you have to buy a new phone?	Based on Mean	2.505	15	85	.004
	Based on Median	.639	15	85	.834
	Based on Median and with adjusted df	.639	15	52.923	.829
	Based on trimmed mean	1.974	15	85	.027

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.[a]
a. Design: Intercept + control_technological + control_security + control_technological * control_security

APPENDIX I: TWO-WAY ANOVA

First aggregation

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Q1. Which of the following options would you prefer when you have to buy a new phone?	5.539[a]	19	.292	1.306	.202
	Q2. Which of the following options would you prefer when you have to buy a new phone?	4.723[b]	19	.249	.990	.480
	Q3. Which of the following options would you prefer when you have to buy a new phone?	6.030[c]	19	.317	1.407	.145
	Q4. Which of the following options would you prefer when you have to buy a new phone?	3.360[d]	19	.177	.796	.706
	Q5. Which of the following options would you prefer when you have to buy a new phone?	1.638[e]	19	.086	.698	.811
	Q6. Which of the following options would you prefer when you have to buy a new phone?	4.012[f]	19	.211	.887	.599
	Q7. Which of the following options would you prefer when you have to buy a new phone?	1.293[g]	19	.068	.676	.832
Intercept	Q1. Which of the following options would you prefer when you have to buy a new phone?	58.772	1	58.772	263.273	.000
	Q2. Which of the following options would you prefer when you have to buy a new phone?	61.399	1	61.399	244.632	.000
	Q3. Which of the following options would you prefer when you have to buy a new phone?	60.801	1	60.801	269.598	.000
	Q4. Which of the following options would you prefer when you have to buy a new phone?	49.734	1	49.734	223.824	.000

	Q5. Which of the following options would you prefer when you have to buy a new phone?	31.611	1	31.611	256.005	.000
	Q6. Which of the following options would you prefer when you have to buy a new phone?	81.716	1	81.716	343.255	.000
	Q7. Which of the following options would you prefer when you have to buy a new phone?	31.268	1	31.268	310.694	.000
Technological_Interest	Q1. Which of the following options would you prefer when you have to buy a new phone?	.298	4	.075	.334	.854
	Q2. Which of the following options would you prefer when you have to buy a new phone?	.434	4	.108	.432	.785
	Q3. Which of the following options would you prefer when you have to buy a new phone?	.301	4	.075	.334	.855
	Q4. Which of the following options would you prefer when you have to buy a new phone?	1.577	4	.394	1.774	.142
	Q5. Which of the following options would you prefer when you have to buy a new phone?	.159	4	.040	.321	.863
	Q6. Which of the following options would you prefer when you have to buy a new phone?	.333	4	.083	.350	.843
	Q7. Which of the following options would you prefer when you have to buy a new phone?	.287	4	.072	.712	.586
Security_Interest	Q1. Which of the following options would you prefer when you have to buy a new phone?	1.778	4	.444	1.991	.103
	Q2. Which of the following options would you prefer when you have to buy a new phone?	.647	4	.162	.645	.632
	Q3. Which of the following options would you prefer when you have to buy a new phone?	1.514	4	.378	1.678	.163

	Q4. Which of the following options would you prefer when you have to buy a new phone?	.426	4	.107	.480	.751
	Q5. Which of the following options would you prefer when you have to buy a new phone?	.184	4	.046	.373	.827
	Q6. Which of the following options would you prefer when you have to buy a new phone?	1.502	4	.375	1.577	.188
	Q7. Which of the following options would you prefer when you have to buy a new phone?	.148	4	.037	.368	.831
Technological_Interest * Security_Interest	Q1. Which of the following options would you prefer when you have to buy a new phone?	2.920	10	.292	1.308	.239
	Q2. Which of the following options would you prefer when you have to buy a new phone?	3.475	10	.348	1.385	.201
	Q3. Which of the following options would you prefer when you have to buy a new phone?	4.410	10	.441	1.955	.049
	Q4. Which of the following options would you prefer when you have to buy a new phone?	1.410	10	.141	.635	.780
	Q5. Which of the following options would you prefer when you have to buy a new phone?	1.133	10	.113	.918	.521
	Q6. Which of the following options would you prefer when you have to buy a new phone?	2.350	10	.235	.987	.461
	Q7. Which of the following options would you prefer when you have to buy a new phone?	.807	10	.081	.801	.628
Error	Q1. Which of the following options would you prefer when you have to buy a new phone?	18.975	85	.223		
	Q2. Which of the following options would you prefer when you have to buy a new phone?	21.334	85	.251		

	Q3. Which of the following options would you prefer when you have to buy a new phone?	19.170	85	.226		
	Q4. Which of the following options would you prefer when you have to buy a new phone?	18.887	85	.222		
	Q5. Which of the following options would you prefer when you have to buy a new phone?	10.496	85	.123		
	Q6. Which of the following options would you prefer when you have to buy a new phone?	20.235	85	.238		
	Q7. Which of the following options would you prefer when you have to buy a new phone?	8.554	85	.101		
Total	Q1. Which of the following options would you prefer when you have to buy a new phone?	222.000	105			
	Q2. Which of the following options would you prefer when you have to buy a new phone?	276.000	105			
	Q3. Which of the following options would you prefer when you have to buy a new phone?	231.000	105			
	Q4. Which of the following options would you prefer when you have to buy a new phone?	201.000	105			
	Q5. Which of the following options would you prefer when you have to buy a new phone?	147.000	105			
	Q6. Which of the following options would you prefer when you have to buy a new phone?	306.000	105			
	Q7. Which of the following options would you prefer when you have to buy a new phone?	138.000	105			
Corrected Total	Q1. Which of the following options would you prefer when you have to buy a new phone?	24.514	104			

	Q2. Which of the following options would you prefer when you have to buy a new phone?	26.057	104			
	Q3. Which of the following options would you prefer when you have to buy a new phone?	25.200	104			
	Q4. Which of the following options would you prefer when you have to buy a new phone?	22.248	104			
	Q5. Which of the following options would you prefer when you have to buy a new phone?	12.133	104			
	Q6. Which of the following options would you prefer when you have to buy a new phone?	24.248	104			
	Q7. Which of the following options would you prefer when you have to buy a new phone?	9.848	104			

a. R Squared = .226 (Adjusted R Squared = .053)

b. R Squared = .181 (Adjusted R Squared = -.002)

c. R Squared = .239 (Adjusted R Squared = .069)

d. R Squared = .151 (Adjusted R Squared = -.039)

e. R Squared = .135 (Adjusted R Squared = -.058)

f. R Squared = .165 (Adjusted R Squared = -.021)

g. R Squared = .131 (Adjusted R Squared = -.063)

Second aggregation

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Q1. Which of the following options would you prefer when you have to buy a new phone?	5.653[a]	19	.298	1.341	.181
	Q2. Which of the following options would you prefer when you have to buy a new phone?	5.620[b]	19	.296	1.230	.254

	Q3. Which of the following options would you prefer when you have to buy a new phone?	4.868[c]	19	.256	1.071	.394
	Q4. Which of the following options would you prefer when you have to buy a new phone?	4.103[d]	19	.216	1.012	.457
	Q5. Which of the following options would you prefer when you have to buy a new phone?	1.114[e]	19	.059	.452	.974
	Q6. Which of the following options would you prefer when you have to buy a new phone?	4.568[f]	19	.240	1.038	.428
	Q7. Which of the following options would you prefer when you have to buy a new phone?	1.039[g]	19	.055	.528	.942
Intercept	Q1. Which of the following options would you prefer when you have to buy a new phone?	62.927	1	62.927	283.583	.000
	Q2. Which of the following options would you prefer when you have to buy a new phone?	74.176	1	74.176	308.512	.000
	Q3. Which of the following options would you prefer when you have to buy a new phone?	66.382	1	66.382	277.522	.000
	Q4. Which of the following options would you prefer when you have to buy a new phone?	55.184	1	55.184	258.523	.000
	Q5. Which of the following options would you prefer when you have to buy a new phone?	37.297	1	37.297	287.701	.000
	Q6. Which of the following options would you prefer when you have to buy a new phone?	93.148	1	93.148	402.326	.000

	Q7. Which of the following options would you prefer when you have to buy a new phone?	35.355	1	35.355	341.176	.000
control_technological	Q1. Which of the following options would you prefer when you have to buy a new phone?	1.005	5	.201	.906	.481
	Q2. Which of the following options would you prefer when you have to buy a new phone?	1.152	5	.230	.959	.448
	Q3. Which of the following options would you prefer when you have to buy a new phone?	1.358	5	.272	1.136	.348
	Q4. Which of the following options would you prefer when you have to buy a new phone?	1.000	5	.200	.937	.462
	Q5. Which of the following options would you prefer when you have to buy a new phone?	.288	5	.058	.444	.816
	Q6. Which of the following options would you prefer when you have to buy a new phone?	.698	5	.140	.603	.698
	Q7. Which of the following options would you prefer when you have to buy a new phone?	.174	5	.035	.336	.890
control_security	Q1. Which of the following options would you prefer when you have to buy a new phone?	2.249	5	.450	2.027	.083
	Q2. Which of the following options would you prefer when you have to buy a new phone?	1.341	5	.268	1.116	.358
	Q3. Which of the following options would you prefer when you have to buy a new phone?	.818	5	.164	.684	.637

	Q4. Which of the following options would you prefer when you have to buy a new phone?	1.715	5	.343	1.607	.167
	Q5. Which of the following options would you prefer when you have to buy a new phone?	.179	5	.036	.277	.925
	Q6. Which of the following options would you prefer when you have to buy a new phone?	1.384	5	.277	1.196	.318
	Q7. Which of the following options would you prefer when you have to buy a new phone?	.246	5	.049	.475	.794
control_technological * control_security	Q1. Which of the following options would you prefer when you have to buy a new phone?	1.581	9	.176	.792	.625
	Q2. Which of the following options would you prefer when you have to buy a new phone?	4.052	9	.450	1.873	.067
	Q3. Which of the following options would you prefer when you have to buy a new phone?	2.062	9	.229	.958	.481
	Q4. Which of the following options would you prefer when you have to buy a new phone?	1.231	9	.137	.641	.759
	Q5. Which of the following options would you prefer when you have to buy a new phone?	.585	9	.065	.501	.870
	Q6. Which of the following options would you prefer when you have to buy a new phone?	2.167	9	.241	1.040	.416
	Q7. Which of the following options would you prefer when you have to buy a new phone?	.367	9	.041	.394	.935

Error	Q1. Which of the following options would you prefer when you have to buy a new phone?	18.861	85	.222		
	Q2. Which of the following options would you prefer when you have to buy a new phone?	20.437	85	.240		
	Q3. Which of the following options would you prefer when you have to buy a new phone?	20.332	85	.239		
	Q4. Which of the following options would you prefer when you have to buy a new phone?	18.144	85	.213		
	Q5. Which of the following options would you prefer when you have to buy a new phone?	11.019	85	.130		
	Q6. Which of the following options would you prefer when you have to buy a new phone?	19.679	85	.232		
	Q7. Which of the following options would you prefer when you have to buy a new phone?	8.808	85	.104		
Total	Q1. Which of the following options would you prefer when you have to buy a new phone?	222.000	105			
	Q2. Which of the following options would you prefer when you have to buy a new phone?	276.000	105			
	Q3. Which of the following options would you prefer when you have to buy a new phone?	231.000	105			
	Q4. Which of the following options would you prefer when you have to buy a new phone?	201.000	105			

	Q5. Which of the following options would you prefer when you have to buy a new phone?	147.000	105			
	Q6. Which of the following options would you prefer when you have to buy a new phone?	306.000	105			
	Q7. Which of the following options would you prefer when you have to buy a new phone?	138.000	105			
Corrected Total	Q1. Which of the following options would you prefer when you have to buy a new phone?	24.514	104			
	Q2. Which of the following options would you prefer when you have to buy a new phone?	26.057	104			
	Q3. Which of the following options would you prefer when you have to buy a new phone?	25.200	104			
	Q4. Which of the following options would you prefer when you have to buy a new phone?	22.248	104			
	Q5. Which of the following options would you prefer when you have to buy a new phone?	12.133	104			
	Q6. Which of the following options would you prefer when you have to buy a new phone?	24.248	104			
	Q7. Which of the following options would you prefer when you have to buy a new phone?	9.848	104			

APPENDIX J: CHI-SQUARE TEST

First aggregation

Technological_Interest * Q1.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.342[a]	5	.196
Likelihood Ratio	8.253	5	.143
Linear-by-Linear Association	4.968	1	.026
N of Valid Cases	105		

a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is .37.

Technological_Interest * Q2.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.008[a]	5	.699
Likelihood Ratio	3.406	5	.638
Linear-by-Linear Association	.568	1	.451
N of Valid Cases	105		

a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is .46.

Technological_Interest * Q3.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)

Pearson Chi-Square	4.248[a]	5	.514
Likelihood Ratio	4.579	5	.469
Linear-by-Linear Association	3.116	1	.078
N of Valid Cases	105		

a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is .40.

Technological_Interest * Q4.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.606[a]	5	.126
Likelihood Ratio	8.684	5	.122
Linear-by-Linear Association	.916	1	.339
N of Valid Cases	105		

a. 4 cells (33.3%) have expected count less than 5. The minimum expected count is .30.

Technological_Interest * Q5.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.603[a]	5	.901
Likelihood Ratio	1.916	5	.861
Linear-by-Linear Association	.002	1	.962
N of Valid Cases	105		

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is .13.

Technological_Interest * Q6.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.623[a]	5	.898
Likelihood Ratio	1.923	5	.860
Linear-by-Linear Association	.374	1	.541
N of Valid Cases	105		

a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is .36.

Technological_Interest * Q7.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.367[a]	5	.644
Likelihood Ratio	4.907	5	.427
Linear-by-Linear Association	1.919	1	.166
N of Valid Cases	105		

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is .10.

Security_Interest * Q1.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)

Pearson Chi-Square	8.134[a]	5	.149
Likelihood Ratio	9.259	5	.099
Linear-by-Linear Association	2.935	1	.087
N of Valid Cases	105		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .37.

Security_Interest * Q2.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.502[a]	5	.623
Likelihood Ratio	3.927	5	.560
Linear-by-Linear Association	.040	1	.842
N of Valid Cases	105		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .46.

Security_Interest * Q3.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.256[a]	5	.385
Likelihood Ratio	5.700	5	.337
Linear-by-Linear Association	1.789	1	.181
N of Valid Cases	105		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .40.

Security_Interest * Q4.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.410[a]	5	.637
Likelihood Ratio	3.573	5	.612
Linear-by-Linear Association	.085	1	.770
N of Valid Cases	105		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .30.

Security_Interest * Q5.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.496[a]	5	.777
Likelihood Ratio	3.128	5	.680
Linear-by-Linear Association	.004	1	.952
N of Valid Cases	105		

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is .13.

Security_Interest * Q6.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)

Pearson Chi-Square	5.225[a]	5	.389
Likelihood Ratio	5.706	5	.336
Linear-by-Linear Association	2.681	1	.102
N of Valid Cases	105		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .36.

Security_Interest * Q7.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.539[a]	5	.618
Likelihood Ratio	4.628	5	.463
Linear-by-Linear Association	1.380	1	.240
N of Valid Cases	105		

a. 8 cells (66.7%) have expected count less than 5. The minimum expected count is .10.

Second aggregation

control_technological * Q1.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9.323[a]	5	.097
Likelihood Ratio	10.885	5	.054
Linear-by-Linear Association	6.753	1	.009
N of Valid Cases	105		

a. 4 cells (33.3%) have expected count less than 5. The minimum expected count is .74.

control_technological * Q2.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.848[a]	5	.870
Likelihood Ratio	1.849	5	.870
Linear-by-Linear Association	.417	1	.518
N of Valid Cases	105		

a. 2 cells (16.7%) have expected count less than 5. The minimum expected count is .91.

control_technological * Q3.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9.051[a]	5	.107
Likelihood Ratio	9.796	5	.081
Linear-by-Linear Association	6.058	1	.014
N of Valid Cases	105		

a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is .80.

control_technological * Q4.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.180[a]	5	.394
Likelihood Ratio	5.330	5	.377
Linear-by-Linear Association	.217	1	.641
N of Valid Cases	105		

a. 5 cells (41.7%) have expected count less than 5. The minimum expected count is .61.

control_technological * Q5.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.797[a]	5	.876
Likelihood Ratio	2.192	5	.822
Linear-by-Linear Association	.047	1	.828
N of Valid Cases	105		

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is .27.

control_technological * Q6.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.569[a]	5	.471
Likelihood Ratio	5.237	5	.388
Linear-by-Linear Association	.428	1	.513
N of Valid Cases	105		

a. 4 cells (33.3%) have expected count less than 5. The minimum expected count is .72.

control_technological * Q7.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.310[a]	5	.506
Likelihood Ratio	5.592	5	.348
Linear-by-Linear Association	1.888	1	.169
N of Valid Cases	105		

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is .21.

control_security * Q1.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	13.399[a]	5	.020
Likelihood Ratio	17.983	5	.003
Linear-by-Linear Association	3.605	1	.058
N of Valid Cases	105		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .37.

control_security * Q2.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.011[a]	5	.548
Likelihood Ratio	4.508	5	.479
Linear-by-Linear Association	.167	1	.682
N of Valid Cases	105		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .46.

control_security * Q3.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.185[a]	5	.394
Likelihood Ratio	5.658	5	.341

Linear-by-Linear Association	.693	1	.405
N of Valid Cases	105		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .40.

control_security * Q4.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9.180[a]	5	.102
Likelihood Ratio	11.487	5	.043
Linear-by-Linear Association	.136	1	.712
N of Valid Cases	105		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .30.

control_security * Q5.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.104[a]	5	.835
Likelihood Ratio	2.657	5	.753
Linear-by-Linear Association	.999	1	.318
N of Valid Cases	105		

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is .13.

control_security * Q6.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.502[a]	5	.260
Likelihood Ratio	8.107	5	.150
Linear-by-Linear Association	.980	1	.322
N of Valid Cases	105		

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .36.

control_security * Q7.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.035[a]	5	.544
Likelihood Ratio	4.908	5	.427
Linear-by-Linear Association	1.489	1	.222
N of Valid Cases	105		

a. 8 cells (66.7%) have expected count less than 5. The minimum expected count is .10.