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Attitude Towards Chip Implant Devices for Individual Enhancement Purposes on Example of Estonian Population.

Master's thesis

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I have written this master's thesis independently. All viewpoints of other authors, literary sources and data from elsewhere used for writing this paper have been referenced.

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Abstract

This paper examines the attitude towards chip implant devices for individual enhancement purposes on example of Estonian population, in order to understand the factors that impact the willingness for an individual to receive a chip implant for enhancement purposes. We generated a Likert scale survey based on previous literature surrounding chip implantation to create a sample of 305 individuals who currently reside in Estonia. The results show that health, identity and privacy concerns affect the willingness to adopt chip implants for enhancement purposes. Especially, identity protection measure and legislative support to safeguard data for chip implants for enhancement purposes need to be increased. On the contrary, privacy and health concerns must also be decreased in order to increase the willingness to get a chip implant for enhancement purposes.

Keywords: Radio frequency implant devices (RFID), Attitude, Implementation, Enhancement, Estonia, Chip Implant.

Table of Contents

Introduction

Technologies rapid advancement and continual refusal to slow down presents vast new opportunities for humanity, allowing the current population to bring science fiction to reality through the transformation into a cybernetic organism. No longer a perceived fantasy term, which was first fabricated in 1960, as a human being with both biomechatronic and organic body parts (Clynes & Kline, 1960). McGee & Maguire concluded cyborgs are machine-assisted minds (McGee & Maguire, 2007). The implantation of electronic devices to achieve 'cyborg' status, which was once a distant dream, has now become reality. Cochlear implants have become an everyday medical implantation with over 60,000 users since 1957 (McGee, 2008). A small device implanted directly into the cochlear nucleus in the brainstem which sends impulses to your auditory nerve. Today, over 30,000 people live with deep brain stimulation implants (Lozano,2006).

Implantation devices are not however just limited to medical uses as previously mentioned. Organisations, individuals and society can benefit from utilising the implantation technology available (Gasson, 2008). These technologies will have the ability to transform humanity, enabling enhancements beyond previously imagined (McGee & Maguire, 2007). Bioelectronic implants can transform the human, bestowing benefits beyond the biological (McGee, 2008). In March of 1998, a "locked in" victim of a brain-stem stroke became the first recipient of a brain to computer interface system, allowing the patient to communicate on a computer through thought alone (Headlam, 2000). The capabilities of this technology are profound and will continue to advance (Kass, 2003). Allowing the ability to cyber think, via memory enhancement and increasing the dynamic range of senses, providing invisible communication with others (Ach & Wiedemann, 2008).

Throughout literature implantation devices are divided into two main categories, therapy and enhancement (Gladden, 2016; McGee, 2008). The contrast is commonly made between implants that are therapeutic in their intent, thus utilised to treat a disease or disability. This category is also commonly referred to as medical. Alternatively, implants designed for enhancement increase the normal human species functioning or can bestow entirely new capacities upon humanity and are deemed to be non-health related improvements (Parens, 1998). Both categories have gathered interest recently, including high and low technology implantation. However, it is the high technology implants in the medical domain which continue to grow, through increasing restorative devices (Gasson, 2008). These implanted devices have been largely accepted by the current population. Thus, usage has continually grown, highlighting an accepting attitude towards electronic implantation when it is required for health or as a last resort rather than a personal choice (Werber *et al*, 2018).

Nonetheless the enhancement implantation devices seem to be gaining very little attraction especially the low technology devices which could bring mass benefits if exploited (McGee, 2008). Low technology implantation devices require a relatively low monetary investment for consumers, in comparison to current everyday technology such as mobile phones which most individuals own. Radio frequency implantation devices (RFID) are the most common form of low technology information and communications technology (ICT) implants. Already incorporated in passports worldwide and inserted into livestock animals (Want, 2006; Ahson & Ilyas, 2008), but enhancement implantation remains a controversial topic. Focusing our research specifically on chip implantation technology for enhancement purposes as a result of its availability, ample current usage in various products and extensive data currently accessible. Previous literature has given reasoning for these technologies failure to be adopted on a commercial scale including ethical, religion, privacy, health, security and ownership concerns in general (Klas, 2003; Hansson, 2004; McGee, 2008). One study reviewing RFID for medical purposes identified GPS tracking as the main concern why these technologies have not been utilised widely by the general population (Weber & Žnidaršič, 2015). The extensive potential benefits which could be accessed through this unchartered available technology, we discovered no research has reviewed individuals' attitudes towards why they have not embraced chip implants for enhancement purposes. A technology which would bestow new biological enhancements amongst humanity plus produce greater efficiency amongst their day to day capabilities.

The aim of the thesis is to evaluate Estonian attitudes towards implantation of RFID chips for enhancement purposes and understand what variety of aspects form negative and/or positive attitudes. We want to understand the factors that might influence the adoption of chip implantation devices for enhancement purposes. Understanding individuals' attitudes towards RFID devices would allow organisations and societies to overcome the current barriers which are preventing the technology from being utilised to enhance humanity. We have chosen to focus on the Estonian population due to its tech-ecosystem which is rapidly evolving and becoming a world leader in technological advancements. Estonia has placed the same weighting on an electronic signature as a written signature (Horowitz, 2006). Estonia have already integrated most of identification services onto its ID card. An Estonian ID card is equipped with RFID chip technology. Therefore, it can be utilised as a driving license and identification for corporate loyalty programs. Since 2019, new Estonian ID cards are equipped with Near Field Communication (NFC) technology permitting it to be used as electronic ticket for public transportation (e-Estonia, 2019). NFC is a RFID based technology that enables short range wireless information exchange. (Lahtela *et al*., 2008).

Firstly, conducting a literature review to formulate an understanding of the key factors preventing individuals from adopting chip implementation technology for enhancement purposes. Followed by a methodology section explaining how we will obtain our data and the analysis techniques we have chosen to use on the data obtained. We will then present our data and the results from the analysis undertaken. Finally, discussing our results before concluding our paper.

Literature Review

Implantable RFID devices

Implantable identification devices are designed based on radio frequency identification (RFID) technology. RFID is a wireless communication technology which facilitates identification of objects tagged from a distance (Foster & Jaeger, 2008). RFID utilises electromagnetic fields to automatically identify and track tags attached to objects, animals or people. The tags contain electronically stored information (Ahson & Ilyas, 2008). A development from earlier technology such as bar codes, the tags are not required to be within the line of sight of the reader. A common RFID system encompasses tags, readers, application software, computing hardware, and middleware (Liao et al., 2011). They are two divisions of RFID tags, passive and active. Active RFID tags require a source of power, thusly adopt an integrated battery or are connected to a powered infrastructure. In contrast passive RFID tags absorb energy from a neighbouring RFID reader's interrogating radio-wave (Want, 2006).

The first ancestor of the modern RFID device was a passive radio transponder with memory designed by Mario Cardullo patented in 1973 (Chen, 2015). Since there first introduction, RFID microchips have been used for variety of purposes, due to a field where new concepts, techniques and technologies are constantly being introduced (Liao *et al*., 2011). Since its first introduction RFID resources have been employed in a vast variety of applications, including labelling airport luggage, to time marathon runners, prevent theft of goods, locating lost items and to identify animals (Want, 2006). The organisation Applied Digital Solutions have widely used implantable RFID devices to identify lost livestock and domesticated pet animals becoming a common occurrence during the 1990's (Weber & Žnidaršič, 2015). Tens of millions of animals have been implanted with RFID technology. Revolutionising the animal market, Japan has even adopted legislation requiring dogs and cats brought through the country to be identified with a RFID microchip (Foster & Jaeger, 2008).

Examples of its usage

The premier experiment on humans was conducted in 1998 by a British scientist, Kevin Warwick. Inserting a RFID chip implant in order to authenticate himself when entering buildings, interacting with electrical systems such as turning on and off lights (Warwick, 2019). In 2004 the United States department of Food and Drug Administration (FDA) approved the first implant with RFID technology intended specially for human implantation on an epidermal layer. Creating the first regulation regarding human chip implantation devices, permitting its use for healthcare and medical purposes. Manufactured by a company called Verichip, the microchip is a glass encapsulated RFID chip which is the size of grain of rice; typically 11mm long and 1mm in diameter and it is injected into human body mostly on hands between thumb finger and forefinger area using a local anaesthetic (US FDA, 2004). The user now has been allocated an individual 16-digits identification code which can be used with an appropriate scanning equipment to identify and to gain an insight into patient's recorded medical data such as known allergies, blood type, previous treatments, organ donation. The advantage of this system lies in the case of patient critical health situations when they are unable to provide the necessary information. Moreover, making the hospital 'check in' process vastly more efficient (Swartz, 2005). Mexican law enforcement officials were implanted with RFID chip technology in order to increase safe access to the premises to confidential documents with reference to drug cartels. Costing \$150 per person, the Attorney General and 160 officials received the technology (Information week, 2004). In addition to more example cases of its usage, general willingness to adopt an RFID implant is slowly rising (Perakslis *et al*., 2014). More than 4,000 Swedish citizens have now embraced the technology for enhancement purposes, with the main benefit being authentication (Npr.org, 2018). Presenting its embrace albeit slowly, most these individuals are working within Sweden's tech community.

RFID technology adoption has been led by the various benefits it can present from a commercial point of view in a world where companies are seeking to obtain a competitive advantage through technological advancements. Supply chain management is a key aspect of most retail business, utilising RFID systems can help in managing the updates of stocks, and during the transportation and logistics of the product (IBM, 2004). RFID chip technology can increase efficiency, through reduced monitoring, which increases the availability of human resources within the organisation. The freed up human resources available to focus on alternative aspects of the organisation, enabling greater efficiency. The automatic nature of the technology provides a reduction in the amount of error as no human intervention is needed to read data. Furthermore, generating greater efficiency within the organisation processes and allowing better decision making as the data obtained is of a superlative accuracy (Fan *et al*., 2014).

Benefits

Individual benefits are vast, allowing the enhancement of humanity to a person through this constantly developing technology. Presenting individuals with an increased security, as the technology can prevent kidnapping and human trafficking. With everyone having a unique ID number which could be tracked should a person go missing (Michael & Masters, 2004). Unfortunately, about 28,000 babies get mixed up in hospitals every year, ultimately leaving with the wrong parents. Also, bodies occasionally get mixed up at funeral homes as well. Chip implantation at birth would completely negates less-capable individuals' inability to identify themselves (Gaille, 2017). Utilisation as a method of identification can transform everyday life to become paperless, streamlining many aspects of an individual's life, converting mundane tasks to no more than an efficient chip scan. Generating more free time for an individual, the one commodity we all strive to obtain more of. Companies like Vivokey have created RFID chip implants which can be used by individuals to validate financial transactions or payments using combination of biological and cryptographic technologies (Michael, 2016). Also providing health metadata through a simple scan, informing doctors of allergies, prescriptions and a wealth of other information that can be taken into account when you need medical attention. Possibilities of the seamless technology can spread to unlocking houses, garages and many more objects. Removing the idea of having keys and increasing security as these items can't be stolen. Consumers behavior towards technological implants were influenced by their perceived usefulness and ease of use. Reiterating benefits as a factor prompting individuals' willingness to receive an implant for enhancement purposes (Pelegrín-Borondo *et al*., 2016).

Although, the benefits, efficiency and potential brought by the technology is colossal, failure to be widely accepted by individuals seeking to gain from the implantation available for personal enhancement remains unknown. Especially in comparison to alternative technology in the 21st century, such as mobile phones and wearable technology, entailing a weightier financial burden for the individual. Much has been discussed over why chip implants for enhancement have not been adopted by individuals.

Ethical concerns

Hanson demonstrates new implants brings new ethical concerns. Changes won't just be implemented on individuals but on social groups and society as a whole (Hansson, 2004). Religious societies could prevent the usage of RFID chip implants. Christianity, Judaism and Islam prohibits tattoos or piercings, therefore religious preachers may prohibit followers to use chip implants. Further raising the concern of modifying god's creation, deemed inappropriate from a religious aspect (Berry, 2000). Generating a variation of religion, the potential introduction RFID and cyborgs has brought across scope for a new religion, the transhumanist movement, a belief in technological evolution surpassing biological evolution (Mercer & Tracey, 2015).

Should the technology be adopted by organisations and become a requirement for employees, ethics will begin to be jeopardised. Although, laws currently prevent forcing people to get chip implanted as it is seen as a violation of Article 3 of Universal Declaration of Human Rights which guarantees everybody right to life, liberty and security of person (United Nations, 2009).

The implantation technology acceptance and development may lead to a 'techno-species', where the brain can be in one place and your body wherever you want (McGee & Maguire, 2007). RFID could be seen as a gateway to the creation of this new species, as once accepted individuals will begin to push the boundaries with the implantable device capabilities. Many, including Fukuyama, fear tampering with human nature as we know it. He asserts that human nature, which provides continuity to our species and defines our values and politics, should not be altered (Fukuyama 2002). Creating a potential cyborg species has been deemed as adjusting the dignity of the naturally human way of activity and biology (Klas, 2003).

Fairness concerns

Implanting chip technology for individual enhancement purposes could result in a fairness concern erupting upon embracing the technology, regarding the access to the chipping technology and it costs. Those deemed more economically wealthy will have another way to ensure their economic dominance when they become cyborgs. Similar cases are currently visible in society with the availability of expensive prosthetic limbs only being available to those who have an economical advantage (Ip *et al.*, 2008). Fairness concern is again raised as consumer's behaviour is deemed to have an effect on the availability of life enhancing products. Consumer's do not have equal access to life enhancing products, their access depends on a combination of medical and non-medical factors (Marinova *et al.*, 2017).

Health concerns

Health concerns arise during the discussion of RFID although medical safety is paramount with no previous mass study on human ICT devices it remains a worry. Risks include bleeding, infections, and reactions to anaesthesia from a short-term view and immune reactions to foreign substances from a long-term view (McGee, 2008). Furthermore, psychological questions have been raised as the world between reality and virtual will potentially blur if chip implants commence the beginning of cyborgs and cyber thinking. Especially with mental health issues currently on the rise, innovations could obscure the boundaries between a patient sense of identity and the computerised implantable devices virtual reality in unprecedented ways (Gilbert *et al*., 2019).

Individual expectation

Potentially the social barricade preventing mass usage may be due to an individual's expectation of a monetary gain. Graafstra sets up an "implantation station" offering attendees the chance to be chipped at $50 a time. Using a large needle designed for microchipping pets, Graafstra injected a glass-coated RFID tag the size of a rice grain into each volunteer. By the end of the day Graafstra had created 15 new cyborgs (Graafstra, 2012). Alternatively, Estonian company Tele2 CEO, Chris Robbins, attempted to break the social barricade by volunteering first at the organisation to be fitted with an NFC chip in order to highlight there is nothing to be afraid of (Clark, 2018).

Privacy and security

Most studies stipulate the biggest safety concern is not medical but technological. The era of big data, "*data sets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyse*" (Manyika *et al*., 2011). Now encompassing us, has revolutionised the way we make decisions in today's society (Janssen & Kuk, 2016). Advancements across information and technologies have enabled the data era to commence, enabling organisations to understand consumers behaviours and preferences if properly collected, stored and processed (Chen *et al*., 2018). The use of data now proves vital in organisations gaining a competitive advantage through specialisation; trust, security and privacy which made up consumer loyalty, causing a new privacy concerns regarding personal data and how it is shared (Flavián & Guinalíu, 2006). Consumers' willingness to provide personal information is reliant on their privacy protection and trust placed on the organisations. Organisations now face great security due the unknown power capabilities of these technological advancements to utilise the consumers data (Wu *et al*., 2012). Trust is further put under scrutiny as privacy policies are generally lengthy and difficult to read, with the average consumer often struggles to understand (Story *et al*., 2019). Individuals will not be able to disconnect from this technology due to its implementation causing privacy to still remain a major concern amongst literature for the introduction of chip implementation (Patel, 2018; Perakslis et al, 2014; McGee, 2008). Patel states; "*since the birth of this technology, controversy for this technology whether its safety design, tracking capabilities, and privacy of consumers has become a concern for many potential consumers*" (Patel, 2014). Security of collected data was deemed one of three existential issues regarding the interaction of technology for identification; including computer chip wrist implants by individuals in the USA (Trocchia & Ainscough, 2006). Privacy remains a continual theme although if this is what has prevented the technologies wide usage remains unknown.

Legislation

These data scandals have led to a massive change amongst legislation within the EU. The General Data Protection Regulation (GDPR) was introduced in 2018 as a European Union (EU) law on data protection and privacy for all individual citizens of the EU and European Economic Area (EEA). It aimed primarily to hand control to individuals over their personal data and to simplify the regulatory environment for organisations through unifying the regulation across the EU (European Commission, 2019). Gasson et al, discuss the lack of legal status surrounding the usage of human ICT implants. They state EU law holds a general structure for electronic privacy, however they become irrelevant as neither of them defines human ICT implants. Leaving a wide scope to understand and perceive laws based upon the current wording. Werber & Žnidaršič further highlighted the variety of concerns regarding the use of RFID implantable microchips for commercial use evaluating they would be accepted if GPS tracking had a guaranteed disablement (Werber & Žnidaršič, 2015). Although their study was concluded on a medical basis not for enhancement purposes, it serves a good insight into the reluctant acceptance of such technology. We agree with the caution reflected in a recent report of the Council on Ethical and Judicial Affairs of the American Medical Association on the technology: "*Radio frequency identification (RFID) devices may help to identify patients, thereby improving the safety and efficiency of patient care, and may be used to enable secure access to patient clinical information. However, their efficacy and security have not been established"* (Sade, 2007). Raising the concern of autonomy, the scaremongering of science fiction films portrays of these new technologies resulting in a belief of being controlled or manipulated by an external person (McGee, 2008).

Attitude

Seeking to understand the attitudes of an individual towards chip implants for enhancement purposes. There are multiple techniques and methods which can be employed to a research problem, choosing the specific methods is dependent on the researchers, and their perceptions for the study (Kothari, 2004). Attitude has been defined as *"a mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which is related"* (Gardner, 1985). In general, much literature agrees evaluation is a key feature to understanding an attitude (Eagly & Chaiken, 2007; Fazio, 2007; Schwarz, 2007). Eagly and Chaiken (1993) definition remains one of the most cited definitions; "*attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour*".

Understanding attitudes requires a variety of multiple measures that can gather information on a respondent's feelings, actions and potential actions towards an object through utilisation of quantitative or qualitative analysis tools. It is apparent that both qualitative and quantitative methods involve differing strengths and weaknesses (Amaratunga *et al*., 2002). Quantitative researchers aim to establish general laws of behaviour across different settings and contexts. Research can be used to test a theory, thus supporting or rejecting it (McLeod, 2019). The basic assumption behind attitude scales is that it is possible to uncover a person's internal state of beliefs, motivation, or perceptions by asking them to respond to a series of statements (Fraenkel & Wallen, 1996).

Likert scales develop several statements are collected relating to the issue chosen to analyse. These statements are then rated into a set number of categories, normally a five-point scale: from disagree through to agree. The total score for each individual subject is calculated by summing up each individual response. Thereafter, inter-correlating the scores of each item, with the total scores on all the items by the item analysis techniques. Providing information regarding attitude of the subject (Likert, 1931). Such with all surveys, the validity of the Likert scale attitude measurement can be compromised due to social desirability (Paulhus, 1984).

Methodology

Attitude is a sure set of observable behaviour preliminary to and indicative of the subsequent actual behaviour. Attitude questionnaires and rating scales are instruments that present information to a respondent in writing and then require a written response. Attitude rating scales are developed according to strict procedures that ensure that individual responses can be summed to yield a single score, which can in turn be analysed to measure the attitude of the respondent. We selected to measure attitudes through utilising a questionnaire, because they permit anonymity, allow the responder time to answer, multiple individuals can be provided the questionnaire simultaneously and include relatively easy data interpretation for participants to comprehend. Furthermore, employing a Likert scale enables us to gather information on a respondent's feelings through a variety of questions using scaled measurements obtaining the individuals attitude towards a diversity of variables (Amaratunga *et al*., 2002). Upon our decision being made many sources were used to develop the Likert scale including reviewing previous literature from google scholar, analysing scientific articles as a point of reference for developing the questionnaire and examining Likert's original paper written in 1931, *"a technique for the measurement of attitudes,"* to grasp a true understanding of the measurement technique selected. Limitations of implementing a Likert scale do exist, it's deemed to be unidimensional as it only allows the participants to a limited number of response options and the wording of the descriptive categories can affect responses (Hasson & Arnetz, 2005). Although generally, a Likert scale is deemed to be reliable, valid and responsive. Thus, its continuity of usage from its development in the original paper to its continual presence within the world of academia to measure attitudes of individuals. Validating our decision to proceed with its usage.

For our dataset sample we chose to review the Estonian population. In addition, *"Estonia has a thriving IT start-up culture and has digitally streamlined an unprecedented number of public services for citizens and businesses"* (visitestonia.com, 2017). Leading us to believe the population would be more knowledgeable, interested and welcoming regarding advancements in technology. Furthermore, Estonian identification cards contain RFID chips, hopefully increasing their understanding of the technology and the study we are undertaking. Application of the chip implant technology requires a country where strong technological infrastructure is already in place, which is currently present in Estonia. Although, it remains to be adopted and accepted as it has in Sweden, its neighbouring Baltic country. Understanding the factors why it has not been accepted in Estonia, allowing these factors to be addressed to commence adoption of the technology. With Estonia being pioneers in technological advancements, once accepted on societal level with the country, could lead to other countries adopting the technology. Providing a reference point and data for other countries considering chip implantation enhancement technology.

We implemented self-selection sampling for our study. Application of this technique reduced the amount of time necessary to search for appropriate subjects, establishing all participants met the selection criteria needed for the sample. Moreover, subjects undertaking the survey in the study are deemed to be a committed participant, through volunteering their own time to complete the survey. Providing greater insight into the phenomenon being surveyed and increasing the chances of open-ended questions being completed. Although there is likely to be an element of self-selection bias, possibly deriving a non-representative population being sampled. Our sample size was targeted to contain a minimum of 300 respondents.

We proceeded to design an initial questionnaire, deciding on a six-point measurement Likert scale ranging from “strongly disagree" through to “strongly agree”. We made questions non-mandatory to answer to prevent participants being forced to generate an opinion, which may not be representative of the individual’s true feelings. Followed by open ended questions to highlight any further attitude regarding factors surrounding the subject of our study, which we had not considered. Participants had to meet a certain criterion in order to proceed. Respondents must be over eighteen years of age and either a temporary, permanent or citizen of Estonia. Allowing the ability to analyse if attitudes different based on age, gender or residential status. Prior to undertaking the Likert scale survey each respondent was provided a short brief how to undertake the questionnaire, a background regarding the topic and contact details should any further questions arise. A pilot study was then presented to ten colleagues and friends to review for any errors and to determine if it was understandable to individuals once we had concluded the questions. After we obtained feedback from a field expert, our thesis supervisor, enabling us to construct validity through her vast knowledge. The process we undertook is outlined in table 1. We pursued to obtain validity through a multiple reviewing and changing process of the survey to ensure all questions were relevant to the research.

Stage	Description	Process	Result
Stage 1	Analysis of the literature on RFID chip technology.	Reviewed all variables which prevented individuals from obtaining RFID chip within literature review.	Generated survey questions based upon the most common variables.
Stage 2	Pilot study reviewed and tested.	10 colleagues and university course members tried the survey and provided feedback.	Reviewed comments and suggestions to create new survey.
Stage 3	Survey re-analysed and tested.	Resent to previous people who tested survey for further feedback.	Made minor changes based upon feedback and reviewing.
Stage 4	Survey submitted to expert for comments.	Sent copy of survey to thesis tutor to review and provide feedback.	Reviewed feedback provided to make adequate changes suggested.
Stage 5	Survey re-submitted for supervisor to review.	Again, sent copy via email to tutor to review.	Minor considerations to be made before completing final survey.
Stage 6	Revised survey based on expert feedback.	Reviewed feedback received and discuss how to proceed.	Finished survey was generated.

Table 1: Description of the stages of developing Likert survey

The literature brought out the key variables we were seeking to analyse; legislation, religion, benefits, fairness, ethical concerns, health, privacy and security as the key variables for chip implantation not becoming a wide used technology amongst individuals. Resulting in development of 16 statements as seen in appendix 1 for our survey based on these variables, providing literature sources as seen in the following table 2.

Variable Considered	Liker Scale Statement	Supporting Sources
Religion	• My religion prevents me from implanting chips for enhancement purposes. • It depends upon one's beliefs towards having a foreign object in a body.	Berry, 2000 Mercer & Tracey, 2015
Benefits	• I would get a chip implant for enhancement purposes. • Chip implantation will provide new benefits to significantly enhance people's lives	Michael & Masters, 2004 Michael, 2016
Fairness	• Any data produced from a chip implant should be legally owned by the chipped individual. • A universal regulation is required to safeguard data generated from chip implants.	Ip et al., 2008
Ethical Concerns	• Inserting chip implants into humans is unethical	Hansson, 2004 Mercer & Tracey, 2015 United Nations, 2009 Klas, 2003
Health	• I would consider getting an implant for medical purposes. • Chip implants pose a threat to health. • Chip implantation is a painful procedure. • Chip implants cause health problems in the long term. • Chip implants should be clinically tested extensively before implantation becomes freely available.	McGee, 2008 Gilbert et al., 2019
Privacy and Security	• Chip implantation violates personal privacy. • Chip implants are less vulnerable to identity fraud compared to other identification methods • Chip implants is a secure technology for identification • Chip implants should not have GPS tracking.	Janssen & Kuk, 2016 Manyika et al., 2011 Chen et al., 2018 Patel, 2014 Uchida & Cook, 2005 Osborne and Parkinson, 2018 Story et al., 2019
Legislation	• Any data produced from chip implant should be legally owned by the chipped individual. • A universal regulation is required to safeguard data generated from chip implants.	EU, 2018 European Commission, 2019 McGee, 2008 Sade, 2007 Werber & Žnidaršič, 2015

Table 2: Classification of statements based on variables

Concluding in the final survey with two open ended questions; *"What would motivate you to have a chip implant"* and *"What prevents you from receiving a chip implant"*. Allowing individuals to bring into consideration additional variables which were not discovered through our literature review or reinforce an individual's opinion regarding a certain variable.

Confidentially was key to each respondent to obtain honest feedback regarding the research topic, whilst it believed to provide the best environment for individuals to have a willingness to participate (Hasson & Arnetz, 2005). Google Form was selected as our survey platform to collect responses. We successfully obtained the minimum 300 responses to ensure we had a reliable sample size.

A variety of different methods are implemented in the analysis of data in the results section. Initially, quantitative analysis is performed to understand relations between variables and the significance of those relationships, which helped us in the creation of our discussion model later. Apart from the Likert scale survey, we included two open ended questions to understand what factors prevented and motivated individuals to adopt chip implants for enhancement purposes. We will perform qualitative word cloud analysis based on the responses we received to both questions. Determining the frequency of answers and if any factors which have not been considered were brought to light. Our quantitative analysis started with factor analysis to create reliable factors by reducing variables. Factor analysis is performed with principle axis factoring and promax rotation to form factors. To find the relationship between two variables, correlation analysis is performed with significance level p is less than our equal to 0.5. To predict the values of one variable using another variable, linear regression analysis is implemented. A Glejser test was performed to ensure our model is free from heteroscedasticity. Absence of multicollinearity is found from collinearity diagnostics which is measured using variance inflation factor should not be greater than 10 (Hinton et al,2004). ANOVA analysis of variance is implemented in order to find differences in opinion between different study participants. A significance level p less than or equal to 0.5 is selected to consider reliable differences in the mean values. Finally, we presented our analysis on open ended questions using word clouds and collective theme behind the responses.

Data

We collected 305 valid units within our sample. Figures 1-4 shows some information on the composition of the 305 subjects which conclude our sample. We present the response frequencies for our four background questions.

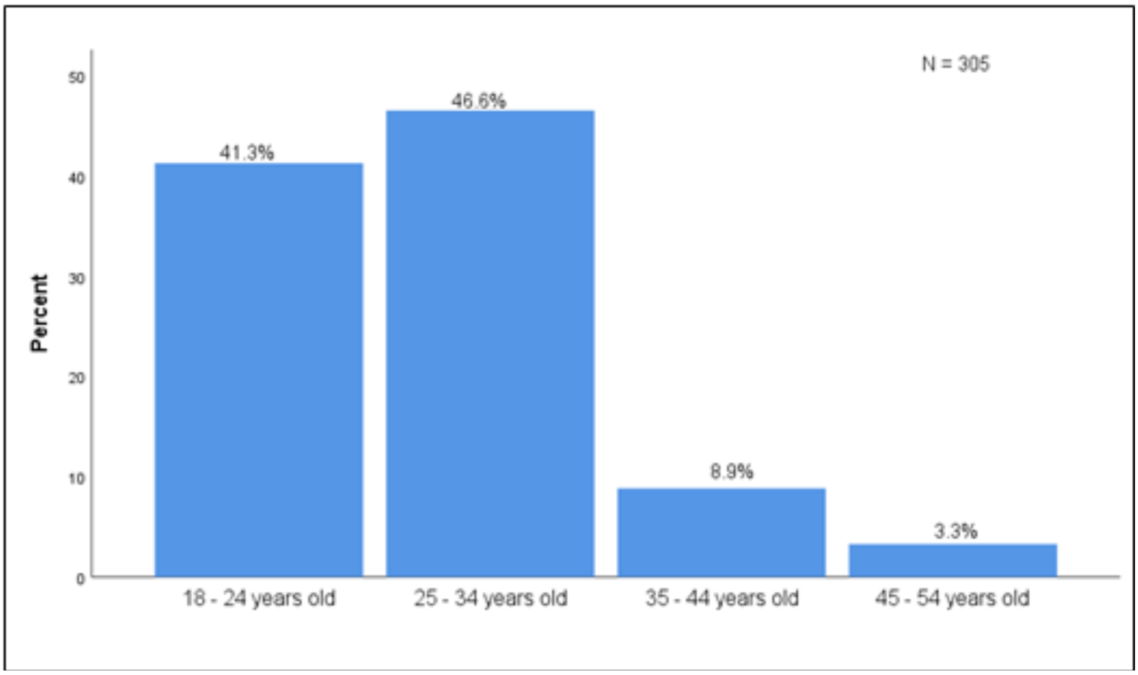

Figure 1: Frequency results for age of survey respondents

Each plot shows the marginal response category frequencies for a background question, calculated for 305 participants. The gender frequency displayed in figure 2, “male 43.6% and female 56.4%”, granted a very similar sample to the current Estonian population statistics, “male 47.3% and female 52.3%” (Statisticstimes.com, 2019).

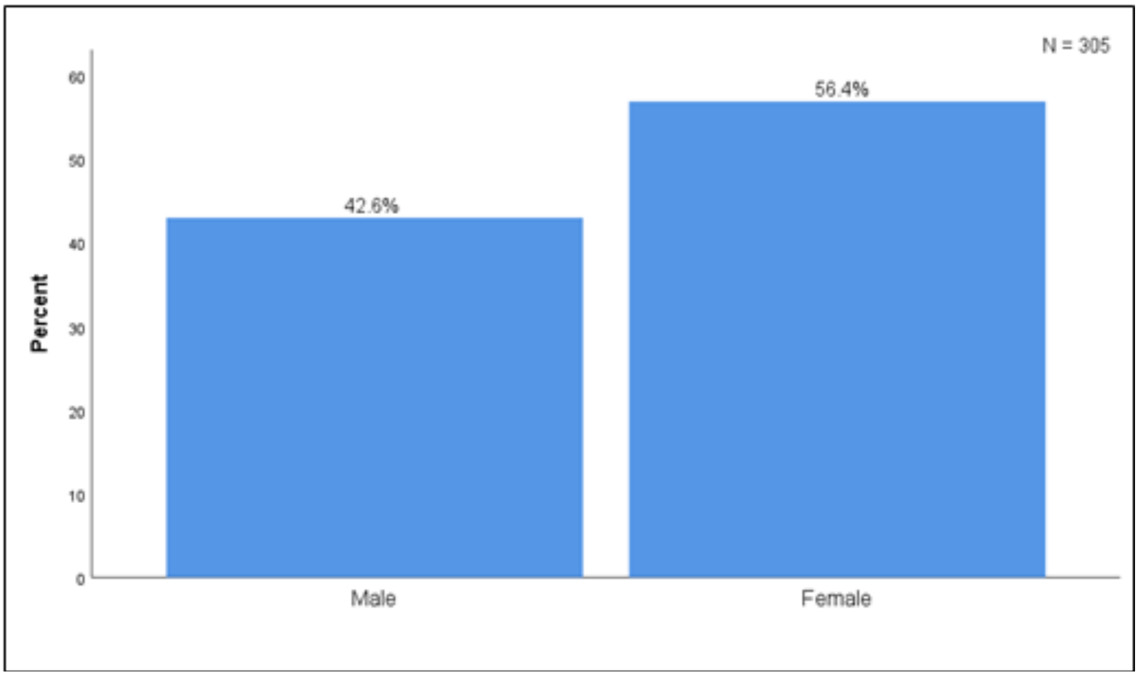

Figure 2: Frequency results for gender of Likert scale survey respondents

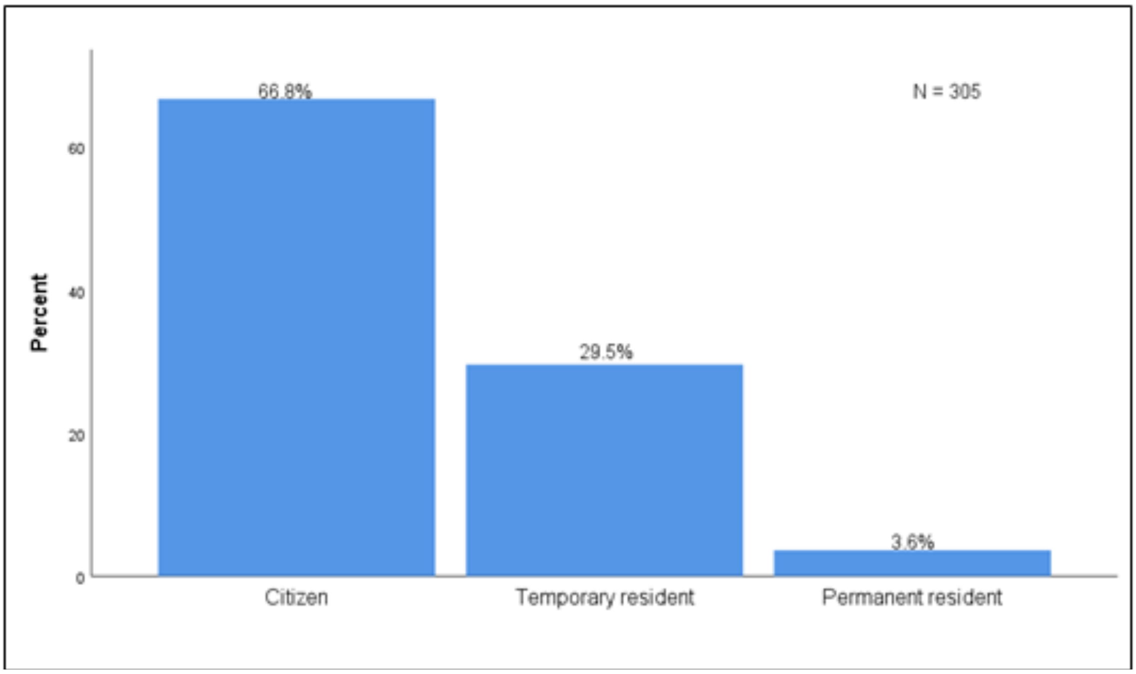

Figure 3: Frequency results for current status in Estonia of Likert scale survey respondents

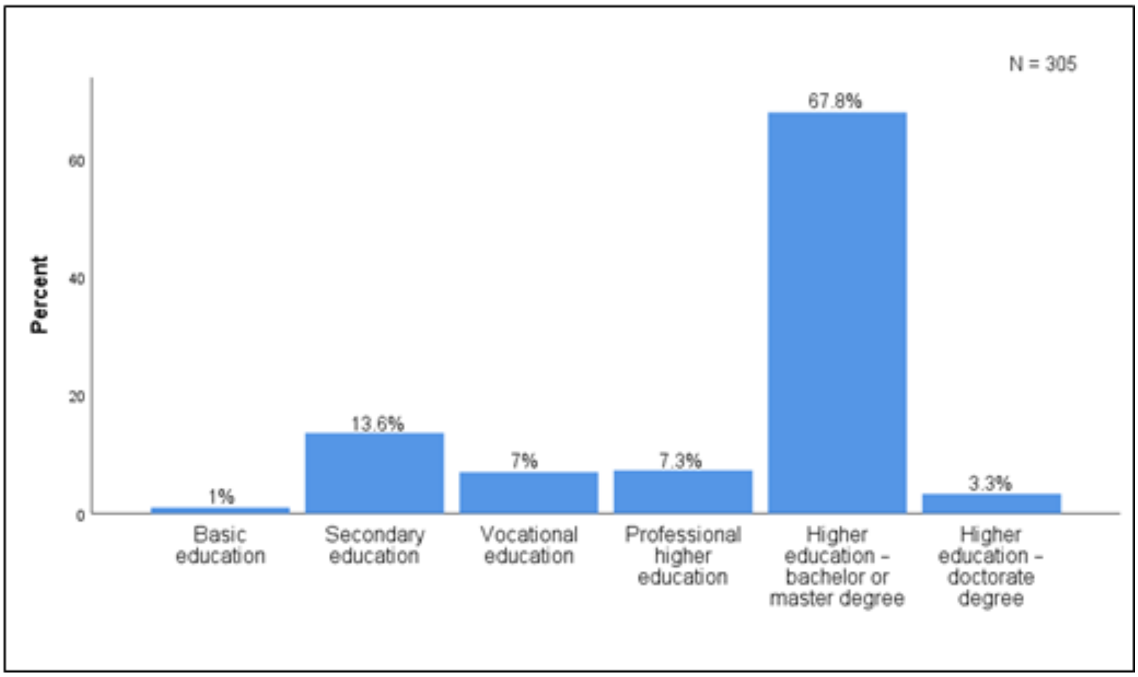

Figure 4: Frequency results for education level of Likert scale survey respondents

Offering a very accurate sample regarding gender, yet other background questions didn't provide such an accurate representative sample of the Estonian population. Although, the education and age frequency, displayed subsequently in figures 4 and 1, were the most unrepresentative sample in comparison to the current Estonian population statistics, 66.9% of respondents fell into the "*Higher education - bachelor or master's degree*" category and 87.9% of respondents were between the age of 18-34. Nevertheless, the sample obtained does hold a variety of backgrounds based upon the four participant composition questions proving to be a very valued sample.

Results

Frequency Analysis

Shown below in table 3 is the results of the frequency analysis carried out on the 16 Likert scale statements. The majority of the respondents agreed with statement "Chipped implants should be tested extensively before implantation becomes freely available" as mean value is 5.77 and as Standard Deviation (SD) values is 0.6, disagreement in respondent's opinion is very low. Most of the respondents agreed with statement "Any data produced from chip implant should be legally owned by the chipped individual" as mean value is 5.61 and as SD values is 0.7, difference in respondent's opinion is minute. Majority of the respondents agreed with statement "A universal regulation is required to safeguard data generated from chip implants" as mean value is 5.53 and as SD values is 0.8, difference in respondent's opinion is minute.

The frequency analysis highlights the three statement in which respondents mostly disagreed with. With a cumulative total of 95.7% on the disagreement side of the scale and 80.9% strongly disagreeing alone with the statement, "*my religion prevents me from implanting chips for enhancement purposes"*. Religion can be deemed to be the least concerning variable, further support as the standard deviation amongst answers was the second lowest at 0.859. "*Chip implantation is a painful procedure*", totalled 79.3% of the disagreement side of the scale. Thus, respondents didn't deem the pain associated with the procedure as a factor to prevent them obtaining an implant for enhancement purposes. Finally, initial analysis based on frequency supported individuals believed ethics was not a major concern when considering the topic of chip implantation. As 65.6% of respondents fell on some form of the disagreement side of the scale when answering the statement, "Inserting chip implants into human is unethical".

Statements	Mean	Std. Deviation	1	2	3	4	5	6
I would get an implant for medical purposes.	4.72	1.398	4.6%	5.6%	7.2%	14.4%	32.5%	35.7%
I would get a chip implant for enhancement purposes.	3.19	1.525	17.1%	19.5%	20.4%	22 %	12.8%	8.2%
Chip implantation violates personal privacy.	3.68	1.403	4.6%	16.1%	29.2%	21.6%	14.1%	14.4%
Inserting chip implants into human is unethical.	3.15	1.423	13.5%	19.8%	32.3%	14.5%	12.6%	7.3%
Chip implants are less vulnerable to identity fraud compared to other identification methods.	3.63	1.183	5 %	11.6%	25.7%	36.6%	15.8%	5.3%
Chip implants is a secure technology for identification.	3.69	1.238	4.6%	12.5%	25.1%	31.7%	19.5%	6.6%
Chip implantation will provide new benefits to significantly enhance people's lives.	3.80	1.212	3.6%	11.5%	22 %	34.5%	21.1%	7.3%
My religion prevents me from implanting chips for enhancement purposes.	1.35	0.859	80.9%	9.9%	4.9%	2.6%	1 %	0.7%
It depends upon one's beliefs towards having a foreign object in a body.	5.00	1.226	3 %	1.7%	6.6%	15.5%	27.7%	45.5%
Chip implants pose a threat to health.	3.07	1.145	7.9%	23 %	35.9%	23.6%	6.6%	3 %
Chip implantation is a painful procedure.	2.72	1.111	14.8%	26.7%	37.8%	29.2%	6.7%	4.3%
Chip implants cause health problems in the long term.	3.31	1.081	3.3%	18 %	38.5%	29.2%	6.7%	4.3%
Chip implants should not have GPS tracking.	4.95	1.241	2.3%	2.6%	8.2%	16.1%	26.2%	44.6%
Chip implants should be clinically tested extensively before implantation becomes freely available.	5.77	0.609	0.7%	0	0	3 %	13.9%	82.4%
Any data produced from chip implant should be legally owned by the chipped individual.	5.61	0.705	0.3%	0	1 %	6.6%	21.5%	70.6%
A universal regulation is required to safeguard data generated from chip implants.	5.53	0.828	0.3%	0	3.9%	6.6%	20.4%	68.8%

Table 3: Likert scale statement frequency results

Factor Analysis

We implemented factor analysis as it shows content of scale in the most representative way by reduction of number of items in a factor. Factor analysis consists of a collection of procedures for analysing the relations among a set of random variables measured for each individual of a group (Cameron & Quinn, 1999). For our extraction method we selected principle axis factoring as it was appropriate for relatively simple factor pattern and to find underlying dimensions behind the variables (De Winter &

Dodou, 2012). Amongst the oblique rotation's methods, promax rotation was chosen as it is suitable for correlated factors. To represent each subscale with sufficient value, loading of 0.3 was selected to suppress small coefficients with an absolute value below 0.3 following the advice of Field (2013: 692) displayed in table 4. Further explaining a loading of 0.4 value is considered substantial but not sensible, hence advising to adopt the value 0.3. In addition, we removed statements which loaded in more than one factor or are not present in any factor. Upon completion of factor analysis, four main factors health, identity, privacy and legislation were formed. Helping in finding the perception of individuals to get a RFID chip implant for enhancement purposes.

Statements	**Factors**			
	Health ($\alpha = 0.8$)	Identity ($\alpha = 0.7$)	Legislation ($\alpha = 0.7$)	Privacy ($\alpha = 0.6$)
Chip implants pose a threat to health	0.908			
Chip implantation is a painful procedure	0.700			
Chip implants cause health problems in the long term	0.741			
Chip implants are less vulnerable to identity fraud compared to other identification methods		0.811		
Chip implants is a secure technology for identification		0.701		
Chip implants should be clinically tested extensively before implantation becomes freely available			0.420	
Any data produced from chip implant should be legally owned by the chipped individual			0.741	
A universal regulation is required to safeguard our data generated from chip implants			0.672	
Chip implantation violates personal privacy				0.373
Inserting chip implants into human is unethical				0.969
My religion prevents me from implanting chips for enhancement purposes				0.451

Table 4: Items and loadings for factors

Correlation Analysis

Initial results of correlation analysis are that health and privacy have negative correlation with the dependent variable and only identity has a positive correlation with the dependent variable. The legislation factor has not been explained in the analysis as it had scored a low significance value. The identity factor had a moderate positive correlation of 43.2% at a significant level of 0.01 with the dependent variable. Exhibiting respondents who agree that chip implantation is a secured technology and less vulnerable identification method are likely to get chip implants for enhancement purpose.

Statements		I would get a chip implant for enhancement purposes	Legislation	Health	Identity	Privacy
I would get a chip implant for enhancement purposes	r	1				
	Sig.					
	n	304				
Legislation	r	-.026	1			
	Sig.	.650				
	n	304	305			
Health	r	-.372**	.133*	1		
	Sig.	.000	.020			
	n	303	304	304		
Identity	r	.432**	.059	-.223**	1	
	Sig.	.000	.309	.000		
	n	303	304	303	304	
Privacy	r	-.547**	.121*	.443**	-.323**	1
	Sig.	.000	.034	.000	.000	
	n	304	305	304	304	305

Note: r – Pearson Correlation Coefficient, Sig. – significance (2-tailed), n – sample size
**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 6: Correlations between statements and factors

The privacy factor had a moderate negative correlation of 54.7% at a significant level of 0.01 with the dependent variable. Demonstrating respondents who have higher agreement with getting chip implant for enhancement purposes are more likely to disagree that chip implantation undermine concerns regarding privacy. Health factor had a weak negative correlation of 37.2% with a significant level of 0.01 with the dependent variable. Expressing respondents who agree with getting chip implant for enhancement purposes are less concerned about health issues.

Linear Regression Analysis

In order to identify the predictors of factors that can influence adoption of chip implants for enhancement purpose, a linear regression analysis was performed. A model was compiled where factors; legislation, health, identity and privacy were chosen as independent variables. The significance value of the F statistic (F = 48.826) is 0.000 explains that variation of the model is statistically significant. The Durbin-Watson test indicates non-autocorrelation of the residuals as value (Durbin-Watson=1.781) is close to 2. As intercorrelation between the independent variables is small (1.03 <VIF<1.34) indicates that there is no multicollinearity. Results from Glejser test indicates that regression model is free from heteroscedasticity as no variable has significant effect on the residual value.

Variables	Coefficient	Standard error	t	p	Confidence interval lower	Confidence interval higher
Constant	3.902	0.742	5.258	0.000	2.441	5.363
Legislation	0.062	0.122	0.504	0.614	-0.179	0.303
Health	-0.208	0.082	-2.550	0.011	-0.369	-0.048
Identity	0.378	0.068	5.553	0.000	0.244	0.512
Privacy	-0.666	0.083	-8.005	0.000	-0.829	-0.502

Table 5: Variables in the model

Thus, our model remains with the following factors: health, identity and privacy. The linear regression analysis's results explain:

- Willingness to get a chip implantation for enhancement purposes will increase by 0.06 points when the respondent's estimations of the legislation factor increases by one point in the scale.
- Willingness to get a chip implantation for enhancement purposes will decrease by 0.2 points when the respondent's estimations of the health factor increases by one point in the scale.

- Willingness to get a chip implantation for enhancement purposes will increase by 0.4 points when the respondent's estimations of the identity factor increases by one point in the scale.
- Willingness to get a chip implantation for enhancement purposes will decrease by 0.7 points when the respondent's estimations of the privacy factor increases by one point in the scale.

ANOVA Analysis

One-way ANOVA test was implemented in order to determine whether there is a relevant difference in the mean values between different groups of respondents (residential status, gender, education level and age) for the statement "I would get a chip implant for enhancement purposes", and all the four factors which were generated from the factor analysis. As per results seen in appendix 4, statistically significant differences between groups were found, the health factor concerning the residential status and for identity plus privacy factors regarding gender. The results revealed the following difference that survey respondents who are citizens (m=2.9) considerably agreed less in comparison to temporary resident permit holders (m=3.1) about the opinion of chip implants pose a threat to health, can cause health problems in long term and it is a painful procedure. Gender revealed a statistically significant difference when reviewing the results of ANOVA analysis in relation to the identity and privacy factors. Male survey respondents (m=3.8) strongly agreed in comparison to female respondents (m=3.5) on chip implants being less vulnerable to identity fraud and a more secure technology for identification. Male participants (m=2.5) also considerably disagreed with chip implantation being an unethical procedure in comparison to female participants (m=2.7).

Factor Groups	Citizen		Temporary resident		Permanent resident		Results of ANOVA
	m	SD	m	SD	m	SD	
Legislation	5.6	0.6	5.7	0.4	5.6	0.4	F = 0.760, p = 0.469
Health	2.9	0.9	3.2	0.9	3.1	0.6	F = 4.112, p = 0.017
Identity	3.6	1.1	3.7	0.9	3.6	0.9	F = 0.276, p = 0.759
Privacy	2.7	1	2.7	0.7	2.7	0.6	F = 0.018, p = 0.982

Table 7: Descriptive statistics for current residential status

Factor Groups	Male		Female		Results of ANOVA
	m	SD	m	SD	
Legislation	5.6	0.4	5.6	0.6	F = 0.641, p = 0.424
Health	2.9	0.9	3.1	0.9	F = 3.162, p = 0.076
Identity	3.8	1.1	3.5	1.0	F = 7.575, p = 0.006
Privacy	2.5	0.8	2.9	0.9	F = 15.428, p = 0.00

Table 8: Descriptive statistics for gender

Open Question Analysis

Following completion of our Likert survey we asked participants two open ended questions, we analysed comments by categorising them into factors and then proceeding to generate word clouds based on the responses received. It is clear the biggest motivation for receiving a chip implant concerning health purposes which coincides with the current situation regarding chip implantation devices where health implants are widely accepted. Furthermore, nothing was a common response showing individuals remain sceptic towards receiving an implant for enhancement purposes. Followed by strong regulation requirements to safeguard data which falls under legislation factor group. The main themes concerning prevention of obtaining a chip for enhancement purposes, respondents highlighted privacy violation, data misuse and health concerns mainly long term. Respondents are mostly worried about violation of privacy and to be possibly tracked by governments or big brother organisations. Both word clouds seen in figures 4 & 5 have captured the similar theme of our analysis. Hence, support our previous data analysis of the Likert survey that individuals' largest concerns surround the privacy and health factors. We received 154 written responses to the open-ended question, "*What prevents you from receiving a chip implant?'* In compliance with the word clouds generated we obtained 74 responses which mentioned privacy and security and a further 10 concerning the privacy aspect. Totalling to 55% of respondents mentioning aspects concerning the privacy factor derived from the factor analysis. "*Also, the question of the data regulations and privacy question*", a vast majority questioned their privacy consequent to receiving a chip implant for enhancement purposes. "*It might seem that it is a strong privacy violation*", "*seems like a violation of my privacy*", and simply "*privacy reasons*" was stated 3 times.

Figure 5: 'What would motivate you to have a chip implant?' Word cloud.

Figure 6: 'What prevents you from receiving a chip implant?' Word cloud.

The cost factor was an interesting variable brought to light which affects an individual's willingness to receive a chip implant for enhancement purposes. With eight people representing just over 5% of respondents, mentioning the factor in various ways;

"*finances*", "*lack of availability and money*" and "*it would cost a lot of money, there is no practical incentive to get them*". One individual divulged upon the fairness variable, "*I think it would also probably make our current injustices far worse (in democratic as well as autocratic states) just as many other technologies have done might benefit vast parts of more privileged people (dominant ethic group, upper and middle-class) whilst making the lives of the disenfranchised even worse.*" Raising a great topic for discussion regarding how the technology should be available to individuals especially if the enhancements are beneficially life changing. Regarding the opposing open-ended question, *"what would motivate you to have a chip implant?"* We received 152 responses from our sample, with the majority mentioning health as exhibited in the respective word cloud. 45% of respondents mentioned this factor with supporting statements, "*if it could monitor my health and if it was able to call help in case of an emergency*", "*if it had a significant improvement on my everyday life (especially in medical purposes)*" and "*if the chip provides you with health data like vitamin deficits or real time data about a person's health condition*". All mentioned health enhancements increasing their willingness to receive a chip implant. Although, the majority did mention it was "*due to a medical requirement*". Interestingly, 27 respondents, representing 18%, stated there was no means of motivating them. In comparison to the 3% of individuals who were very clear they required financial rewards.

Discussion

The study results analysis has contributed that for an individual to be willing to adopt a chip implant for enhancement purposes are directly influenced by the following concerns health, identity, privacy and legislation. Especially, steps to safeguard identity and legislation support to data protection need to be increased. Contrastingly, privacy and health concerns must also be decreased for willingness to get a chip implant for enhancement purposes to increase. The increased legislation requirement could be due to the current lack of standard national and international rules regarding chip implantation for humans. General Data Protection Regulation (GDPR) policy might provide a relief regarding of safeguarding individual integrity to Europeans. Although, there is no knowledge if GDPR rules would apply to chip implant devices for enhancement purposes and the raised concern by European participants in our study further explains the reasoning for increased legislation and identity safety prior to individuals becoming willing to embrace the technology.

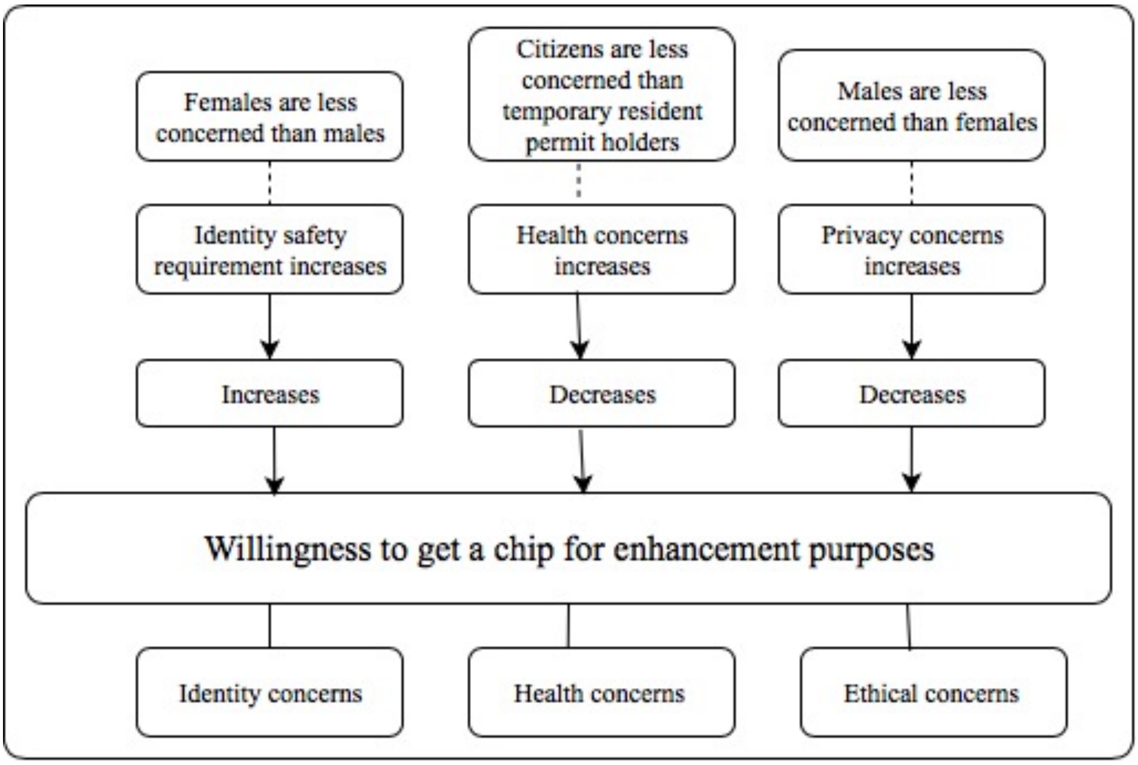

Figure 7: Model of willingness to receive chip implant for enhancement purposes

Estonian citizens are less concerned about the health concerns surrounding the adoption of chip implant for enhancement purposes than temporary resident permit holders. Estonian citizens enjoy the benefits of Estonia's solidary health insurance system which states that all medically insured people are entitled to same quality health care regardless of whether they pay the health insurance tax system (Estonian Health Insurance Fund, 2020). Considering that most of the temporary resident permit holders excluding those who are employed, and EU citizens must purchase private insurance coverage or pay for medical care. Thus, they are likely to have greater concerns surrounding the health aspect due to means based finances having previously played a role in their assigned healthcare treatment. Furthermore, the country's development as technological leader, through introduction of an "*e-government*", we can assume explains their understanding of modern technology and lack of fear when it comes to the health factor.

Revealing new information relating to identity concerns, females' respondents have less identity concerns when compared to males. Highlighting an interesting finding as a study in 2005 found out that women are more likely to be victims of identity theft than men (Anderson, 2005). Inferring women are more likely to trust chip implants as a safe means of technology. A contradictory situation is exposed with privacy concerns, male participants have less concerns than the female counterparts.

Respondents agreed in a majority with legislative concerns. Thus, stronger legislative procedures need to be developed to safeguard their data, create strict laws to avoid misuse of data and ensuring chip implants don't create additional health problems. Differing from legislative concerns, the respondent's majority disagreed enhancement chip implantation will bring ethical concerns and the implant procedure causes pain.

The religion variable we considered due to previous studies raising the concern of messing with god's creation from a religious aspect and banned in certain religions (Berry, 2000). We discovered individuals least concerns surround the religious aspect, leading to speculate it may be a result of Estonia's secularisation (Ringvee, 2014). Mental health was also discussed in the review of previous literature, Gilbert *et al*., conclude in 2019 innovations may blur the boundaries between a patient sense of identity and computerised implantable devices in unprecedented ways. Our open-ended research questions seconded this concern *"Psychologically it's also a bit disturbing for me to think that I'd be some way 'connected' all the time"* and *"Impact on my everyday life (mentally)"*. Future research may want to focus more on the mental health aspect and less regarding religion. We can conclude that respondents' personal characteristics are important when considering how to get individuals to welcome chip implants for enhancement purposes.

Herein we present practical implications of our study results on a societal, organisational and individual levels. At a societal level chip implant technology may create inequality concerns if availability is on a financial means basis, making it unaffordable for the economically underprivileged. Generating a unique new social group with elevated human capabilities enhancing social inequality, which would need to be addressed before implantation could be accepted on a societal level. This technology can ensure increase safety by making it easier to locate location of person who is lost plus increased border security which has become a common concern in the recent political sphere. It can also increase adherence to the law for example, a minor can no longer have access to alcohol or tobacco products as chip authentication becomes mandatory to buy such products.

On an organisational level implementation of such technology will bestow an enhanced level of safety not yet feasible. Through use an identification method will also bring a new source of valuable data, but in order to become accepted will have to consider how their employees value such data and its ownership. Organisations would become obliged to abide by new legislation regarding standards and protocols implemented to ensure data security, training and revealing its usage. Finally, whether implement devices in employees or for sale of the device's health, legislation, identity and privacy concerns must be addressed and targeting through marketing and advertisement campaigns.

On an individual level chip implant increases security of identification to new levels as there’s no chance of losing one’s identification device which is biologically embedded in a person. It allows an individual to carry few personal items as chip itself become single solution replacement for all identification cards and bank cards. Granting individual to access living and working spaces conveniently and gathering a realm of new data to help benefit our day to day lives. If the legislation factor is not addressed, it could lead to individuals seeking black market procedures to obtain the technology available.

The research conducted in our study has limitations. Questioning the small sample size of 305 participants, potentially reducing the power of the study and increasing the margin for error. Research was conducted on the Estonian population which could generate a bias toward chip implantation for enhancement purposes due to its recognition as one of the most tech-savvy countries. The cultural aspect of individuals who participated may not produce results which are adequate when considering implications for other nations especially considering low religiosity of the Estonian population. Furthermore, it captured only one specific slice of the population namely individuals under 35 years of age and possessing a higher education – bachelor or master degree. Hence may come under bias scrutiny. Finally, we utilised a singular survey method to obtain the attitude of individuals and not a variety of methods including interviews and observations. Incorporating these methods could have added greater knowledge plus extra validity to the results of our study.

Conclusion

The main purpose of the present work was to understand the attitudes of individuals towards implant devices for enhancement purposes on example of the Estonian population. We must first state it was not an accurate representation sample of the current Estonian population in terms of the demographic variables we considered, but it was a non-biased volunteer sample which provided an interesting insight into the topic of chip implants for enhancement purposes. Even if the Likert survey only gave a static picture of a very dynamic topic several lessons can be drawn, and the study can fill an apparent gap in the literature regarding usage of chip implants for enhancement purpose. It allows us to understand there are three main factors influencing individuals to obtain chip implants for enhancement purposes. Health, identity and privacy concerns have the greatest impact on an individual's attitude towards getting an implant. Identity protection measures, strong legislation to safeguard data are needed to increase the willingness. Potential health and privacy concerns must be addressed to increase the willingness of an individual to adopt chip implants for enhancement purposes. In addition, the current research contributes to the field by highlighting these areas need to be addressed prior to individuals adopting chip implants for enhancement purposes and the technology becoming widespread. We propose future research seek to understand what can be done to overcome these barriers which are preventing individuals form utilising the technology.

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Appendix

Appendix 1: Survey questionnaire

		Strongly Disagree (1)	Disagree (2)	Slightly Disagree (3)	Slightly Agree (4)	Agree (5)	Strongly Agree (6)
S1	I would get an implant for medical purposes.						
S2	I would get a chip implant for enhancement purposes.						
S3	Chip implantation violates personal privacy.						
S4	Inserting chip implants into human is unethical.						
S5	Chip implants are less vulnerable to identity fraud compared to other identification methods.						
S6	Chip implants is a secure technology for identification.						
S7	Chip implantation will provide new benefits to significantly enhance people's lives.						
S8	My religion prevents me from implanting chips for enhancement purposes.						
S9	It depends upon one's beliefs towards having a foreign object in a body.						
S10	Chip implants pose a threat to health.						
S11	Chip implantation is a painful procedure.						
S12	Chip implants cause health problems in the long term.						
S13	Chip implants should not have GPS tracking.						
S14	Chip implants should be clinically tested extensively before implantation becomes freely available.						
S15	Any data produced from chip implant should be legally owned by the chipped individual.						
S16	A universal regulation is required to safeguard data generated from chip implants.						

1. What would motivate you to have a chip implant?
2. What prevents you from receiving a chip implant?

Appendix 2: Descriptive statistics for respondent's education level

Factor Groups	Basic education		Secondary education		Vocational education		Professional higher education		Higher education – bachelor or master degree		Higher education		Results of ANOVA
	m	SD	m	SD	m	SD	m	SD	m	SD	m	SD	
Legislation	5.6	0.3	5.6	0.5	5.4	0.5	5.5	0.6	5.6	0.5	5.8	0.3	F = 1.142, p = 0.338
Health	2.3	0.4	3.1	1	2.8	0.7	2.7	1	3	0.9	3.1	1	F = 1.069, p = 0.378
Identity	3.5	1	3.4	1.2	3.4	1.1	3.2	1	3.7	1	4	0.8	F = 1.630, p = 0.152
Privacy	2.5	1.4	2.8	1	2.5	0.8	2.9	0.8	2.7	0.9	2.6	1.2	F = 0.393, p = 0.854

Appendix 3: Descriptive statistics for respondent's age group

Factor Groups	18-24 years old		25-34 years old		35-44 years old		45-54 years old		Results of ANOVA
	m	SD	m	SD	m	SD	m	SD	
Legislation	5.6	0.5	5.6	0.6	5.7	0.5	5.8	0.2	F = 0.918, p = 0.432
Health	3	0.9	2.9	1	3.2	0.8	2.9	1.2	F = 0.655, p = 0.581
Identity	3.7	1	3.6	1.1	3.2	1	3.5	0.9	F = 1.493, p = 0.217
Privacy	2.6	0.7	2.7	1	3	1	3.1	1.2	F = 1.959, p = 0.120

Appendix 4: F statistics of ANOVA Table

Demographic variables	Factor Groups				
	I would get a chip implant for enhancement purposes	Health	Identity	Legislation	Privacy
Age	F = 1.459, Sig = 0.226	F = 0.655, Sig = 0.581	F = 1.493, Sig = 0.217	F = 0.918, Sig = 0.432	F = 1.959, Sig = 0,120
Gender	F = 49.642, Sig = 0.0	F = 3.162, Sig = 0.076	F = 7.575, Sig = 0.006	F = 0.641, Sig = 0.424	F = 15.428, Sig = 0.0
Education level	F = 0.881, Sig = 0.494	F = 1.069, Sig = 0.378	F = 1.630, Sig = 0.152	F = 1.142, Sig = 0.338	F = 0.393, Sig = 0.854
Residential status	F = 0.647, Sig = 0.524	F = 4.112, Sig = 0.017	F = 0.276, Sig = 0.759	F = 0.760, Sig = 0.469	F = 0.018, Sig = 0.982

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