Attitudes and concerns on automated vehicles

ATTITUDES AND CONCERNS ON AUTOMATED VEHICLES

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ABSTRACT

People's mindset and attitudes exert a strong influence on how quickly a new technology is adopted, thus also affecting how well the benefits resulting from automated vehicles can be realised. In previous studies on people's attitudes towards automated vehicles, the number of respondents surveyed has been small, or alternatively survey's sample has not been representative. By describing the results of a large citizen survey, this study aims to fill this identified research gap and to reveal, whether people are ready for automated vehicles and what concerns people have that hinder the adoption of these vehicles. The study's results indicate that people's attitudes towards automated vehicles reflect the general adoption of technology well. We can assume that those who currently view automated vehicles positively are most likely to belong in the group of early adopters. We found that men, highly educated individuals, people living in densely populated area and those living in households without a car had a more positive attitude to automated vehicles than the other respondents did. The results indicate that traffic safety and ethical perspectives have a key role in the acceptance of automated vehicles. Developers of automated vehicles should also take into account the finding that currently most people consider that all automated vehicles must have the option of manual drive.

Keywords: automated vehicle; autonomous vehicle; survey; attitude; concern; adoption

1. INTRODUCTION

For a long time now, the automotive industry has been in the process of developing automated vehicles that do not require drivers to steer them, either at all or in a set of predetermined situations. The development of automated vehicles has been rapid, and several countries have allowed the use of these vehicles in road traffic in the 2010s, with certain restrictions (FT 2017; NCSL 2018). Nowadays, nearly all large car manufacturers as well as some operators in various fields of technology are running their own development projects for automated vehicles.

Several car manufacturers are already testing their highly automated vehicles. A high level of automation refers to vehicles of driving automation levels 4 and 5, defined in SAE's (2016) standard J3016, that can manage most or all driving tasks without a human driver having to interfere. A large number of manufactures believe they will be able to launch their automated vehicles in the 2020s. For example, the CEO of Nvidia has stated that the automation level 4 vehicle being produced through collaboration between Nvidia and Audi will be completed in 2020 (IEEE Spectrum 2017). Similarly, Ford, BMW and Volvo, among others, believe they can launch their high-level automated vehicles in 2021 (Reuters 2016; Reuters 2017; Automotive Fleet 2017).

Automated vehicles are expected to introduce notable benefits to the transport system, due to improvements in traffic safety and efficiency, for example (e.g. Andersson et al. 2016; Litman 2018). Transport policy-making tends to cautiously welcome automated vehicles, which is reflected in legislative decisions and policy development. In 2016, for example, the European Union agreed that its member states would commit to drawing up rules and regulations that would allow for automated vehicles to be used on public roads (European Commission 2016). Likewise, several states in the US have approved the limited testing of automated vehicles, subject to authorisation, within their territory (Techcrunch 2016).

Some studies have been conducted on people's attitudes towards automated vehicles and how prepared they would be to begin using them (e.g. Kyriakidis et al. 2015; Schoettle & Sivak 2014). Previous studies are typically conducted as online surveys and with non-representative samples (Becker & Axhausen 2017). Generally, people's feelings and attitudes exert a strong influence on how quickly a new technology is adopted (Patel & Connolly 2007), thus also affecting how well the benefits resulting from automated vehicles can be realised. Therefore, this study aims to reveal, whether people are ready for automated vehicles, which user groups are presumable early adopters, and what concerns people have that hinder the adoption of these vehicles. The following questions are used to achieve the goals of this study:

1. Are the perceptions of people in different demographics towards automated vehicles similar to general adoption of new technologies?

2. What is the general opinion of people towards automated vehicles and what concerns do people express regarding automated vehicles?

The study consists of a literature review and a wide-scope public survey on the subject. The literature review describes how new technologies are generally adopted and which user groups are early adopters of innovations. Especially, the study looks at surveys previously conducted on the attitudes and concerns towards automated vehicles. The public survey section will bridge the knowledge gap of the literature review with a data set comprising responses from over 2,000 people, thus answering the research questions of this study.

2. ADOPTION OF INNOVATIONS AND AUTOMATED VEHICLES

The perceived usefulness, ease of use and costs of a technology, as well as the general attitudes towards it, are highlighted as important factors in models illustrating how new technologies become more mainstream (Patel & Connolly 2007). With automated vehicles, the most important factors include the smooth functioning and reliability of the vehicles and related services, the cost of the vehicles and political decision-making (Fagnant & Kockelman 2015). Political instruments, such as pricing and legislation, can be utilised to have a significant impact on how extensively automated vehicles are used. In addition, Choi & Ji (2015) emphasise the notable effect that people's trust in automated vehicles and therefore their attitudes towards them have on adopting this technology.

Certain recurring trends have been identified in the process of new technologies and innovations becoming more widely used. Typically, people can be divided into five groups based on how they adopt new technologies, i.e. innovators, early adopters, early majority, late majority and laggards. First, a new innovation is adopted by few people – the innovators and the early adopters. This is then followed by a phase where the innovation becomes more widely spread as the early and late majority begin adopting it. The last group to adopt an innovation will be the laggards. Thus, innovations spread out following an S-curve pattern. It is noteworthy that a certain innovation may only be adopted by a certain group, and the total adoption rate of an innovation is not likely to be 100% in the total population. (Rogers 2003)

Innovations can be related to technologies (e.g. electric cars or automated vehicles), but can also involve social habits and common practices (e.g. increased popularity of carsharing). However, not all innovations and technologies become mainstream. Some may only become popular among specific user groups while others are quickly replaced by new solutions. (Pöllänen et al. 2014)

According to Rogers (2003), people in a certain innovation adoption group share many common characteristics. Early adopters typically have a background of higher education and enjoy a better social status than later adopters. A person's social status is affected by factors such as income, wealth, standard of living and the perceived value of their profession. On average, earlier adopters are also more rational, intelligent, and have a more positive attitude towards science and change than later adopters.

However, age has not been found to have an effect on the adopter groups. Depending on the case, the earlier adopters may be younger or older than the later adopters. On average, a person's age does not seem to affect the adoption of new technologies and innovations. (Rogers 2003)

It is common that most of the people in the early and late majorities belong to the same group with nearly all new innovations. Nevertheless, the innovators and laggards in a particular change may belong to a different group, depending on the innovation. Therefore, we cannot presume that an individual would, regardless of the new innovation or technology, always remain an innovator or a laggard. (Robinson 2009) Therefore, there is a need to study the adopters of new technologies and innovations in different cases.

Adams et al. (2017) have studied which factors would generally seem to affect the adoption of new technologies by ordinary households. As part of their research, they conducted a case study investigating the increasing access to high-speed broadband in Australia. The study's results showed that the technology's correspondence with an individual's lifestyle and the perceived cost-effectiveness had an impact on the technology's adoption. The correspondence with an individual's lifestyle refers to the extent to which households perceive an innovation to be appropriate for their current needs. Based on this, it could be concluded that training and information campaigns illustrating the benefits of new technologies promote their widespread adoption.

When it comes to automated vehicles, Litman (2018) predicts that automated vehicles will become more commonly accepted based on similar trends with previous vehicle technologies. Litman (2018) presents two predictions, an optimistic and a pessimistic one, of automated vehicles' sales, fleet, and the trips travelled with these vehicles. Particularly the optimistic curves shows an S shape. The pessimistic estimate accounts for the situation in which users are not yet sufficiently ready to begin using automated vehicles, due to factors like fears or possible deterioration of privacy. Similar to Litman (2018), also Kröger et al. (2016) present forecasts of high and low adoption of automated vehicles. The trend of new registrations does not form an S shape in the simulation, but the increase in the relative number of automated vehicles follows an S-curve (Kröger et al. 2016).

3. PEOPLE'S ATTITUDES TOWARDS AUTOMATED VEHICLES

Schoettle and Sivak (2014) have studied public opinion in China, India, Japan, the USA, the UK and Australia on automated vehicles. A survey was conducted in each of these countries as part of the study, with approximately 500–600 respondents per country. The following were the most important findings in the study:

- The majority of the respondents had heard of automated vehicles before and had a generally positive opinion, as well as high expectations about the benefits resulting from them.
- However, the majority of the respondents also expressed their concern over the safety of automated vehicles and the appropriate functioning of their technology.
- In particular, their concerns related to automated vehicles that have none of the controls of ordinary vehicles.
- On the one hand, the majority of the respondents were keen to have smart technology in their cars, but on the other, they were not prepared to pay any extra for this technology.

Table 1 illustrates people's attitudes towards automated vehicles in different countries. People in China and India had the most positive attitudes to automated vehicles, with approximately 85% of the respondents having a very positive or somewhat positive attitude. In Japan, more than half of the respondents took a neutral view towards automated vehicles. The largest number of negative responses came from the USA, where 16% of the respondents had a very negative or somewhat negative attitude. (Schoettle & Sivak 2014)

Table 1. *Attitudes towards automated vehicles in different countries according to Schoettle and Sivak (2014).*

Response	Very positive	Somewhat positive	Neutral	Somewhat negative	Very negative
China (N=610)	49.8%	37.4%	9.8%	2.3%	0.7%
India (N=527)	45.9%	38.3%	12.5%	3.0%	0.2%
Japan (N=585)	10.1%	32.8%	50.3%	6.2%	0.7%
USA (N=501)	22.0%	34.3%	27.3%	12.4%	4.0%
UK (N=527)	13.9%	38.3%	34.2%	11.2%	2.5%
Australia (N=505)	16.2%	45.7%	26.7%	8.3%	3.0%

Kyriakidis et al. (2015) conducted an extensive online survey on the general opinion about automated vehicles. The survey comprised approximately 5,000 respondents from 109 countries all around the world. The following were the main findings in the survey:

- The respondents were mostly concerned about cyber security, traffic safety, the legal aspects and privacy.
- The general opinion was fairly divided. Some of the respondents expressed that automated driving is a positive thing, while others were not prepared to pay for it and did not view automated driving as an enjoyable experience.
- The respondents from high-income countries in particular disliked the idea of a vehicle sharing data directly with insurance companies or the tax and traffic authorities. (Kyriakidis et al. 2015)

Similarities between certain population groups' interest in automated vehicles have been identified by several literary sources. Many surveys have discovered men to be more interested in automated vehicles than women (Alessandrini et al., 2014; Schoettle & Sivak 2014). In addition, it has been observed that people who live in densely populated urban areas in particular and have a higher educational background as well as a high income tend to be more interested in automated vehicles than others (Bansal et al. 2016). Furthermore, young people are generally more interested in using automated vehicles than older people. (Ipsos MORI 2014; Kyriakidis et al. 2015).

In recent years, a number of studies on people's interest in and willingness to use automated vehicles have been conducted. Some of these studies have found that the majority of their respondents are not interested in automated vehicles or willing to use them. Reasons for this include distrust towards automated vehicles in addition to attachment to one's own car and personal pleasure in driving. Other studies, though, have concluded that a large percentage of their respondents would be willing to use automated vehicles. Nevertheless, most of these surveys have been rather one-sided and targeted at specific groups. Their respondents may not have been selected randomly, which is why the results cannot be generalised to cover the entire population. (Cavoli et al. 2017)

König and Neumayr (2017) conducted a case study on automated vehicles to look at people's opposition towards radical new innovations. The study material was compiled through a quantitative online survey, and the aim was to include respondents from several different countries. Ultimately, the study consisted of 489 respondents from 33 countries. It discovered that the hypothesis about the psychological barriers concerning automated driving does apply. On average, people are reluctant to hand vehicle controls over to automation. Mostly people feared potential cyberattacks and disruptions in the automation systems.

Based on the surveys on automated vehicles, attitudes towards these vehicles seem to conform with the general theory of technology adoption. However, usually the number of respondents in these surveys has been small, or alternatively their sample groups have not represented the

population (Becker & Axhausen 2017). Therefore, existing research indicates a need to study people's attitudes towards automated vehicles with a survey that is conducted using a large, representative sample.

4. RESEARCH HYPOTHESES

The hypotheses below on people's general attitudes towards automated vehicles were created, based on the literature review. The hypotheses 1–5 link to the research question number 1 and the hypotheses 6–8 to the question number 2.

- H1 Most people have a positive attitude towards automated vehicles
- H2 Men have a more positive attitude towards automated vehicles than women
- H3 Highly trained individuals have a more positive attitude towards automated vehicles than those with a low level of education
- H4 The younger generations have a more positive attitude towards automated vehicles than older generations
- H5 People living in densely populated areas have a more positive attitude towards automated vehicles
- H6 People mainly have concerns about automated vehicles that have none of the controls of ordinary vehicles.
- H7 The safety of automated vehicles and the unreliability of their technology are the main concerns associated with automated vehicles
- H8 Deterioration of privacy is a major concern related to automated vehicles.

Hypotheses H1, H2 and H6 are set based on Schoettle and Sivak's (2014) study on people's attitudes towards automated vehicles. Hypothesis H3 builds on the finding by Alessandrini et al. (2014) that people with a higher educational background express a more positive attitude towards automated vehicles than those with less education. Related to this hypothesis, Rogers (2003) stated that earlier adopters typically have higher education than the later adopters. Hypothesis H4 is based on Kyriakidis et al. (2015) and Ipsos MORI (2014) studies, which have discovered that typically younger generations express a more positive attitude towards automated vehicles. Hypothesis H5 builds on the study by Bansal et al. (2016), which found that people living in densely populated urban areas show a more positive attitude towards automated vehicles compared to others. Hypothesis H7 is based on surveys by Schoettle and Sivak (2014) and Kyriakidis et al. (2015), in which the respondents expressed their concern on the traffic safety of automated vehicles. Hypothesis H8 is based on study by Kyriakidis et al. (2015), which found that deterioration of privacy was considered a major concern with automated vehicles, especially in higher income countries.

5. METHOD AND DATA

In May - August 2017, a survey was conducted in Finland on the attitudes of 18–64 year old towards automated vehicles and the effects of these vehicles to how people move from one place to another. The survey consisted of five parts: Part I: Interest in automation, Part II: Travel behaviour, Part III: Automated taxis, Part IV: Fears and obstacles regarding automated vehicles, and Part V: Background information and open feedback. Total number of questions was 22 and it took about 10–15 minutes to complete the survey. The questions consisted of propositions with Likert scale 1 to 5, multiple choice, option ranking, and open-ended questions. Some questions were using the SP method (stated preference), i.e. utilising hypothetical options. Additionally, the survey mapped the respondents' background information, such as age, gender, and whether they had a driving licence, to help categorise the respondents.

The survey was conducted in the official languages of Finland, i.e. Finnish and Swedish. English translation of the questionnaire is presented in appendix A. In the questionnaire, question number 1 about the general opinion towards automated vehicles connects with hypotheses H1–H5. This question was placed first so that the respondents could answer it immediately after reading the instructions, without the questionnaire affecting the answers. Furthermore, the aim was to make the question comparable with international studies, and thus the same five-level Likert scale that, for example, Schoettle and Sivak (2014) had used in their study was chosen.

Survey's question number 4 on people's opinions on the direction to which automation should develop links with hypothesis H6. Question 4 presented six statements, which the respondents answered using a five-level Likert scale (agree – disagree). The statements aimed to identify how strongly people want to utilise automation, what their feelings are towards using automated systems, and whether they consider the development towards vehicle automation is a desirable trend. In order to answer hypotheses 7 and 8, the respondents were asked to rank various concerns, fears and threats according to their significance in question number 11. As the survey was a part of a larger research project related to automated vehicles, this study focuses only on some of the issues and questions in the survey.

The sample group for the survey was randomly selected from the population register by age and gender group in proportion to the population's age and gender distribution. The sample was extracted by Population Register Centre of Finland per procuration. For the study purpose, the names, addresses, ages, gender and native language of the people were available in the sample data. In the use of this data, we followed Population Register Centre's terms and conditions. Throughout our study, we followed Finnish legislation and good academic practices.

The population of the sample consisted of 18–64 year olds living in Finland. The size of the population was 3,271,630 people, based on the population projection of 2017 (Statistics Finland 2015). The sampling fraction was 0.3%, and the size of the sample was 10,000 people. Table 2 presents the sample in terms of the various age and gender groups.

Table 2. *Sample group by age and gender.*

Age groups	Men	Women
18-24	683	654
25-34	1,084	1,028
35-44	1,052	995
45-54	1,056	1,036
55-64	1,185	1,227
In total	**5,060**	**4,940**

All people who were selected for the sample were sent a postal questionnaire with a cover letter in May 2017. People had the option either to respond on the internet with an identification code or to send the questionnaire back by mail (postage paid). A postcard reminder was sent to everyone who did not respond to the survey in two weeks. The last answers were received in August 2017. A total of 2,036 respondents participated in the survey, of which 1,640 prior to postcard reminder and 396 afterwards, resulting to a total response rate of 20.4%. The response rate and number of respondents by age and gender group are presented in Fig. 1. The mean age of all respondents was 47 years, for women 47 and men 48 years, respectively.

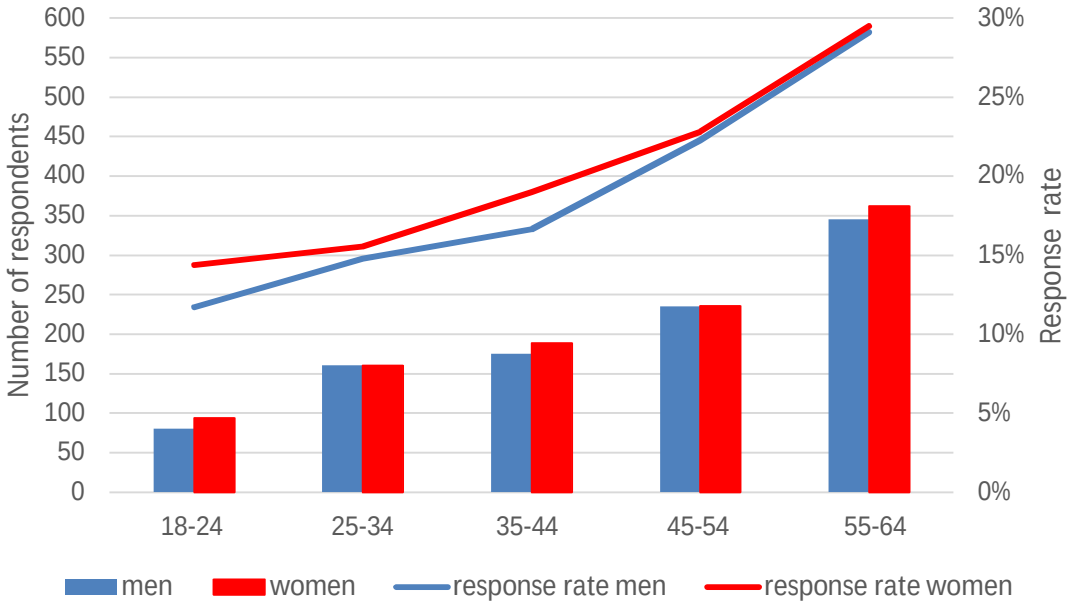

Figure 1. Response rate and number of respondents by age group and gender.

As Fig. 1 shows, the proportions of men and women among the respondents remained relatively similar in all age groups, with women being slightly more active to respond. The total number of men in the sample was 995 (response rate 19.7%), and the total number of women

was 1,041 (response rate 21.1%). The response rate by age group increased continuously so that the response rate among the 18–24 year olds was 13.0% and among the 55–64 year olds 29.3%.

We present the survey results without using sampling factors, which would make the results representative of the 18–64 year old population of Finland, i.e. we present the results as the number of respondents and frequency percentages of different responses. Our focus in the analysis is in the differences between user groups, and the parameters usually deployed in sampling factors (age and gender) are analysed separately.

Regarding the background information gathered with the survey, we found the respondents to represent the Finns relatively well e.g. in terms of driver's licences. 93% of the respondents held a driver's licence, which is slightly more than Finnish population of 18–64 years old in general, of which 89% held a driver's licence on 1.1.2018, based on statistics from Finnish Transport Safety Agency (2018) and Statistics Finland (2018). 13% of the respondents stated to be from households without a car, whereas 44% had one car, 34% two cars, 7% three cars, and 3% four or more cars. These figures can be compared to average Finnish households, of which 26% were without a car, 54% had one car, 17% two cars, and 3% three or more cars in 2016 (Statistics Finland 2016b). It must be noted that the respondents do not include over 65 years olds, who typically live in small households with less cars. Also the number of kilometres travelled by car was asked to be estimated by the respondents, and the responses are presented in Fig. 2. Related to use of other transport modes, there was one background question in the survey. 38% of the respondents stated to travel at least once a month by public transport.

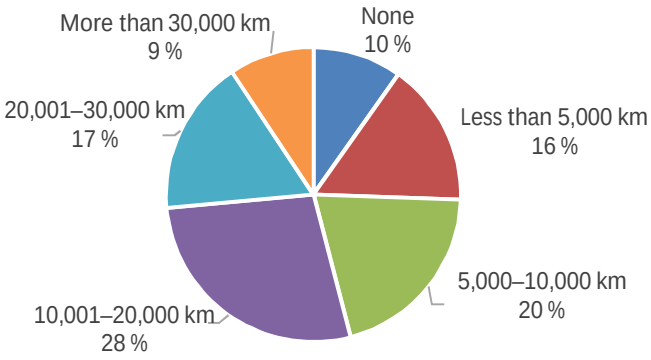

Figure 2. Respondents' answers to the background question 'How many kilometres do you estimate to drive a car in a year?'

The respondents' place of residence is also a key piece of background information. The respondents' addresses' postal codes were connected through Statistics Finland's (2016a) database with the urban-rural category by Finland's environmental administration (2017). With this procedure, all the respondents can be relatively accurately categorised based on their postal codes, using seven-levels of areas:

1. Inner city: A tightly developed and efficiently utilised urban area
2. Outer city: An efficient urban area reaching all the way to the suburbs
3. Exurbs: An area directly linked to a city in the border zone between rural and urban areas
4. Local rural centres: Urban settlements and small towns located outside of large urban areas
5. Countryside near cities: A rural area, but both functionally and physically close to a city
6. Rural heartland: A relatively densely populated rural area with diverse economic structures
7. Sparsely populated countryside: Sparsely populated areas without diverse centres or with small centres far apart. These areas consist mainly of forests. (Finland's environmental administration 2017)

To better facilitate our analysis, the places of residence were divided into three categories, which are I) densely populated urban area (includes areas 1 and 2), II) sparsely populated urban area (includes areas 3, 4, and 5), and III) sparsely populated area (includes areas 6 and 7).

The survey results were analysed by using IBM SPSS Statistics software. Cross tabulations were used in the statistical analysis of the responses. These provided information on which factors affected the answers and how. The statistical significance of the cross tabulations was tested with the Mann-Whitney U test and the Kruskal-Wallis H test, which are suitable for testing statistically significant differences of variables with preference scales (Taanila 2015).

6. RESULTS

Fig. 3 shows that the majority of the respondents in the Finnish survey had either a very positive (23%) or a somewhat positive attitude (41%) to automated vehicles. Roughly one in four respondents expressed a negative attitude towards automated vehicles, and the proportion of those with a very negative attitude was approximately 7%. The means and standard deviations of all survey results are presented in appendix B.

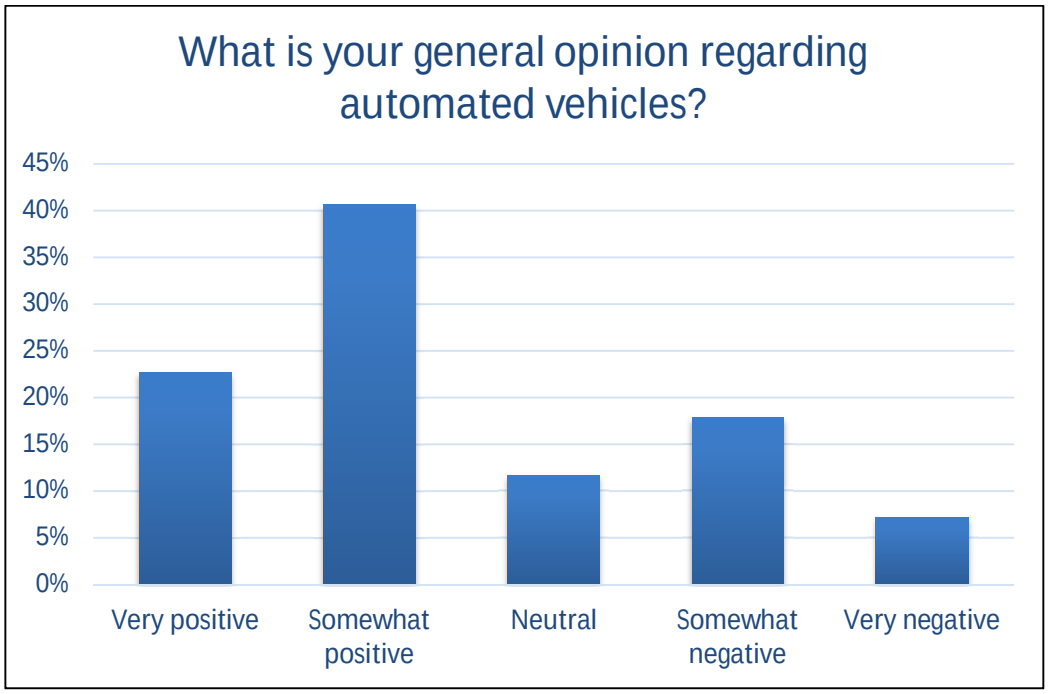

Figure 3. General opinion regarding automated vehicles of Finns in 2017. N = 2,022.

Fig. 4 shows how gender affects the general attitude towards automated vehicles. According to the Finnish survey, almost 30% of men hold a very positive attitude towards automated vehicles, while only about 17% of women have a very positive attitude. Table 3 contains the results from the Mann-Whitney U test on the effect's statistical significance, where rows on 'Gender' presents test results related to Fig. 4, and rows on 'Car ownership' to Fig. 8 which is presented later. The differences between men and women are statistically very significant ($p < 0.001$).

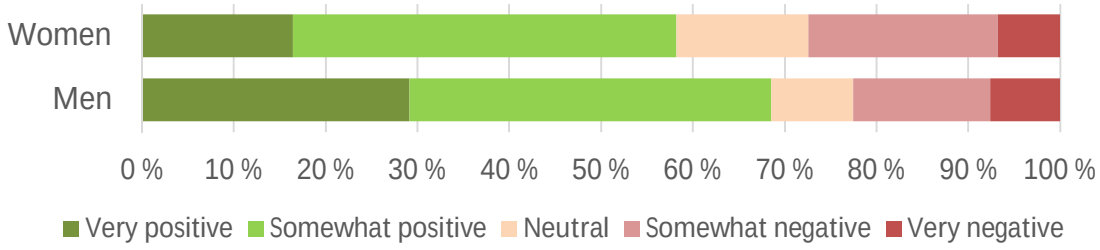

Figure 4. Attitudes towards automated vehicles by gender in Finland in 2017. N = 2,022.

Table 3. *Mann-Whitney U test results on differences in attitudes towards automated vehicles related to gender and car ownership.*

General opinion		Ranks			Test statistics			
Grouping variable		N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Gender	Woman	1,032	1,084.31	1,119,009	435,699	926,244	-5.99	<0.001
	Man	990	935.6	926,244				
Car ownership	No cars	253	873.7	221,046.5	188,915.5	221,046.5	-4.029	<0.001
	At least 1 car	1,756	1,023.92	1,797,999				

Fig. 5 shows how the level of education affects the general attitude towards automated vehicles. People with higher education have markedly more positive attitudes than people with less education. Table 4 shows that the differences are also statistically very significant ($p < 0.001$). Table 4 contains the results from the Kruskal-Wallis H test, where rows on 'Education' presents test results relate to Fig. 5, rows on 'Age group' to Fig. 6 and rows on 'Residential location' to Fig. 7.

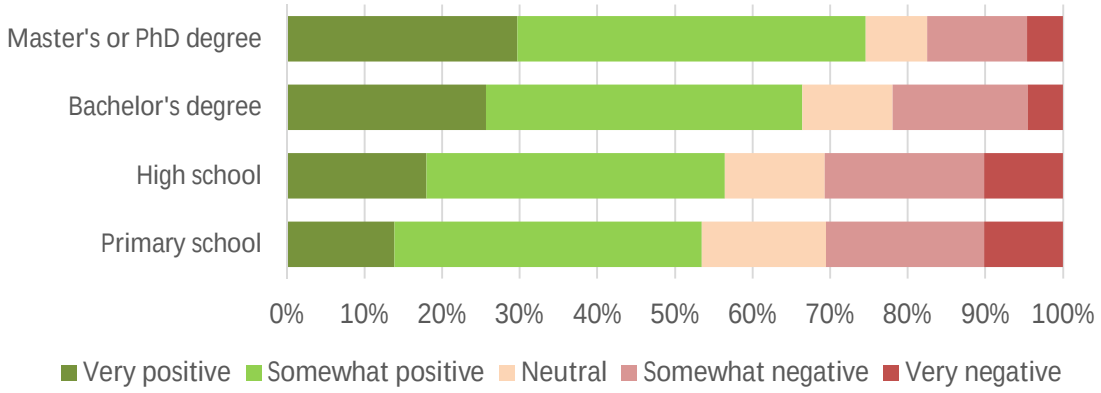

Figure 5. Attitudes towards automated vehicles by the level of education in Finland in 2017. N = 2,000.

Table 4. *Kruskal-Wallis H test results on differences in attitudes towards automated vehicles in relation to education, age group and residential location.*

General opinion		Ranks		Test statistics		
Grouping variable		N	Mean Rank	Kruskal-Wallis H	df	Asymp. Sig.
Education	Primary school	187	1,132.3	63.077	3	<0.001
	High school	753	1,090.81			
	Bachelor's degree	579	949.81			
	Master's or PhD degree	481	868.9			
Age group	18-24	173	1,000.67	12.777	4	0.012
	25-34	319	922.29			
	35-44	362	1,008.23			
	45-54	467	1,011.51			
	55-65	701	1,056.45			
Residential location	Densely populated area	993	925.34	63.195	2	<0.001
	Sparsely populated urban area	638	1,034.24			
	Sparsely populated area	388	1,186.8			

Conversely, no significant differences in attitudes towards automated vehicles were detected between different age groups. The survey answers showed that the 25–34 year olds had more often a very positive attitude towards automated vehicles. According to the Kruskal-Wallis H test, the differences between the attitudes in different age groups are statistically significant ($p = 0.012 < 0.05$). However, on closer inspection, statistically significant differences only exist between the 25–34 year olds and other age groups. For example, there is no statistically significant difference between the 18–24 year olds and 55–64 year olds. Therefore, we cannot generalise that the younger generations have a more positive attitude to automated vehicles than the older generations. Fig. 6 presents the effect of the age group on the attitudes towards automated vehicles.

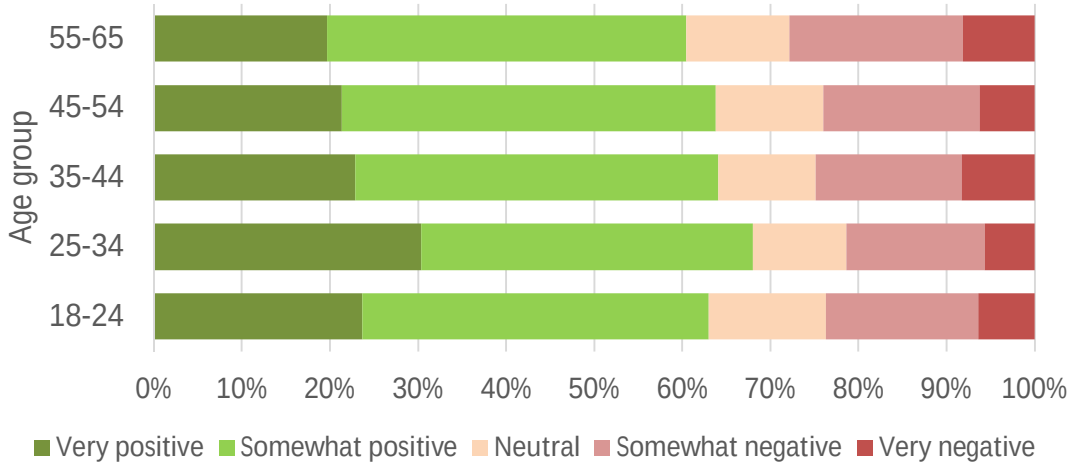

Figure 6. Attitudes towards automated vehicles by age group in Finland in 2017. N=2,022.

The place of residence among the respondents was noted to cause, statistically speaking, very significant ($p < 0.001$) differences in the respondents' general attitudes towards automated vehicles. According to Fig. 7, respondents living in densely built areas (in cities) had more positive attitudes towards automated vehicles than the other respondents. The figure shows that the more densely populated the area of residence, the more positive the attitude to automated vehicles.

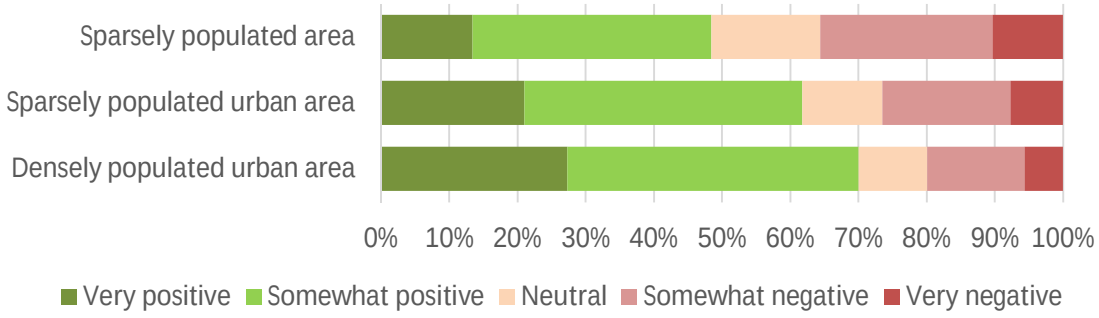

Figure 7. Attitudes towards automated vehicles by place of residence in Finland in 2017. N = 2,019.

As the higher average educational background of people living in cities can in part explain the differences in attitudes based on the place of residence, we looked at the correlation coefficient ($r = -0.260$), which reflects a slight correlation between the place of residence and educational background. However, by cross-tabulating the place of residence and the attitudes separately for each educational level, we find that the educational background does not fully explain the more positive attitude of those living in cities: rather, the place of residence also has a marked effect. It must be noted that the number of individual observations regarding the

different combinations of educational backgrounds and places of residence is small, and thus the result cannot be considered completely reliable.

In order to study deeper the potential early adopters of automated vehicles, we analysed whether there are other background factors, which have an impact on the attitudes towards automated vehicles besides those found in the literature survey and expressed in the hypotheses. In particular, the respondents living in households without a car as well as those respondents using public transport regularly had, statistically speaking, significantly more positive attitudes to automated vehicles. Fig. 8 shows how owning a car affects the attitude to automated vehicles.

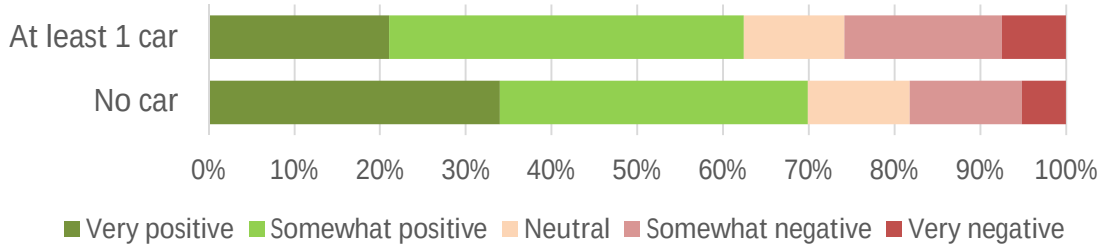

Figure 8. Attitudes towards automated vehicles in relation to car ownership in Finland in 2017. N=2,009.

As presented in table 3, respondents currently living in a household without a car had highly positive attitudes to automated vehicles more often, statistically speaking, and more frequently when compared to the other respondents on a very significant basis ($p < 0.001$). One-third of the respondents living in a household without a car expressed a very positive attitude towards automated vehicles, whilst among the respondents living in households with a car, this number was approximately one-fifth. Households with four or more cars had the most negative attitudes towards automated vehicles. Nearly half of the respondents from such households took either somewhat negative or very negative view towards automated vehicles.

As depicted in Fig. 9, as many as 90% of the respondents expressed that all automated vehicles must have the option of manual drive. The majority of the respondents (92%) would also like to determine where and when to use the automated functions and which functions to use. Based on this, we can conclude that people are not comfortable with automated vehicles that have no control devices.

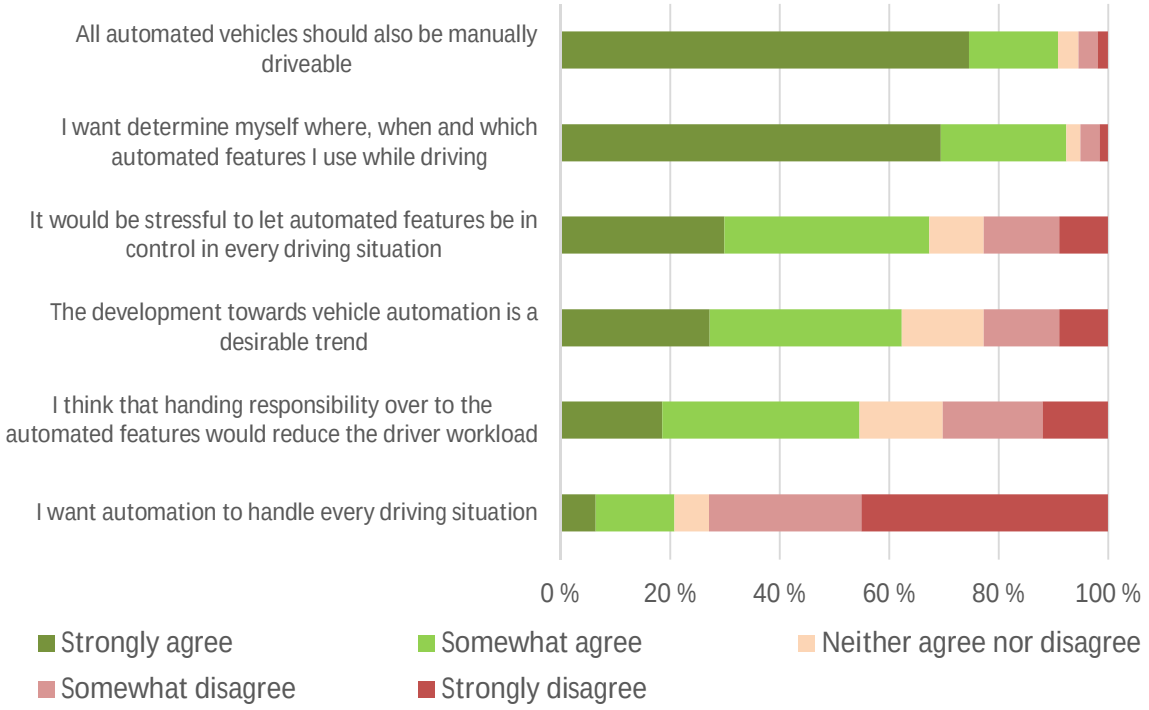

Figure 9. Responses to six statements on the development of vehicle automation in Finland in 2017. N = 2,022–2,027 depending on the statement.

Giving the driving responsibility over to a computer would make almost 70% of the respondents feel stressed. Only slightly more than one-fifth of the respondents stated that they would not feel stressed about releasing the driving responsibility to a computer. Just over half of the respondents, however, expressed that having automation in charge of the driving would make driving less demanding. Approximately one-third of the respondents disagreed with the statement.

More than 60% of the respondents expressed that it is positive that automation is developing in the direction of automated vehicles. Only about 10% of the respondents disagreed with the statement completely. Only approximately one-fifth of the respondents would prefer automation to take care of the driving in all situations. Only about 45% of the respondents disagreed with the statement completely.

Fig. 10 shows the respondents' concerns related to automated vehicles in ranking order. Traffic safety was considered the biggest threat related to automated vehicles with approximately 36% of the respondents ranking it as number one concern. Also, technical unreliability and the moral dilemma caused a relative amount of concern among the respondents. Traffic safety is the biggest cause for concerns, but moral issues were considered to cause more concerns than technical unreliability. However, if the concerns ranking second and third are also taken into account, technical unreliability becomes a more significant concern than the moral issues.

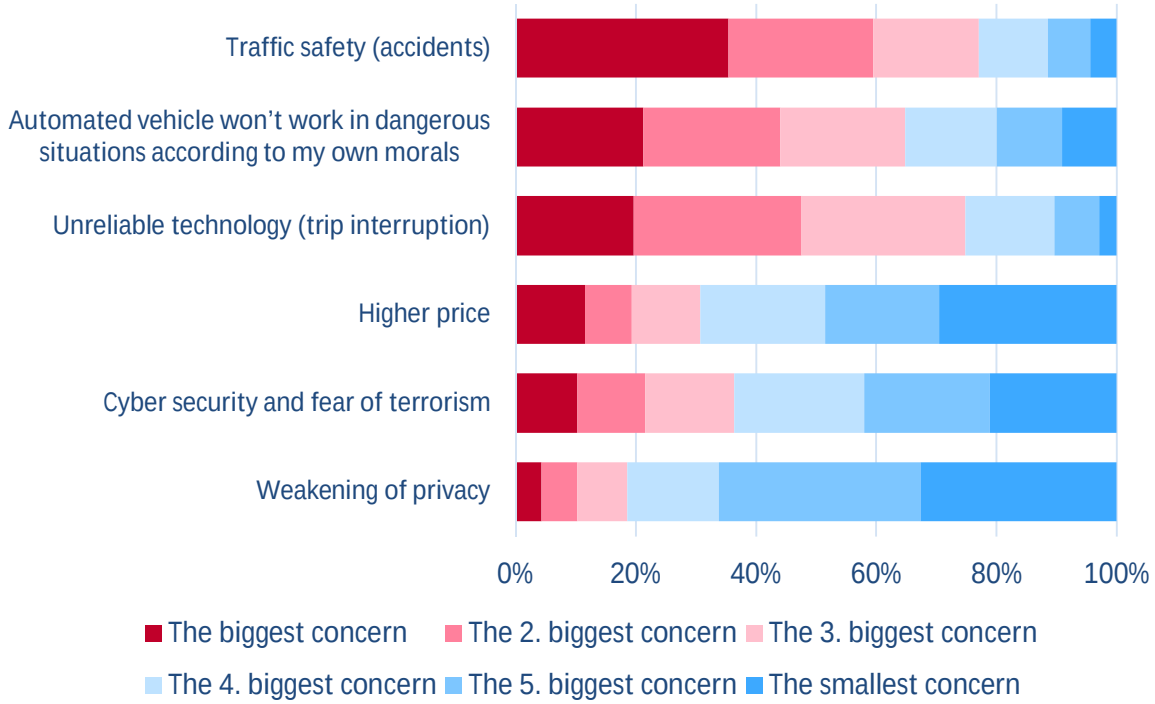

Figure 10. Rank of concerns regarding automated vehicles in Finland in 2017. N = 2,022.

The higher price of automated vehicles and, in particular, deterioration of privacy was the smallest concern for the respondents. The respondents were the most divided on cyber security and fear of terrorism, as this option was assigned the most equal distribution of different numeric values.

In connection to research question 2, it is interesting to find that the general attitude towards automated vehicles somewhat affects the importance of concerns related to automated vehicles. Those expressing generally a very positive attitude towards automated vehicles more commonly consider that the higher price and cyber security are bigger concerns compared others. We also find that the ranking of concerns differ between women and men, but across different age groups, the differences are small. Generally, women consider traffic safety as a bigger concern compared to men, whereas men consider higher price and privacy issues as bigger concerns. The results of cross-tabulating the rank of concerns and the general opinion as well as rank of concerns and gender are presented in Fig. 11 and in appendix B. We present the results as means and standard deviations. In the analysis, we tested the statistical significance with Chi-Square test and verified that there was no notable exceptions in the distributions, and the means and standard deviations are suitable for presenting the results.

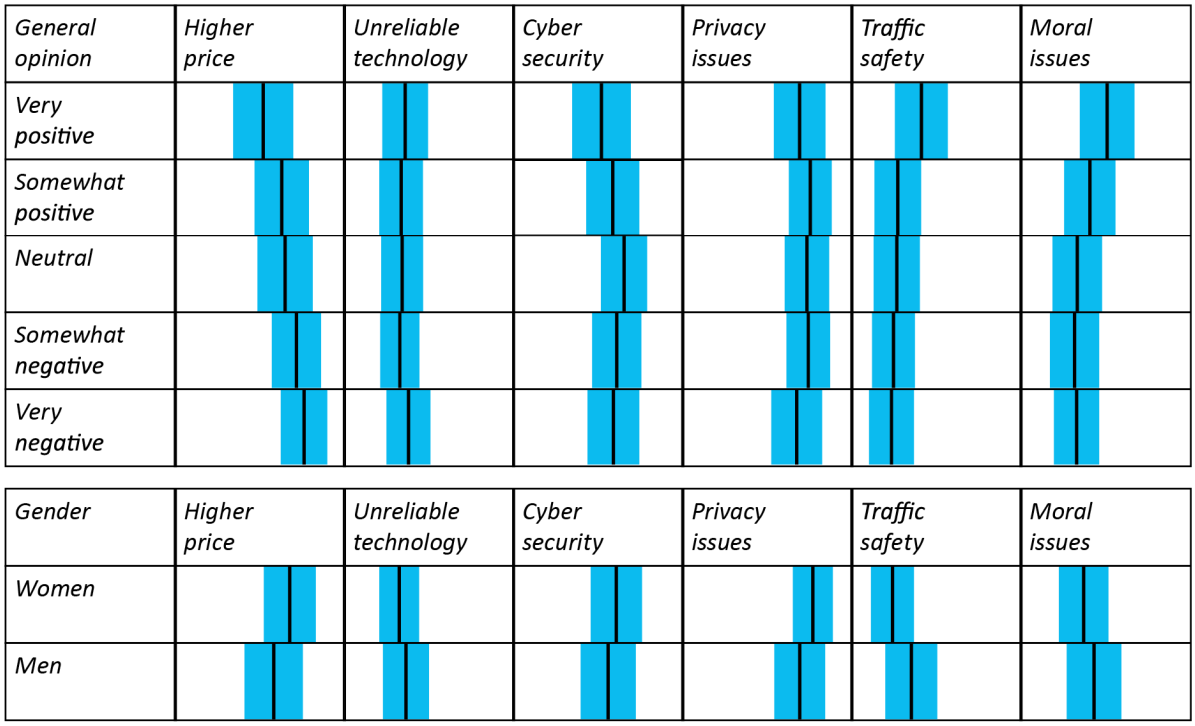

Figure 11. The mean rank of concerns regarding automated vehicles in relation to general opinion towards automated vehicles and gender. The closer the vertical bar is to the left column, the bigger the concern. The coloured area round the bar depicts the standard deviation.

On the other hand, those with a very positive attitude do not consider traffic safety of the vehicles to be the biggest concern as often as all the respondents on average. Similarly, moral issues are not such a big concern for those with a very positive attitude, compared to the other respondents. Traffic safety of the automated vehicles and moral issues are the most significant concerns for the respondents with a negative attitude towards automated vehicles, whilst the higher price of the vehicles does not cause much concern among those who have a generally negative attitude. The deterioration of privacy was not found to have a notable effect on the general attitude.

7. DISCUSSION

7.1 Assessing the hypotheses

H1 Most people have a positive attitude towards automated vehicles

Fig. 12 describes how the attitudes towards automated vehicles in Finland situate compared to those of other countries based on Schoettle and Sivak's (2014) study. The Finnish survey expressed that 23% of the respondents had a very positive attitude and 41% a somewhat positive attitude to automated vehicles. In comparison to other countries, Finland had the largest number of both positive and negative responses towards automated vehicles. Similarly as in China and India, only a few had a neutral attitude or were undecided Finland, whereas in Australia, the UK, the USA and, in particular, Japan, many respondents had a neutral reaction towards automated vehicles. Apart from Japan, the majority of respondents had either a very positive or somewhat positive attitude towards automated vehicles. In Japan, about half of the respondents had a neutral and 43% either very positive or somewhat positive attitude towards automated vehicles. Based on these findings, the hypothesis is valid, and we can conclude that most people have a positive attitude towards automated vehicles. As people's feelings and attitudes exert a strong influence on how quickly a new technology is adopted (Patel & Connolly 2007), we could assume, that countries, which people possess a positive attitude towards automated vehicles, are in the forefront in adopting these vehicles. Yet it must be acknowledged that there are many also other things, which affect the adoption of automated vehicles, including e.g. the economic constraints.

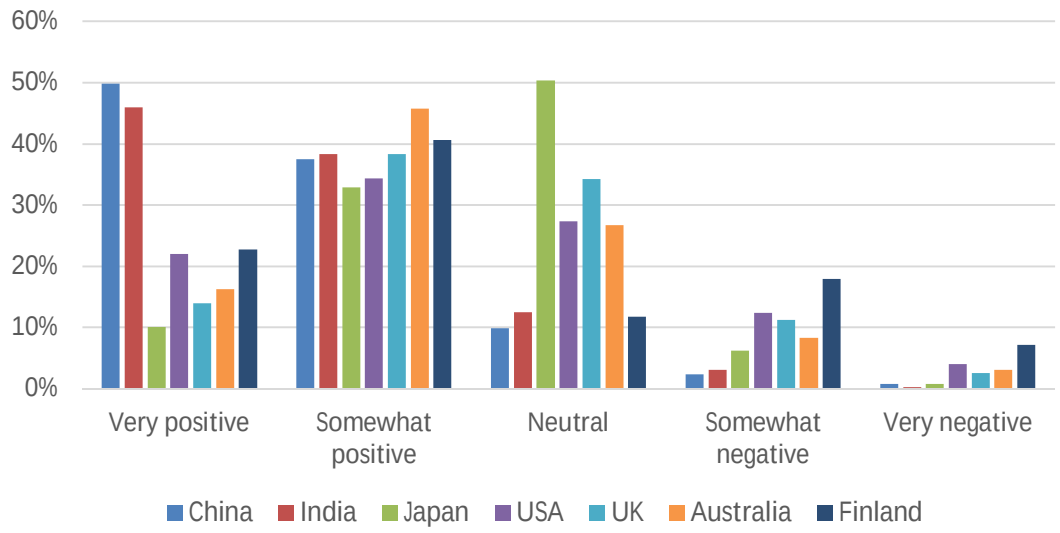

Figure 12. Attitudes towards automated vehicles in China, India, Japan, the USA, the UK, and Australia in 2014 (adapted from Schoettle & Sivak 2014) and in Finland in 2017.

It is worth to note that the respondents in Schoettle and Sivak's (2014) study does not necessarily represent the overall population in these countries particularly well, besides which the number of responses was relatively low. In addition, the contexts of the studies are slightly different, which may reduce their comparability. In addition, as there has been a lot of public discussion around the topic, the attitudes may have changed in only three years.

H2 Men have a more positive attitude towards automated vehicles than women

Similar to Schoettle and Sivak's (2014) study, we found that men express a more positive attitude towards automated vehicles than women also in Finland. The difference in the attitudes of men and women was statistically very significant, meaning that the hypothesis is correct. Based on the connection between adoption of new technologies and attitudes towards new technology and innovations, we can assume men to adopt automated vehicles earlier than women.

H3 Highly trained individuals have a more positive attitude towards automated vehicles than those with a low level of education

Similar to Alessandrini et al. (2014), we found that people with a higher educational background express a more positive attitude towards automated vehicles than those with less education. In the Finnish survey, the differences between people with different levels of education are clearly identifiable and statistically very significant. As a general discovery has also been that the earlier adopters typically have higher education than the later adopters (Rogers 2003), we can assume the highly educated, holding also typically a more positive attitude towards automated vehicles, to be the early adopters of these as well.

H4 The younger generations have a more positive attitude towards automated vehicles than older generations

Kyriakidis et al. (2015) and Ipsos MORI (2014) have discovered that the younger generations typically express a more positive attitude towards automated vehicles. In the Finnish survey, we observed that the 25–34 year olds had a more positive attitude towards automated vehicles than others, but in other age groups (including the youngest group of 18–24 year olds compared to the oldest group of 55–64 year olds), there was no statistically significant difference. Therefore, this hypothesis is rejected. This is in line with the observations that a person's age generally has no direct impact on the adoption of new innovations. Young people adopt some innovations earlier than the older generations, but on the other hand, a number of studies have concluded that age does not influence how people adopt innovations (Rogers 2003). Based on these findings, we can assume that in the adoption of automated vehicles person's age will not be an important factor.

H5 People living in densely populated areas have a more positive attitude towards automated vehicles

Bansal et al. (2016) has found that people living in densely populated urban areas show a more positive attitude towards automated vehicles compared to others. In the Finnish survey, we found that the place of residence has, statistically speaking, a very significant impact on people's attitude to automated vehicles. The respondents from more densely populated areas express a more positive attitude, whereas people residing in sparsely populated rural areas had the most negative attitudes. This means that the hypothesis is correct. Based on this finding,

we can assume that automated vehicles are likely to be adopted earlier in densely populated areas.

H6 People mainly have concerns about automated vehicles that have none of the controls of ordinary vehicles.

As in Schoettle and Sivak's (2014) survey, where the respondents expressed strongest concerns for the type of automated vehicle that has none of the controls of ordinary vehicles, the Finnish survey showed that as many as 90% of the respondents considered that all automated vehicles must have the option of manual drive. In addition, the 92% of the respondents would like to determine where and when to use the automated functions and which functions to use. This is in line with the finding that people are reluctant to hand vehicle controls over to automation (König and Neumayr 2017). Thus, this hypothesis is accepted. For the adoption of automated vehicles, this means that people's mindset is still in a driver-mode and the path to fully automated vehicles could go through vehicles, in which the driver can be in control, if one wants to.

H7 The safety of automated vehicles and the unreliability of their technology are the main concerns associated with automated vehicles

Schoettle and Sivak (2014) and Kyriakidis et al. (2015) have found that safety of automated vehicles and their technical unreliability was a major concern among the survey respondents. In the Finnish survey, traffic safety of automated vehicles (accidents) was the biggest concern related to these vehicles. In addition, the vehicles' unreliable technology (interrupted trip) and moral issues related to automated vehicles were the biggest concerns among the respondents. However, the moral issues can be considered an equally notable concern as the technical unreliability, and therefore the hypothesis is only partly correct, as there are also other main concerns. When considering this result's implication on the adoption of automated vehicles, the stakeholders, such as car manufacturers and regulators, need to address several concerns, of which safety is a major one, to build confidence towards automated vehicles.

H8 Deterioration of privacy is a major concern related to automated vehicles

Kyriakidis et al. (2015) have found the deterioration of privacy as a major concern with automated vehicles, especially among the respondents from higher income countries. In the Finnish survey, the deterioration of privacy was generally the smallest concern related to automated vehicles. We can state that the hypothesis is incorrect as compared to the other concerns, the deterioration of privacy is considered to be of minor importance. Yet it needs to be acknowledged that the respondents were only asked to rank the concerns in order of importance and not to specify the amount of concern the issue generated in them. As distrust towards automated vehicles is a reason for not being interested in automated vehicles or willing to use them (Cavoli et al. 2017), there are psychological barriers concerning automated driving and people mostly fear potential cyberattacks and disruptions in the automation systems (König and Neumayr

2017), we can state that all concerns, which cause distrust, need to be addressed. As some concerns are dispelled, the once that remain, are more highlighted.

7.2 The reliability and general applicability of the results

This study is based on a literature review and a postal questionnaire. The hypotheses were formulated and justified based on findings from previous studies, and new findings are drawn for an original Finnish survey with large sample of 18–64 year olds. Yet, we cannot be sure whether people embellish their answers, e.g. if they do not know the issue or they have not formulated their own opinion, they could choose to answer as they think people in general would or should answer. Related to the validity of the study, the hypotheses are connected with research questions as well as the survey's questions. Related to reliability, the statistical significance of survey results is analysed. Considering the answers to survey, we found the respondents answering to be pertinent, as there was evidently no minimum effort answering in the way of a respondent picking e.g. first or last option in every question. In addition, the open feedback from survey's last open-ended question indicated that the respondents generally appreciated the survey, its topic and their significance. The respondents commented that the questionnaire was clear and understandable, easy to fill in and had suitable length, while the critical comments related mostly to automated vehicles as a phenomenon and few found the questionnaire as leading.

The response rate of the survey was approximately 20%, which is relatively low. Low response rate makes it possible that the respondents do not present the actual view of the whole population as e.g. the ones more in favour or more against or with a neutral attitude towards automated vehicles can be over- or underrepresented among the respondents. As men and younger generations had a lower response rate compared to other groups, and as men and young had a more positive attitude towards automated vehicles, using sampling factors to present representative results of the 18–64 year old would have changed the results slightly. Deploying sampling factors taking gender and age group response rates into consideration would have raised the share of a very positive attitude to 23.9% from 22.7% when presenting the number based on the respondents as has been done in this study. Nevertheless, the respondents represent the 18–64 year old Finnish population sufficiently well, which makes the results reliable and allow identifying statistical differences among the respondents. We also found, that despite of more than 2,000 respondents, the more detailed analysis, e.g. combinations of different educational backgrounds and places of residence, were limited in providing statistically significant differences. We also found that the different background factors (e.g. holding a driver's licence, the amount of cars in respondent's household, the amount of kilometres travelled by car, the use of public transport) were strongly linked with each other. E.g., the ones who used car to a great extent, had similar views with the ones living in a household with a car as well as with the ones not using public transport. Therefore, we do not present the background factors' relevance to the results unless there is a notable importance. As the number of respondents without a driver's

licence was low, we could not draw statistically significant results for this group. Generally, the differences in responses between different groups were small.

As Patel & Connolly (2007) has stated, the general attitude is an important factor in models illustrating how new technologies become more mainstream. This study sought into the general attitudes towards automated vehicles, and found overall a positive attitude, and some user groups with more positive attitudes, which could reflect to adopting these vehicles earlier than those with more negative attitudes. People's trust in automated vehicles and therefore their attitudes towards them have a notable effect on adopting this technology (Choi & Ji 2015), but also the smooth functioning, reliability, cost of the vehicles as well as political decision-making are important factors (Fagnant & Kockelman 2015). Trust was also recognised as an important issue in this study, and should be acknowledged in the different predictions and scenarios related to the adoption of automated vehicles, as has also been done by Litman (2018). As these automated vehicles are not yet in the market, the respondents have not been able to perceive the innovation's appropriateness for their individual lifestyle, with which the innovation needs to be in correspondence according to Adams et al. (2017). This also needs to be acknowledged, when considering the results from user surveys related to attitudes towards automated vehicles. Adams et al. (2017) has also stated that widespread adoption of new technologies can be promoted by illustrating the benefits of new technologies by training and information campaigns. User surveys can in their part bring out the needs and issues for such promotion.

As this study's scope differs from the previous studies, no direct comparison can be made between these. The comparison with results of Schoettle's and Sivak's (2014) study can be criticised as people's perceptions of automated vehicles may have changed considerably in three years as the issue has been extensively discussed in media. However, the phenomenon is global and offers possibilities for comparative studies between countries in future. Making a longitudinal study on this, recognising the early attitudes of people as well as the current (and ones of future, to be studied) would also be an interesting avenue of further research. Repeating the same survey in a few years would allow studying whether the attitudes of people change and to which direction as people become more familiar with the automated vehicles. Repeating the survey could also bring out new concerns and some of the old may be resolved by the development of automated vehicles and their regulation.

Culturally, Finland is fairly close to other western countries in Europe. However, the winter conditions in Finland are challenging for automated driving, and Finland is sparsely populated, which may have some effect on how people view automated vehicles. The general attitude of Finns to automated vehicles is, however, similar to the people in the USA, the UK and Australia. All-in-all, these study results can be considered relatively applicable to other developed countries and to Europe in particular.

8. CONCLUSIONS

Generally, the adoption of new technologies and innovations has been observed to follow certain frequently recurring patterns, leading to e.g. the S shaped adoption curve, S-curve. Depending on the innovation, the early adopters and late adopters, i.e. the laggards, differ. As automated vehicles are a unique entity in the field of technological innovations, particular research on the adoption of this innovation needs to be implemented. In this study, the attitudes towards automated vehicles were assessed to identify the general opinion, possible early adopters as well as concerns, which hinder the adoption of automated vehicles.

Cars typically have a long lifespan and they are costly to acquire, which slows down the adoption of new vehicle technologies. In addition, the adoption of automated vehicles is affected by several factors, some of which are dependent on the available technology. For example, the technical reliability and smooth functioning of automated vehicles, the realisation of their expected benefits, the level of mobility services, the ability of the infrastructure to accommodate automated driving, transport policies (legislation and pricing), and people's preparedness and attitude all exert a major impact on the increase in the popularity of automated vehicles.

The study's results indicate that people's attitudes towards new technology reflect the general adoption of technology well. We can assume that those who currently view automated vehicles positively are most likely to belong in the group of early adopters. In this study's survey, most people expressed a positive attitude towards automated vehicles. Another observation was that men, people with a high educational background, and those living in more densely populated areas all have a more positive attitude towards automated vehicles. The study also showed that the 25–34 year olds express a more positive attitude towards automated vehicles than other people do, but for the rest of the age groups the differences in their attitudes were not statistically significant.

In addition to the literature review based hypotheses, we found that those living in households without a car expressed a more positive attitude towards automated vehicles than other respondents. This is a particularly important finding for the widespread adoption of automated vehicles, because it can mean an increase in passenger vehicle traffic as new users move from public transport to using cars. Therefore, the attitudes regarding this should be studied in more depth. Overall, it should also be studied how attitudes will turn into actual behaviour. In future, also the younger and older generation's attitudes towards automated vehicles would be interesting to study. These generations can represent important user segments for the automated vehicles, allowing car use for a younger generation than today as well as to older people with e.g. health issues.

Based on the study, Finns on average consider that traffic safety (accidents) is the biggest concern when it comes to automated vehicles. Furthermore, the moral issues related to automated

vehicles and their technical unreliability (interrupted trip) caused concerns among the respondents. The role of traffic safety and the moral issues regarding automated vehicles was further highlighted among those respondents with a negative attitude to these vehicles, and these two were clearly the biggest concerns among these respondents.

The results of this study indicate that traffic safety and ethical considerations are the key issues in regard to the acceptance of automated vehicles. Therefore, authorities must ensure the traffic safety, technical functionality and cyber security of automated vehicles by actively influencing international regulations. When planning their transport systems, the municipalities and cities must create traffic environments where the ethical issues will remain insignificant. For example, in situations where a traffic accident cannot be avoided, the speed of an automated vehicle must be set so low, that if an automated vehicle swerves to avoid colliding with a defenceless road user, the vehicle's passengers are not injured. National ethical policies, following Germany's example (BMVI 2017), are necessary (e.g. the artificial intelligence of an automated vehicle may not make decisions based on the demographic or socio-economic status of its passengers or other road users), in order to dispel the fears related to moral issues.

Other subjects for further study include the impact of automated vehicles on people's mobility patterns, especially on the distances travelled, the distribution of modes of transport, and the ownership of cars. It is also important to factor in the combined effect of transport becoming increasingly automated, and consumed as a mobility service. While studies in this area exist, comprehensive research in this area is still awaited.

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APPENDIX A. QUESTIONNAIRE

Part I: Interest in automation

1. What is your general opinion regarding automated vehicles?

☐ Very positive ☐ Somewhat positive ☐ Neutral ☐ Somewhat negative ☐ Very negative

2. Which of the following automated driver assistance systems have you used? You can choose multiple answer options.

☐ Adaptive cruise control ☐ Lane keeping assistance ☐ Automated parking system ☐ None

3. What kind of automation systems would you be most interested in? Please choose one option.

☐ Driver assistance systems such as various warnings

2

☐ Partial automation, such as driving on the highway with minimal actions required from the driver

"Hands off but alerted"

4/5

☐ High automation without any actions required from the driver (allows e.g. sleeping)

"No need to focus on driving"

0

☐ None, I want to drive myself in every driving situation

"The driver does everything"

4. What do you think of the following statements?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I want to determine myself where, when and which automated features I use while driving.	☐	☐	☐	☐	☐
I want automation to handle every driving situation.	☐	☐	☐	☐	☐
It would be stressful to let automated features be in control in every driving situation.	☐	☐	☐	☐	☐
I think that handing responsibility over to the automated features would reduce the driver workload.	☐	☐	☐	☐	☐
All automated vehicles should also be manually driveable.	☐	☐	☐	☐	☐
The development towards vehicle automation is a desirable trend.	☐	☐	☐	☐	☐

Part II: Travel behaviour

Imagine doing an everyday round trip (for example a work trip). Sort the following trip alternatives from 1 to 3 so that 1 is the most desirable and 3 is the least desirable option.

5a. Travelling daily from city centre A to city centre B with one-way distance of 200 km.			
Rank	_____	_____	_____
	Personal car	Personal automated vehicle	Public transport
Costs	40 €	45 €	20 €
Travel duration	2 h 30 min	2 h 15 min	2 h 35 min
Walking distance	500 m	100 m	300 m

5b. Travelling daily from the city outskirts to the city centre with one-way distance of 10 km.			
Rank	_____	_____	_____
	Personal car	Personal automated vehicle	Public transport
Costs	6 €	6 €	2 €
Travel duration	15 min	10 min	25 min
Walking distance	400 m	100 m	600 m

5c. Travelling daily in rural area with one-way distance of 100 km.			
Rank	_____	_____	_____
	Personal car	Personal automated vehicle	Public transport
Costs	18 €	21 €	10 €
Travel duration	1 h 5 min	1 h 5 min	1 h 35 min
Walking distance	50 m	50 m	600 m

6. Would you travel by car more often or do longer trips, if driving was

A) cheaper than currently? ☐ Yes ☐ No

B) less stressful, since you could do other things (e.g read) while driving? ☐ Yes ☐ No

C) always possible even if you were not able to drive yourself? ☐ Yes ☐ No

Part III: Automated taxis

7. Which of the following options would you choose? Vehicle features in different options are similar. Please mark the preferred option.	
☐ Personal automated vehicle	☐ Automated taxi
Always available immediately. Taxes, insurance and vehicle purchase costs are annually 2,000€ on average	Always available within 7 min from order. Costs per kilometer are the same as with personal automated vehicle, but there are no annual fees.

8. You are travelling 10 km from the city outskirts to the city centre. Sort the following trip alternatives from 1 to 4 so that 1 is the most desirable and 4 is the least desirable option.

Rank	_____	_____	_____	_____
	Private automated taxi, with no other passengers	Shared automated taxi, possibly with other passengers	Public transport, e.g. bus	Conventional taxi, with no other passengers
Costs	10 €	5 €	3 €	20 €
Travel duration	14 min	19 min	30 min	14 min

9. You are travelling 100 km to the city centre. Sort the following trip alternatives from 1 to 4 so that 1 is the most desirable and 4 is the least desirable option.

Rank	_____	_____	_____	_____
	Personal conventional car	Personal automated vehicle	Private automated taxi	Public transport (train)
Costs	30 €	35 €	25 €	15 €
Travel duration	1 h 20 min	1 h 15 min	1 h 20 min	1 h 0 min
Walking distance	600 m	100 m	100 m	500 m

10. Assume that all vehicles on the road are automated vehicles. Would you want/need to own a personal automated vehicle, if an automated taxi would always be available within 5 minutes and the annual costs of automated taxis would be about 20 % lower than the costs of personal automated vehicle?

☐ Yes, I would want to own a personal automated vehicle.

☐ No, I would not have a no need to own a personal automated vehicle.

Part IV: Fears and obstacles regarding automated vehicles

11. Sort the following six concerns, threats and fears regarding automated vehicles from 1 to 6 so that 1 is the most significant threat and the 6 is the least significant threat.

_____ Higher price	_____ Unreliable technology (trip interruption)	_____ Cyber security and fear of terrorism
_____ Weakening of privacy	_____ Traffic safety (accidents)	_____ Automated vehicle won't work in dangerous situations according to my own morals

Part V: Background information and open feedback

12. How old are you?
_____ years

13. What is your gender?
☐ Woman ☐ Man

14. Do you have a driver's license?
☐ Yes ☐ No

15. How many people are there in your household, yourself included?
_____ persons

16. How many cars do you have in your household?
_____ car(s)

17. Do you have any permanent injuries or illnesses that affect your driving?
☐ Yes ☐ No

18. Do you travel by public transport at least once a month?
☐ Yes ☐ No

19. How many kilometres do you estimate to drive a car in a year?
☐ None
☐ Less than 5,000 km
☐ 5,000–10,000 km
☐ 10,001–20,000 km
☐ 20,001–30,000 km
☐ More than 30,000 km

20. What is the highest level of education you have graduated or are studying at the moment?
☐ Primary school ☐ High school
☐ Bachelor's degree ☐ Master's or PhD degree

21. Open feedback regarding automated vehicles

22. Open feedback regarding this survey

THANK YOU FOR THE PARTICIPATION!

APPENDIX B. MEANS AND STANDARD DEVIATIONS

Question 1, general opinion **1=Very positive, 2=Somewhat positive, 3=Neutral, 4=Somewhat negative, 5=Very negative**				
Grouping Variable		**N**	**Mean**	**Std. Deviation**
All respondents		2,022	2.46	1.221
Gender	Woman	1,032	2.59	1.180
	Man	990	2.32	1.248
Level of education	Primary school	187	2.73	1.224
	High school	753	2.66	1.267
	Bachelor's degree	579	2.34	1.166
	Master's/PhD degree	481	2.18	1.129
Age group	18–24	173	2.43	1.207
	25–34	319	2.29	1.212
	35–44	362	2.46	1.241
	45–54	467	2.45	1.186
	54–65	701	2.56	1.235
Residental location	Densely populated urban area	993	2.28	1.172
	Sparsely populated urban area	638	2.51	1.229
	Sparsely populated area	388	2.84	1.237
Car ownership	No cars	253	2.19	1.188
	At least 1 car	1,756	2.50	1.220

Question 4, statements **1=Strongly agree, 2=Somewhat agree, 3=Neither agree nor disagree, 4=Somewhat disagree 5=Strongly disagree**			
	N	**Mean**	**Std. Deviation**
I want determine myself where, when and which automated features I use while driving	2,026	1.45	0.832
I want automation to handle every driving situation	2,022	3.91	1.290
It would be stressful to let automated features be in control in every driving situation	2,025	2.34	1.279
I think that handing responsibility over to the automated features would reduce the driver workload	2,022	2.69	1.292
All automated vehicles should also be manually driveable	2,022	1.42	0.872
The development towards vehicle automation is a desirable trend	2,027	2.42	1.265

Question 11, concerns **1=The biggest concern, 2=The 2. biggest concern , 3=The 3. biggest concern,** **4=The 4. biggest concern, 5=The 5. biggest concern, 6=The smallest concern**			
	N	**Mean**	**Std. Deviation**
Higher price	2,012	4.16	1.677
Unreliable technology (trip interruption)	2,009	2.71	1.300
Cyber security and fear of terrorism	2,009	3.95	1.606
Weakening of privacy	2,007	4.65	1.387
Traffic safety (accidents)	2,013	2.44	1.460
Automated vehicle won't work in dangerous situations according to my own morals	2,013	2.99	1.576

Question 11 concerns cross-tabulated with question 1 general opinion and gender **1=The biggest concern, 2=The 2. biggest concern , 3=The 3. biggest concern,** **4=The 4. biggest concern, 5=The 5. biggest concern, 6=The smallest concern**							
General opinion		**Higher Price**	**Unreliable technology**	**Cyber security**	**Privacy issues**	**Traffic safety**	**Moral issues**
Very positive	Mean	3.60	2.79	3.62	4.45	3.03	3.54
	N	456	456	456	456	456	456
	Std. Deviation	1.808	1.378	1.766	1.553	1.589	1.644
Somewhat positive	Mean	4.16	2.67	3.96	4.77	2.32	3.02
	N	820	817	817	817	819	819
	Std. Deviation	1.635	1.314	1.600	1.291	1.406	1.543
Neutral	Mean	4.26	2.70	4.30	4.67	2.29	2.64
	N	228	229	227	228	227	227
	Std. Deviation	1.666	1.260	1.392	1.338	1.393	1.493
Somewhat negative	Mean	4.60	2.63	4.08	4.71	2.19	2.56
	N	355	355	355	353	355	356
	Std. Deviation	1.480	1.180	1.478	1.314	1.293	1.486
Very negative	Mean	4.83	2.89	3.98	4.36	2.13	2.62
	N	139	138	140	139	142	141
	Std. Deviation	1.398	1.322	1.557	1.532	1.349	1.366
	Chi-Square	<0.001	0.016	<0.001	<0.001	<0.001	<0.001
Gender							
Women	Mean	4.40	2.61	4.07	4.85	2.16	2.83
	N	1028	1028	1027	1028	1031	1029
	Std. Deviation	1.565	1.201	1.542	1.201	1.294	1.493
Men	Mean	3.92	2.82	3.82	4.45	2.73	3.15
	N	984	981	982	979	982	984
	Std. Deviation	1.754	1.389	1.663	1.533	1.564	1.644
	Chi-Square	<0.001	<0.001	0.002	<0.001	<0.001	<0.001