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Trust in Automated Public Transport

A qualitative study

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Acknowledgements

We wish to extend a big thank you to everyone involved and who contributed to this project.

Thank you to

Gunnar D. Jenssen and Thor Myklebust from SINTEF,
Johan Sigander and everyone contributing from Brakar,
Jørgen Kjær from Vy,
and our supervisor Cato Bjørkli at UiO.

Introduction

Automated vehicles have the prospect to make traffic more efficient, safer, and more eco-friendly in the years to come, especially when thinking about public transport. However, this development and deployment is dependent on society's willingness to use this technology. Research shows that trust is fundamental to whether automated solutions are used by the public (Schaefer et al. 2016, 377). Given this, it is an important task to explore which factors contribute to an increase or decrease in trust from users of automated vehicles.

While earlier theories of technology acceptance were mainly focused on user reactions to technological features, more recent work has highlighted *trust* as an important determinant for technology acceptance (Glikson and Woolley 2020, 8). In this paper we follow the literature by defining trust as “the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party” (Mayer, Davis, and Schoorman 1995, 712).

The purpose of this study is to give a preliminary account of which factors affect users' trust in public automated transport that can be used as input for future research on the topic. We base our account on a focus group conducted with regards to user experiences from self-driving shuttle buses in Drammen, Norway, where the questions asked were designed with the aim of targeting users' trust in the bus before and after going for a ride in it.

We found that the participants in the focus group exhibited a great deal of trust in the bus they rode with. They appreciated the role of the host in the vehicle and viewed this as fundamental to the trust in the bus, at least at an initial stage of implementation. The older participants were more trusting when asked to consider the case where the host had been removed, while the younger expressed concern especially with regards to night-time driving without a host, because of the potential for crime and unpleasant encounters in an environment that was unsupervised by a physically present host. We also found that most participants viewed the bus as a social arena because of the presence of the host and the intimate situation created when the passengers were gathered in a small bus. Finally, the participants were favourably disposed to most design features of the bus, expressing that it was “cute” and that they liked the yellow colour. However, they would specifically prefer more space. They also expressed that futuristic designs are favourable to traditional van design.

Method

Participants and study design

5 people were recruited for the focus group through Brakar. They were recruited through their Facebook page, mail to contacts who had participated in previous activities at Brakar and by word of mouth by the hosts on the shuttle buses. Participants received a travel gift card and a free lunch for their participation. Among the participants we had 4 people identifying as women and 1 person identifying as a man. 3 of the participants were in the age group 70-90 and thus pensioners. The other 2 were in the age group 30-50, where one of them had a job and the other was not capable of working (social services). Everybody had tried the bus at least once before.

We completed a small qualitative study. It consisted of a questionnaire and a group interview. Between the questionnaire and the group interview the participants took a ride with the self-driving shuttle bus where what they said and how they behaved was noted down. After the group interview, we had a debrief and the participants received their travel gift card. The purpose of the study was to be hypothesis generating, and a starting point for further research. The study is too small for our results to be generalized.

Ethics and data protection

The study was approved by NSD.

We considered the compensation fair. It was sufficient for encouragement, but the amount was not big enough to make participants feel an “obligation to deliver”.

We obtained written consent from each participant before the study started. The questionnaire was completed by hand by the participants and submitted manually by us to Nettskjema. The papers were later destroyed. The group interview was recorded through the Nettskjema-diktafon. Nettskjema provides safe storage of data.

Questionnaire

The questionnaire consisted of 3 multiple-choice questions, 1 Likert scale question, 2 yes-no questions and 5 open questions. It was designed with the purpose of getting independent answers. The questionnaire had focus on mapping the participants’ demographic (age, gender and work) as well as their transportation habits and thoughts and experiences with automated vehicles.

Participants were given 10 minutes to fill in the survey anonymously. The questionnaire can be found in Appendices as Appendix A.

Trip with the self-driving minibus

We did not ask the participants any questions during the trip nor was it recorded. However, we encouraged the participants to speak up if they had any comments or thoughts and took notes whenever it occurred. The purpose of this was to act as a passive observer and not “control” the participants into thinking about a certain aspect. In this way we could get a grasp of the participants’ immediate thoughts. A downside about this method is that the participants may have had thoughts that they didn’t speak up about unless asked about it, and hence we could have missed some important information.

Group interview

The group interview lasted for 1 hour and was a semi-structured interview. We had some questions as a starting point but asked spontaneous questions if some interesting thoughts and opinions appeared. The interview guide can be found in Appendices as Appendix B. Audio from the group interview was recorded and later transcribed. The purpose of the group interview was to explore the different opinions of the participants and have a discussion. The intention was to get immediate viewpoints as well as critical thinking when exposed to other opinions and maybe new beliefs after the discussion.

The group interview was conducted during lunch where everybody, both interviewers and participants, sat at the same table. A representative from Brakar was also present during the interview. The representative from Brakar sat at the opposite side of the interviewers. The

purpose was to give the interview a casual feeling, and at the same time keep interviewers, participants and observers semi-separated and make the participants look mostly in the direction of the interviewers. Other people involved in the project watched through Zoom. The participants of the focus group were informed that there were people attending through Zoom, but they did not see the screen. In this way they would not be distracted by the people online.

In focus groups it is important to think about the appearance of conformity, and how to reduce it. Research shows that conformity is reduced by the presence of an ally (Allen and Levine 1968). No information about the participants' opinions was collected before the study started, and thus the presence of an ally was attempted to be assured through the selection of members of the group. Each participant was chosen so that they shared a demographic variable with at least one other participant (sex, age group, self-driving bus experience). However, our group size was not optimal for conformity to be reduced. With such a small group, the probability of having one person with opposite opinions of the rest is bigger than in larger groups. Thus, there could have been participants who did not have an ally in the group. Asch's findings showed that conformity is the biggest when the majority is of size 4, and an increase in the majority group beyond 4 did not have a significantly bigger impact on conformity (Asch 1951, 188). With this in mind, a bigger group than ours would have been more beneficial. However, the time limit and the depth of our questions did not allow us to increase the group size considerably. In addition, we emphasized to our participants that their opinions were wanted and that there were no right and wrong answers, and thus acted like 'semi-allies'.

The questions were designed with the purpose of having the topics clear and easily understandable to reduce informational conformity. Research shows that conformity is increased when topics appear difficult or confusing to the participant (Sherif 1935). However, in qualitative studies we might ask questions where the participants have no prior opinion. The participant might adopt the other participants' opinions without it being obvious to the interviewer/researcher. We tried to reduce this by having a casual interview with room for asking questions whenever the participants felt that they lacked information about the subject.

We presented pictures of different automated buses during the group interview. The purpose of this slide show was to show and compare different bus designs and get the participants' opinion on specific designs. All images were free-use photographs downloaded from various internet sites. The pictures are present in Appendix C, with the comment on which design the group preferred.

Results

The questionnaire the participants answered before the bus ride showed that all of them were initially very positive towards self-driving buses with an average score of 4.8 out of 5 where 5 is very positive and 1 is very negative. In the free text areas, they described it using keywords like "safe", "efficient", "fun", "environmentally friendly", and "think it's the future", see figure 2 for all. However, there were also questions regarding safety and whether it was safe enough. Figure 1 shows their transport habits and on average they drive their own vehicles more often than they use public transport.

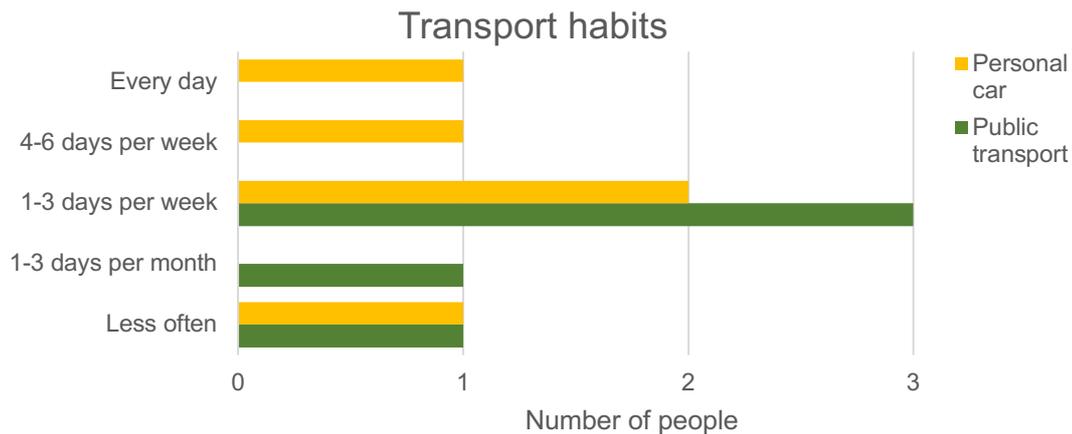


Figure 1. Transportation habits of participants.



Figure 2. Keywords used by the participants to describe their thoughts about self-driving busses in public transport.

Three of the five participants were pensioners and had previously held positions in academia. The two younger participants represented a different segment with both having experience with being on welfare either themselves or through a partner.

On the trip, the host started asking who was unsure of how the bus worked. He continued by showing how the sensors work with the help of a screen. He continued talking about how the sensor data was interpreted and how the bus was programmed. He informed the passengers about the new max speed limit (20 km/h vs. previous 16km/h) and talked about on which distances the shuttle bus would reach the max limit. The host had knowledge of the “rough parts” of the route, i.e. where the shuttle bus had some problems, and told the passengers in advance. The passengers asked questions when they were uncertain about an aspect of how the bus worked or wanted more thorough information.

The host controlled the bus manually on multiple occasions. That is, whenever the bus found any obstacles, it calculated a new course, but it was necessary for the host to press a button to do the actual overtaking.

During the whole trip all the passengers and the host talked together, and the host worked as a “social middleman” for the conversation. In the beginning of the trip there were only a few passengers talking, but the host engaged more passengers and by the end of the trip

everybody was talking. The host himself told that, from experience, young and old would go from quiet to talking together during the trip. The social aspect was commented on several times both during the trip and in the group interview by the participants. During the trip, one participant talked about a small (regular) bus from childhood they enjoyed taking. They highlighted that the size of the bus made it intimate and easier to talk to other passengers. In the group interview we found that the combination of having a small bus going calmly through the city and a social host present was something that all participants appreciated. The participants all agreed that by having the bus considerably small and with a host made favorable conditions for a social arena.

Illustrative quotations from the focus group:

“[...] those four [hosts] one meets, they are always so blithesome and helpful that it’s a joy. So you really have handpicked class there”

“The little bus here is so cozy, very enjoyable every time you speak to the driver. There is something special about that bus. So I hope that there will be more buses like these around Norway [...] because it is a completely different experience”

In the group interview we found that the participants displayed a high amount of trust in the autonomous bus they had tried. They showed significant confidence in the safety of the bus under current conditions (host is physically present, speed limit is 20km/h, the bus drives between 11 a.m. and 5 p.m.). One of the first things they were asked about their experience was how they perceived the role of the host during the bus drive. Several participants remarked about the importance of the host being present for the feeling of safety, especially at an early stage of implementation.

Illustrative quotations from the focus group:

“Very important. [...] I think many people wouldn’t dare to get on if he wasn’t there.”

“[...] maybe it was for the best that [the bus] had a host initially here in Drammen, but it is supposed to drive without a host eventually, and then I expect the technical bits to be so developed that it will be safe, and then I would trust it.”

“I think that at night time, then it might be safer with someone there.”

“As long as there is a driver so that there is someone who can look after that everyone is well-behaved. That’s what I’m after. [...] It might not be needed in the day time, but at night time [...]”

“And the [feeling of] safety that a driver provides. [...] that there is someone there, who can answer questions”

When asked about the removal of the host in the future, the younger participants were more sceptical than the older. One participant from the former group said that that would have to be something that they must be accustomed to and another expressed explicitly that they would not like it to be ridden remotely. The older participants were positive about the removal of the host in the future.

Similarly, the older participants displayed higher levels of trust in the people responsible for implementation of self-driving vehicles and the system governing safety. We found that one of the younger participants expressed lower trust in authorities in general using examples of systems protecting criminals instead of law-abiding citizens. This mistrust extended to the authorities regulating which vehicles are on the road.

Illustrative quote from an older participant:

If they put a bus [on the road] then I would assume that the right safety measures are taken and then I trust [the bus]. [...] There are a lot of competent people [...]

Some participants commented that it was not their preferred vehicle for transportation in particular, but rather something enjoyable that they might take for fun sometimes. One participant said that “It’s nice for those people who need it. I just see it as a fun trip”. The participant also conveyed that it is not something they would use as public transport on a regular basis mostly due to it not fully replacing the role of normal public transport with its speed limitation of 20 km/h whereas normal public transport drives at 30 and 40 km/h in the city.

When it comes to design, we found several interesting results. First, the participants preferred a bus with futuristic design. In fact, they had more trust in a futuristic design than a traditional one. The response was characterized by the notion “that something is happening” and that the futuristic design aspired to a sensation of progression. The trust in such a design was especially present amongst the older participants but shared by all. Second, they would all like the bus to be a little bit bigger than the one they tried. Specifically, a wish for more space for each passenger was expressed, especially if the bus ride would be longer (more than about 20 minutes). One participant explicitly told that they had claustrophobia, and would like the bus to be a bit bigger to counter this. Third, several participants said that they trusted a bus with a bright colour more. Because of its colour and size, the bus had gotten the nickname “the little yellow one” from the participants who were regular users. The participants came across as convinced that the yellow little bus was their favourite, due to their preference of its colour and design.

Finally, they expressed more trust in vehicles that had a design resembling ordinary buses/shuttle buses versus vehicles that looked more like regular private cars.

Illustrative quotations from the participants:

“Without being used to the yellow one, I would have gone with the one that is an eye-catcher. [The one up to the top is too similar] to a regular car, so I am more skeptical towards that one. The square shaped little one is the most appealing one to me.”

“I think color is important. So the yellow one, it is visible in traffic. But it may well be bigger”

“And the top one there, that is too similar to a regular car, so that one I would mistrust. So that small, square lump there, I think it appeals most to me.”

“I wouldn’t dare to get into a private car. I would think ‘What kind of maniac is sitting there?’ Even if it is no one sitting there”

“ [...] I get a bit claustrophobic in the little bus. I think I would have felt much better in a bigger bus regarding the size”

“The white one up to the left, (*a concept car with a futuristic design*) that one is a bit cute. But it should have been yellow”

“[The design] is more future-oriented. A bit more ‘Oh, there is something there, that’s how it will be in the future’. That’s what I think when I see it.”

The group of participants did not share much on the subject of sounds and other sensorial experiences as they (quote) “did not think about it”. The subject of sound was centered towards the act of making sounds, rather than the quality of sounds present. Regarding the act of making sounds - pinging-sounds in particular - the participants expressed that they found the vehicle to be incredibly silent and non-aggressive. Some of the participants noted that they found the autonomous vehicle to be too silent and anonymous in traffic and that they would prefer the vehicle to make more noise in order to increase levels of trust.

Discussion

The role of the host

What became apparent from the focus group was that the host’s role represented more for the participants than just safety in the case of the need of overriding the automation. The hosts informed passengers about how the bus works and socialized with the passengers. Contrary to a driver in a regular bus, the automation in this specific bus made it possible for the host to engage socially with passengers in a new way that all participants appreciated. This we view as an interesting message from the participants, especially as many of them represented groups that are among those scoring high on loneliness in the demographic of society, e.g., pensioners and the unemployed (Macdonald, Nixon, and Deacon 2018, 90-91) (Kim 2012), so similar transportation projects could possibly benefit psychological health in society. We suggest that this is an area of research that should be further explored.

In addition, it is possible that the perception of the setting in the bus as social and pleasant affected the participants’ trust in the technical aspects of the bus. There is some evidence that could back up such a relationship, as earlier studies suggest that there could be a direct relationship between mood and affect on trust developments (Schaefer et al. 2016, 382). One participant specifically expressed that the fact that the host seemed at ease and trusting in the bus, made them feel more comfortable and safer themselves. The younger participants expressed the need for a physically present host to trust the buses, while the older participants would not mind removing the host, but deeply appreciated the host’s social role. Based on this, it would seem that a total removal of hosts should be done gradually over time, to ensure the trust in the bus from more people.

Demographic factors

The fact that the older participants showed a greater trust in the autonomous vehicles than the younger ones fit well with existing research suggesting that older adults are more likely to trust vehicle automation and decision aids than younger adults (Schaefer et al. 2016, 381). It is worth noting that the elderly participants viewed the bus as solving specific everyday needs, while the younger had used it exclusively for the experience of trying an autonomous vehicle. As is stated in the literature, the perceived benefit of an automation can influence whether or not the automation will be trusted (Schaefer et al. 2016, 382).

The differences in trust between young and old in the group were possibly further increased by the differences in social capital. The older participants were pensioners where some of them had previous academic careers, but all had been active in the workforce and thus had a higher social capital. The two younger participants included one who was on welfare benefits and one who had a partner on welfare benefits. The level of trust in authorities has in research proven to be socioculturally qualified: low levels of trust vs high levels of trust in authorities is determined by the socio-cultural background of the individual (Segaard and Haugsgjerd 2020). For example, individuals with high social capital have more trust in authorities than individuals with low social capital (Vrålstad 2012). The differences in trust between the two age groups might be better explained by the differences in social capital than age. Generally speaking, Scandinavian countries score extremely high regarding 'trust', although recent reports do address challenges in preserving the status-quo (Andreasson, 2017).

Design

The notion of anthropomorphism became apparent quite early in the discussion: *Anthropomorphism* in the sense of attributing human assets and traits to a non-human instance. This may include the act of *nicknaming*. Asserting a nickname to an object may indicate a certain degree of personification and trust in the object, such as autonomous vehicles (Waytz, Heafner, and Epley 2014). Several of the participants referred to the bus as "the little yellow one" upon expressing their perceptions of the autonomous vehicle. Other human assets and traits that were mentioned include "cute" and "fun", when talking specifically about the "the little yellow one". This is not to say that all potential passengers would have nicknamed the autonomous vehicle. Rather, it is to say that the level of anthropomorphism amongst some of the passengers might have had an impact on their answers during the discussion, as this was not their first time riding with it, and the sensation of trust was already established based on anthropomorphism.

The size of the autonomous vehicle was also touched upon as a factor in trust. One of the participants shared how his experience of claustrophobia in relation to smaller vehicles affected his perception of the design. He would rather have preferred a vehicle with more space to breathe to counter the claustrophobia. The notion of claustrophobia is something to have in mind when discussing further production and implementation of autonomous vehicles in the public transport sector in order to ensure universal design. All the participants expressed that they wanted seats more like that of regular busses in public transport, which have more space around them. The bus being a bit "cramped" was the main critique of its design.

When presented with alternate designs some participants were concerned with the similarity to a regular private car if the bus decreased in size and changed appearance, associating the

autonomous vehicle with a taxi. The distrust in less spacious vehicles was due to the notion that one would share it with unknown passengers. This reaction could still be investigated further, perhaps in relation to cultural contexts and familiarity: The implementation of autonomous vehicles in the USA are taxis, whereas in Norway they are not taxis, which therefore produce different designs.

Limitations

The limitations of our study mostly concern the size and selection of the focus group. There were only five participants in the focus group and that the selection was done in such a way that the participants had all ridden the bus before and were positively predisposed to it. Therefore, more sceptical voices were not well represented though one participant dissented from the positive viewpoint on certain topics. The three older participants knew each other from before and their views largely overlapped. However, they represented one of the biggest user groups of the bus today and are therefore an important category of people to include.

On some occasions where some participants had positive opinions about the bus, they tended to address the representative from Brakar (on the “wrong side” of the table). As the bus is a test project, one possible theory is that these people wanted to convince the representative into keeping the bus a permanent offer. It is also possible that these participants were hesitant to express their negative thoughts in fear of losing the offer.

Conclusions

The main goal of the present study was to explore possible factors contributing to trust/distrust in automated vehicles by conducting a focus group with passengers that had taken the automated shuttle bus in Drammen. The focus group generated several interesting results that could be used as a steppingstone for future research on the topic. Despite the small number of participants in the study and the fact that there could be bias in our results because of selection issues, what we found conformed to the literature to a great extent. The older participants displayed a higher level of trust in automated vehicles generally than the younger ones. Trust seemed to increase with use and anthropomorphic features of the vehicle seemed to contribute to an increase of trust.

More surprisingly, we found that the shuttle bus in Drammen represented a valued social arena for most of the participants. This experience, we found, was highly affected by the presence of the host in the bus as well as with the fact that the small size of the bus created an intimate space. Even if it is intended that the host will be removed from the bus eventually, the presence of a host at an implementation stage of automated vehicles seems advisable. Aside from creating a socially comfortable atmosphere for the passenger, the host conveyed information and knowledge of how the bus worked to the passenger. This seemed to lead to an increase in passengers’ sense of safety and trust in the vehicle.

The design of Brakar’s bus was well received by the participants with the one caveat of too little space around the chairs. They also responded well to more futuristic designs and

negatively to more traditional car designs in the same size range. Future design considerations should be made towards comfort and space.

Having considered the limitations discussed previously, we still regard our findings as instructive to where new lines of research can be drawn concerning automated vehicles and trust. As there are gaps in the literature relating to human operators' and environmental factors' effect on trust development (Schaefer et al. 2016, 378), we suggest that our findings on the role of the host and on automated vehicles as social arenas can be a starting point for future research and help inform design and development today.

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Appendices

Appendix A - Questionnaire

Appendix B - The questions from the focus group

Appendix C - The powerpoint we showed the participants

Andre kommentarer?

Appendix B

Intervjuguide

Planlagt tidsbruk på intervjuet er 45-60 minutter. Det er åpne spørsmål og det vil bli stilt improviserte oppfølgings spørsmål for å komme dypere inn på temaene som er viktige for forbrukerne.

Presentasjon av moderator, det tekniske utstyret, servering, tidsbruk, gavekort, samt tidsplan for prøvekjøring.

Hver deltaker inkludert moderator presenterer seg selv for å varme opp gruppen og bryte «isen».

- Alle forteller kort om hvordan de «løser» sitt transportbehov per i dag
 - Bil, sykkel, buss, annet

- 1. Kan du fortelle om hvordan du synes denne bussturen var.**
 - a. Har du noen betraktninger rundt sikkerhet?
 - b. Hvordan vurderer du sikkerheten?
 - i. Hvordan kom du til den konklusjonen?
 - c. Hva ville forandret meningen din? *(La de først nevne fritt, deretter probe fra listen nedenfor)*
 - i. Fart
 - ii. Vert tilstede
 - iii. Type buss
 - iv. Rute
 - v. Utseende

- 2. Vil du benytte deg av denne typen tilbud? (Rekk opp en hånd dersom du ville benyttet deg av denne typen tilbud)**
 - a. Hvorfor / hvorfor ikke?
 - b. Burde tilbudet utvides?
 - i. Tid på døgnet
 - ii. Flere ruter

- 3. Se for deg at den selvkjørende bussen hadde vært likestilt med vanlig buss (større rute, flere tider på døgnet). Finnes det ganger der du ikke ville tatt den selvkjørende bussen? (La de først nevne fritt, deretter probe fra listen nedenfor)**
 - a. Alene
 - b. Tid på døgnet

- 4. Hva slags rolle hadde verten i bussopplevelsen?**
 - a. Hvor viktig er dette?

- 5. Se for deg at verten ikke er fysisk tilstede, men at det sitter en person i en vaktentral og passer på fra avstand. Hadde det endret opplevelsen?**
 - a. Hva trenger du eventuelt for å føle deg trygg i bussen?
 - i. Skjerm med video av vert

ii. Stemme

6. Ville du tatt denne bussen? Det er en selvkjørende buss som kjører en normal bussrute.

(Vis bilde av den nye selvkjørende bussen i Stavanger).

a. Hvorfor / hvorfor ikke?

7. Hvilket utseende foretrekker dere? [Viser bilder av ulike busser]

a. Hva synes der om lydene i bussen?

i. Skal de etterligne kjente lydeffekter fra vanlige biler/busser eller gå nye retninger?

8. Når det gjelder sikkerhet og trygghet – hva mener dere er de største utfordringene? Hva er det eventuelt kan oppleves som usikkert og utrygt?

(La de først nevne fritt, deretter probe fra listen nedenfor)

a. Egen sikkerhet?

b. Farten?

c. Andre kjøretøy i gatene?

d. Teknologien

i. Hva må til for at dere skal stole på teknologien?

e. Fotgjengere?

f. Barn?

g. Svaksynte /Funksjonshemmede?

h. Sykelister?

i. El-sparkesykler, Hoover Boards, enhjulinger?

j. Krasj/utforkjøring?

k. De andre passasjerene om bord?

i. Er det noen forskjell på hvordan kvinner og menn tenker her?

Ekstraspørsmål hvis det er tid:

9. Hva tenker dere må være på plass for at selvkjørende busser skal være et alternativ for dere?

a. Hvorfor akkurat ...?

10. Vi har vært litt inne på det, men dette med å føle seg trygg som passasjer i en selvkjørende buss, hva handler det om?

a. Hva er det man skal være trygg mot?

11. Hvis det faktisk skjer en ulykke, hva slags systemer / varslingsrutiner bør da være på plass?

a. Hvordan «løse» dette?

12. Hva med et system hvor bussen automatisk varsler dersom noe uforutsett skjer?

a. Hvordan ser dere for dere et slikt system?

i. Hvem skal varsles?

ii. Hvem skal rykke ut?

iii. Hvordan skal dere som passasjerer bli ivaretatt?

Appendix C

Førerløs buss med 40 plasser



Hvilken foretrekker du?



Preferred

Hvilken foretrekker du?



Preferred

