

Public Opinion on Route 12

Final report on the three panel survey waves regarding the pilot experiment of a self-driving bus service in Neuhausen am Rheinfall

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Executive Summary (English)

Due to the potential advantages of self-driving shuttle buses for individual travellers, the general population, and to the transportation system as a whole, it is essential to monitor public perceptions of this particular technological development. The execution of test runs with self-driving buses presents an excellent opportunity to do so. Alongside the introduction of Route 12 in Neuhausen am Rheinfall on March 27, 2018, the Institute of Science, Technology and Policy (ISTP) at ETH Zürich carried out a panel survey with three waves on the public perceptions of the test run as well as autonomous driving in general. On the whole, the test lab in Neuhausen am Rheinfall provides an excellent opportunity to assess whether and how such trials affect public perception, specifically regarding doubts and fears from a scientific perspective. This report describes the process of data collection and presents the results for all three survey waves carried out between February 2018 and October 2019 among a random sample of 8000 individuals representative of residents of three municipalities in the canton of Schaffhausen, Switzerland. The results can be summarized as follows:

- Awareness of and knowledge about the test run increased by approximately 30 percentage points from the first wave to over 90% in the third wave.
- Public perception of the Route 12 trial and autonomous driving in general remained stable at high levels.
- Residents assess the Route 12 project as worthwhile.
- Overall high and stable acceptance levels exist for the Route 12 trial in Neuhausen am Rheinfall, which is crucial for future technology adoption.
- Although no familiarity effects of the trial on public opinion was identified, the agreement with test runs increased slightly.
- Consequences of the trial for the general population, involved stakeholders and various other aspects are predominantly positive.
- Ride experience with Route 12 is vastly rated as positive, although travel speed is considered slow.

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Zusammenfassung (Deutsch)

Aufgrund der potenziellen Vorteile von selbstfahrenden Shuttlebussen für Reisende, das gesamte Verkehrssystem und die Bevölkerung generell ist es eminent wichtig, die öffentliche Wahrnehmung dieser technologischen Entwicklung zu untersuchen. Die Durchführung von Testfahrten mit selbstfahrenden Bussen bietet dazu eine hervorragende Gelegenheit. Im Zusammenhang mit der Einführung der Linie 12 in Neuhausen am Rheinfall am 27. März 2018 führte das Institute of Science, Technology and Policy (ISTP) der ETH Zürich eine Panelbefragung mit drei Wellen zur öffentlichen Wahrnehmung des Testlaufs sowie des autonomen Fahrens im Allgemeinen durch. Generell bietet der Test in Neuhausen am Rheinfall eine hervorragende Möglichkeit, zu beurteilen, ob und wie sich solche Versuche auf die öffentliche Wahrnehmung auswirken, insbesondere hinsichtlich Zweifeln und Ängsten. Der vorliegende Bericht beschreibt den Prozess der Datenerhebung und präsentiert die Ergebnisse aller drei Erhebungswellen, die zwischen Februar 2018 und Oktober 2019 unter einer repräsentativen Zufallsstichprobe von 8000 EinwohnerInnen aus drei Gemeinden im Kanton Schaffhausen, Schweiz, durchgeführt wurden. Die Ergebnisse lassen sich wie folgt zusammenfassen:

- Das Bewusstsein und das Wissen über den Testlauf stieg von der ersten Welle um ca. 30 Prozentpunkte auf über 90% in der dritten Welle.
- Die öffentliche Wahrnehmung des Versuchs der Linie 12 und des autonomen Fahrens im Allgemeinen blieb auf hohem Niveau stabil.
- Die AnwohnerInnen bewerten das Projekt der Linie 12 als positiv, auch hinsichtlich unterschiedlicher Aspekte.
- Insgesamt hohe und stabile Akzeptanz der Linie 12 in Neuhausen am Rheinfall, was für die zukünftige Technologieentwicklung entscheidend ist.
- Obwohl keine signifikanten Auswirkungen des Testlaufs auf die öffentliche Meinung festgestellt wurden, stieg die Übereinstimmung mit den Testläufen leicht an.
- Die Folgen der Studie für die allgemeine Bevölkerung, die beteiligten Interessengruppen und verschiedene andere Aspekte sind überwiegend positiv.
- Das Fahrerlebnis mit der Route 12 wurde mehrheitlich als sehr positiv bewertet, auch wenn die Geschwindigkeit des Busses als tendenziell zu langsam erachtet wird.

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1 Introduction¹

Self-driving vehicles will substantially change road traffic as we know it today. The absence of a driver and manual steering is expected to have many positive effects, for example on traffic safety or fuel consumption (Howard and Dai 2014). The associated transition thus provides the potential to reap various advantages for the current transportation system in general and travellers in particular. Ushered by advances in sensing, computing power, and electronics, autonomous vehicles are inching closer towards our roads. As the uptake of autonomous vehicles will highly depend on population acceptance, it is essential to monitor public perceptions of this technological development.

The execution of test runs with autonomous vehicles offers a good opportunity to assess public opinion on this issue. Since March 27, 2018, a self-driving bus has operated daily for four hours in Neuhausen am Rheinfall. Overall, the main focus of this test run has been to determine how a self-driving bus behaves in various traffic situations. In addition, this study aimed to assess public opinion towards the trial itself and automation in road traffic in general by conducting a panel study with residents from the canton of Schaffhausen, Switzerland.

In order for self-driving buses to become a reality in public transport, their operation must exclude attending agents. Nevertheless, this requires adjustments to laws and regulations. In a democracy, such adjustments can only be made if the population desires these changes, and it is therefore clear that the public's acceptance of automated driving is of crucial importance.

According to the Swiss Federal Council, intelligent mobility is a megatrend that Switzerland needs to thoroughly prepare for, for example to be prepared for the simultaneous existence of vehicles with different levels of automation. The upcoming challenges also include the clarification of several societal, ethical and political aspects, so that the necessary technical requirements and frameworks can be put in place. Further, it is necessary to answer questions related to planning and conceptualisation and to start the process of amending the relevant legislation and regulatory frameworks (Bundesamt für Strassen ASTRA 2018). These open questions range from adjusting traffic laws, licensing of vehicles, regulations regarding drivers licenses and liability for data protection and accessibility of data (Schweizerische Eidgenossenschaft 2016). Therefore, amendments within the road traffic law will be necessary.

To examine public acceptance with objective criteria, the Institute for Science, Technology and Politics (ISTP) at ETH Zürich conducted a panel study on perceptions of the local population. Randomly selected individuals in three municipalities of the canton of Schaffhausen (Neuhausen am Rheinfall, Stein am Rhein and Thayngen) were invited to participate in a panel

¹ Earlier results from the first two panel waves can be found in the two interim reports for the first wave (Wicki and Bernauer 2018) and the second wave (Wicki and Bernauer 2019). The results presented in this report are partly based on chapters 3 and 4 of the dissertation by Wicki (2020).

study before the project and two times throughout. The questions revolved around the project itself and autonomous driving in general.

Previous studies on autonomous driving have mainly focused on the technical optimisation of vehicles, while specific questions regarding the community's view on autonomous driving technologies remained mostly unanswered. Our research project thus concentrates on the public perception of autonomous driving and the introduction of a self-driving shuttle service. We investigate support, fears, and concerns regarding the introduction of an autonomous bus service in Neuhausen am Rheinfall, as well as autonomous driving in general.

This report is structured as follows. The next chapter will describe the aim of the research project and the research plan. The third chapter will outline the execution of the three waves of the panel survey, as well as the responses. Fourth, results of the panel survey regarding public perception will be discussed in comparison to the first survey. Lastly, a conclusion finishes the report.

2 Research project

The implementation of a test run for a self-driving shuttle bus contains societal as well as political challenges, but also enables the investigation of open questions. The research project was executed in the context of the introduction of Route 12 in Neuhausen am Rheinfall. The project was executed in collaboration with Trapeze Switzerland, AMoTech, Verkehrsbetriebe Schaffhausen VBSH, and Regional Development of the Canton Schaffhausen. The goal was to determine the public perception of the autonomous shuttle bus in Neuhausen am Rheinfall at three different points in time.

2.1 Research aim

The public's attitude towards and trust in technology has proven to be critical in the process of building support regarding technological innovations (Venkatesh, Thong, and Xu 2012). Building on these findings, the following research question is investigated:

How is Route 12 in Neuhausen am Rheinfall as well as, by association, autonomous driving in general perceived by residents?

The research results lead to important insights relevant to politics. Positive effects are expected due to the automation of road traffic and the associated removal of human error. In order for these effects to occur, it is important that autonomous vehicles are accepted by society. Trust in as well as attitude towards technology are central to the process of building support. Research into these attitudes thus assists in increasing support, for example through providing information on the topic beforehand. The survey also enabled us to collect feedback regarding the autonomous shuttle service.

2.2 Participating municipalities

The three survey waves were carried out in three municipalities: Neuhausen am Rheinfall, Stein am Rhein and Thayngen. Neuhausen am Rheinfall is directly involved in the introduction of Route 12. Stein am Rhein and Thayngen serve as control groups. This enabled us to gather relative changes in the perception of autonomous driving.

The three municipalities are all situated within the canton of Schaffhausen. Compared to Neuhausen am Rheinfall, Stein am Rhein only has a third of the population. The proportion of foreign residents is highest in Neuhausen am Rheinfall with approximately 40%, while Stein am Rhein and Thayngen have around half this rate at just over 20%. The age distribution is similar in all three municipalities. However, Stein am Rhein has the highest proportion of residents over 65 years at 24%, while in the other two municipalities, this share is around 20% (Bundesamt für Statistik BFS 2018).

Stein am Rhein and Thayngen were chosen as control groups in order to ensure comparability with Neuhausen am Rheinfall, while at the same time also guaranteeing enough geographical distance. However, this geographical distance could be decreased through commuting to work. Most of the residents in the investigated municipalities work in other places. However, they mainly commute to the city of Schaffhausen and the canton of Zürich. Commuter routes between the investigated municipalities are rare, which thus decreases possible spillover effects (Bundesamt für Statistik 2015).

2.3 Research plan

We planned a panel interview in three municipalities within the canton of Schaffhausen. The panel consisted of three waves of surveys. The first survey was carried out before the introduction of Route 12 in Neuhausen am Rheinfall. Approximately nine months and 18 months after the start of the shuttle services respectively, the other two surveys were carried out.

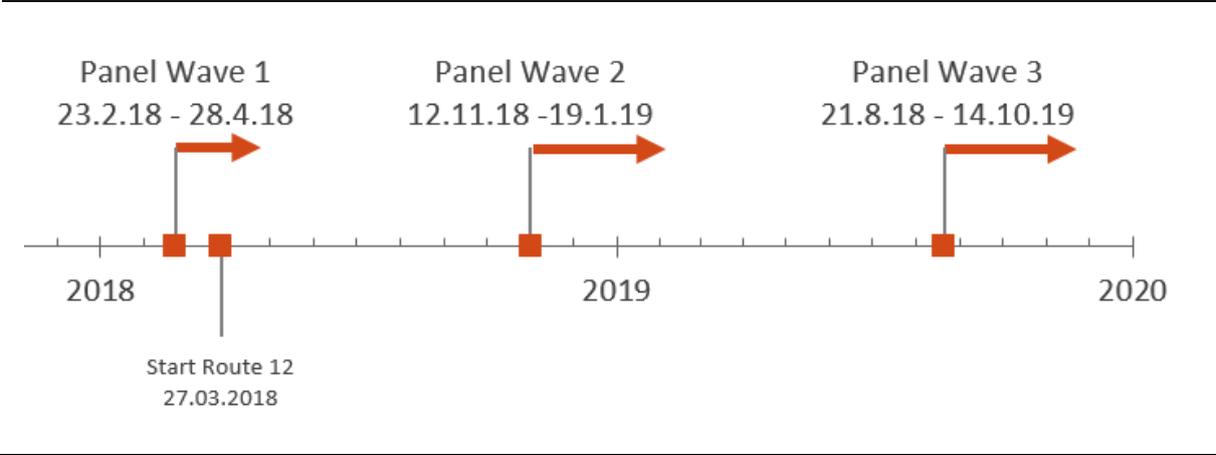
3 Survey waves

This section describes the survey methodology for the three survey waves. First, we provide an overview of the general survey procedure for each wave. Second, we present descriptive statistics regarding response behaviour and sample sizes of the three panel waves.

3.1 Survey procedure

To study public attitudes regarding the implementation of the self-driving shuttle trial in Neuhausen am Rheinfall, we conducted three survey waves. To do so, we conducted a first survey before the trial started in March 2018 and two follow up surveys. An overview of the timeline for all three survey waves is displayed in Figure 1.

Figure 1: Survey Panel Timeline



For the first survey in Neuhausen am Rheinflall and the control groups in Stein am Rhein and Thayngen, a total of 8,000 people were contacted. The data was collected through an online panel survey. Invitations to participate in the online survey were sent out via post. Ten days after the first invitation, reminder letters were sent out to those people who had by then not completed the survey and had also not informed us that they did not wish to do so. To send these invitations and reminders, we received the following information from the respective municipality: gender, name, surname, address, municipality, postcode and age. These data will be irrevocably deleted after the completion of the study in line with the research ethics at ETH Zürich (EK 2018-N-01). The recipients were initially drawn randomly from the register of residents of the three municipalities Neuhausen am Rheinflall, Stein am Rhein, and Thayngen. All participants were aged 18 or older.

Individuals who requested it were sent a paper version of the questionnaire. This approach allows subjects without access to a computer or an internet connection to participate (mainly people of old age). This approach is based on an internet penetration rate in Switzerland of 87%; a pure online questionnaire would exclude approximately 13% of the population of interest. Such an exclusion could lead to population coverage issues. Moreover, lack of computer skills may still hinder the ability to participate in the survey, even if individuals have access to internet. Therefore, to address this coverage bias, we employ a mixed mode survey, as suggested by Sterret et al. (2017).

At the end of the first survey (Wicki and Bernauer 2018), respondents were asked whether they wanted to participate in a second and third part, and were informed about the incentive of CHF 10 for these two parts. If the respondents indicated a willingness to partake in the survey, they either received a personal direct link to participate or an invitation letter with a web address and an individual access code for the online survey, which was conducted using a web script hosted by Qualtrics. Respondents that completed the first wave on a paper questionnaire and were willing to partake in the follow-up surveys again received a paper version.

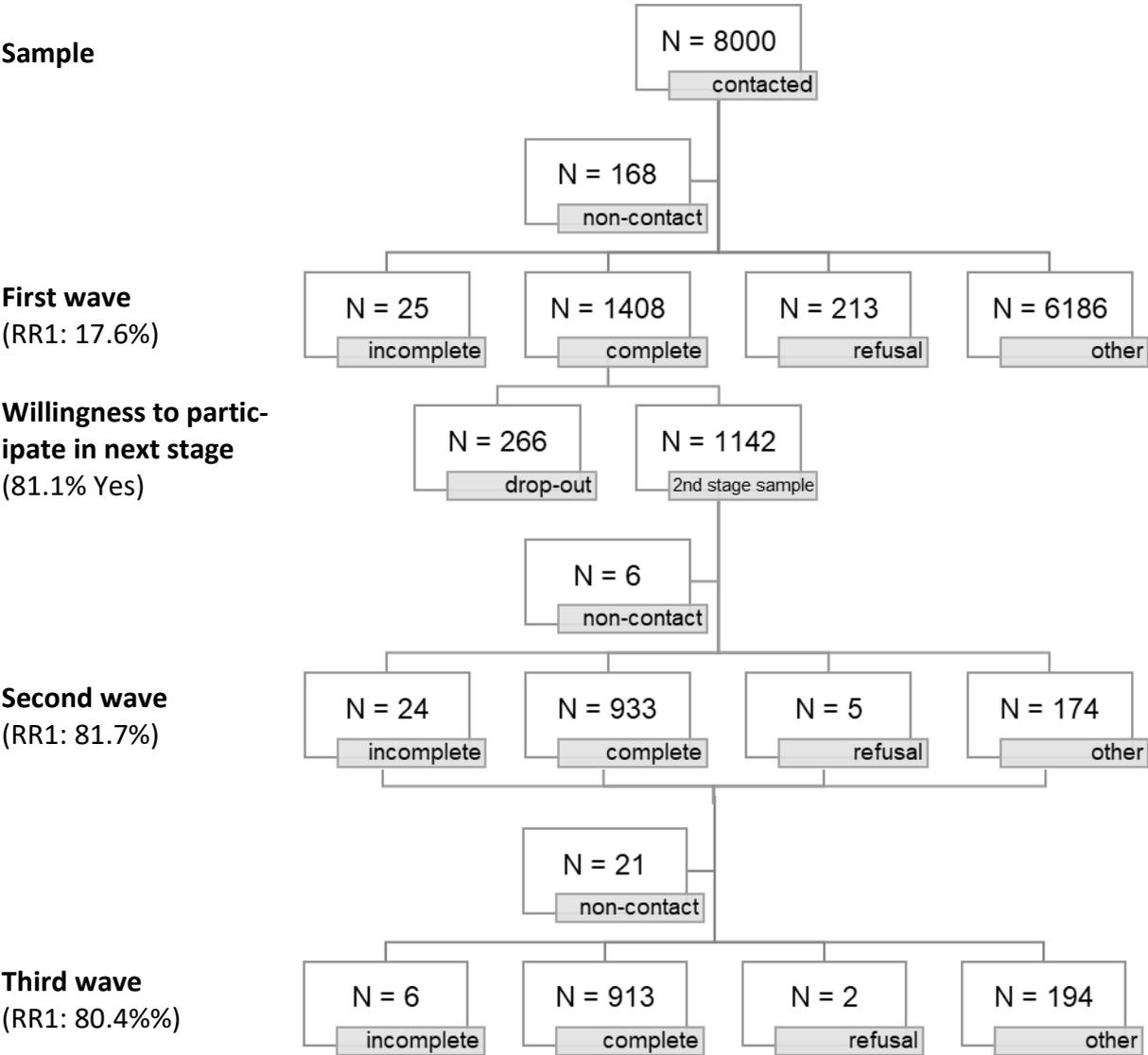
In November of 2018, we sent out an invitation to participate in the first follow-up survey wave to 1,142 residents of the three municipalities Neuhausen am Rheinfall, Stein am Rhein and Thayngen in the canton Schaffhausen who already participated in the first survey and indicated their willingness to do so for two follow-up surveys.

In late August of 2019, we sent out an invitation to participate in the third and final panel wave to 1,136 residents of the three municipalities Neuhausen am Rheinfall, Stein am Rhein and Thayngen. This sample consists of the same residents contacted in the second wave minus individuals that we were not able to contact.

3.2 Responses

Figure 2 shows the stages of the three survey waves. Initially, we contacted a sample of 8,000 residents of the three municipalities Neuhausen am Rheinfall, Stein am Rhein, and Thayngen in the canton of Schaffhausen. Of this originally contacted sample, 168 people were not contacted or were not available due to reasons such as illness. Of the remaining sample, 154 did not consent on the consent form within the survey or contacted us to confirm that they were not taking part. Of the remaining people invited via letter, 1,537 began the survey and 1,408 completed it. 150 participants completed the survey partially. At the end of the survey, participants were asked whether they would like to participate in two further surveys. 1,142 participants consented to this and are thus the basis of the two follow-up survey waves.

Figure 2: Survey stages and participation



Note: Definitions are based on The American Association for Public Opinion Research (2016). "Other" summarizes all contacts that were successfully contacted but did not (partially) complete, refuse, or break off the questionnaire.

Table 1: Responses, response rates and scope of random sample^a

| | First Wave | | | Second Wave | | | Third Wave | | |
|------------------------------------|------------|------------------|-------|-------------|-------|-------|------------|-------|-------|
| | Online | Paper | Total | Online | Paper | Total | Online | Paper | Total |
| Complete responses {I} | 1306 | 102 | 1408 | 879 | 54 | 933 | 860 | 53 | 913 |
| Partial Responses {P} | 23 | 2 | 25 | 24 | 0 | 24 | 6 | 0 | 6 |
| Refusal and dropout {R} | 213 | 0 | 213 | 5 | 0 | 5 | 2 | 0 | 2 |
| Not contacted {NC} | 168 | 0 | 168 | 6 | 0 | 6 | 17 | 3 | 20 |
| Other {O} | 6174 | 12 | 6186 | 166 | 8 | 174 | 189 | 5 | 194 |
| Used sample {TS} | 7884 | 116 ^b | 8000 | 1080 | 62 | 1142 | 1074 | 62 | 1135 |
| Response rate 1 {I/TS} | 0.166 | 0.879 | 0.176 | 0.814 | 0.871 | 0.817 | 0.801 | 0.855 | 0.804 |
| Response rate 2 {(I+P)/TS} | 0.169 | 0.897 | 0.179 | 0.836 | 0.871 | 0.838 | 0.806 | 0.855 | 0.810 |
| Cooperation rate 1 {I/(TS-NC)} | 0.169 | 0.879 | 0.180 | 0.818 | 0.871 | 0.821 | 0.814 | 0.914 | 0.819 |
| Cooperation rate 2 {(I+P)/(TS-NC)} | 0.172 | 0.897 | 0.183 | 0.841 | 0.871 | 0.842 | 0.819 | 0.914 | 0.824 |
| Cooperation rate 3 {I/(I+P+R)} | 0.847 | 0.981 | 0.855 | 0.968 | 1.000 | 0.970 | 0.991 | 1.000 | 0.991 |
| Cooperation rate 4 {(I+P)/(I+P+R)} | 0.862 | 1.000 | 0.871 | 0.994 | 1.000 | 0.995 | 0.998 | 1.000 | 0.998 |
| Refusal rate 3 {R/TS} | 0.027 | 0.000 | 0.027 | 0.005 | 0.000 | 0.004 | 0.002 | 0.000 | 0.002 |
| Contact rate 3 {(TS-NC)/TS} | 0.979 | 1.000 | 0.979 | 0.994 | 1.000 | 0.995 | 0.984 | 0.935 | 0.982 |

Note: Definitions are based on The American Association for Public Opinion Research (2016). “Other” summarizes all contacts that were successfully contacted but did not (partially) complete, refuse, or break off the questionnaire.

^a The numbers correspond to a response rate, cooperation rate, refusal rate and contact quota defined by the American Association for Public Opinion Research (The American Association for Public Opinion Research 2016).

^b Corresponds to the number of people that requested and received a paper version of the survey.

Table 1 shows the response rate and number of responses for the online and paper and pencil versions, as well as the general number of respondents for the second survey (based on the number of individuals recruited from the first survey, N=1142). Unsurprisingly, as respondents were contacted for the second time, the contact rate (contact rate 3) was high at 99.5%. Of the contacted individuals, 0.4% actively refused to participate in the second survey (refusal rate 3), even though they initially agreed to after the first survey. The response rate for the second survey was 81.7% (response rate 1), or 83.6% when partial answers were included (response rate 2). The cooperation rate was 82.1% (cooperation rate 1) and 84.2% (cooperation rate 2) respectively. In general, the response was slightly better for the paper and pencil versions.

In the second survey wave, we contacted the 1142 respondents recruited from the first survey wave. Six people were not contacted or were not available due to reasons such as illness. Of the remaining sample, five individuals contacted us to confirm that they were not taking part. Of the remaining people invited, 957 started the survey and 933 completed it. A total of 24 participants completed the survey partially, and overall, 174 people did not respond to the invitation, but were contacted again for the third wave.

In the third and final survey wave, we contacted the 1136 respondents that were successfully contacted in the second survey wave. Twenty people were not contacted or were not available due to reasons such as illness. Of the remaining sample, five individuals contacted us to confirm that they were not taking part. Of the remaining people invited, 919 started the survey and 913 completed it. Six participants completed the survey partially, and overall, 195 people did not respond to the final invitation. A total of 819 respondents completed all three surveys and thus reflect the relevant sample to compare how public perceptions of the self-driving bus trial and autonomous driving in general developed over time.

4 Results

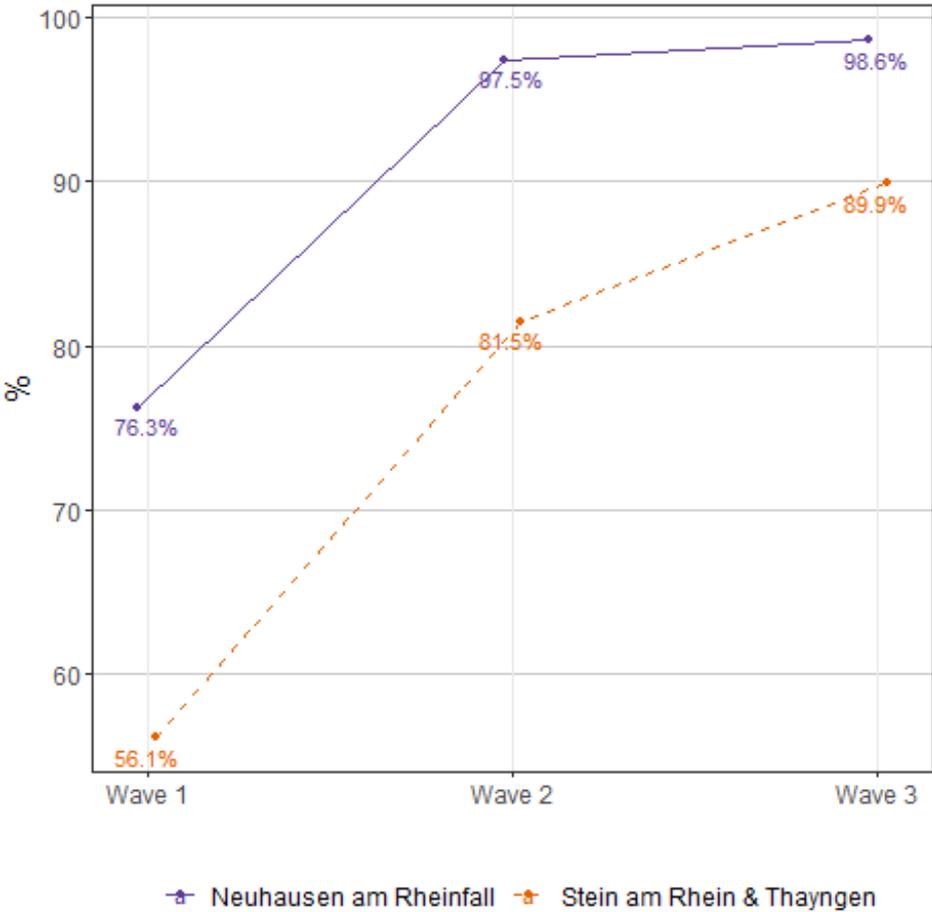
The following chapter details initial results from the three panel survey waves. To begin, we discuss questions regarding public perception of Route 12, and afterwards, we discuss how respondents assess autonomous driving and related concerns in general and how that has or has not changed over the experience of the trial in Neuhausen am Rheinfall.

4.1 Public Perception of Route 12

As for the test trial in Neuhausen am Rheinfall, the awareness of residents about Route 12 departs from an interesting perspective. Figure 3 shows how many respondents among the three municipalities were aware about the test run in Neuhausen am Rheinfall at each of the three survey waves. Generally, knowledge about the test run was rather high and increased steadily. Unsurprisingly, Neuhausen am Rheinfall residents had the highest knowledge, starting with 76.3% in the first wave and increasing to 97.5% at the second and 98.6% at the third

wave. Residents from the two control municipalities Stein am Rhein and Thayngen were slightly less informed, which can be explained given their geographical distance from the test trial of Route 12. Compared to the first survey that was conducted before the launch of Route 12, knowledge about the test trial still increased from 56.1% in the first wave to 81.5% in the second wave and almost 90% in the third wave for respondents from these two municipalities. Overall, awareness among all three municipalities increased by approximately more than 30 percentage points.

Figure 3: Awareness about the Route 12 test run by municipality (N=819)

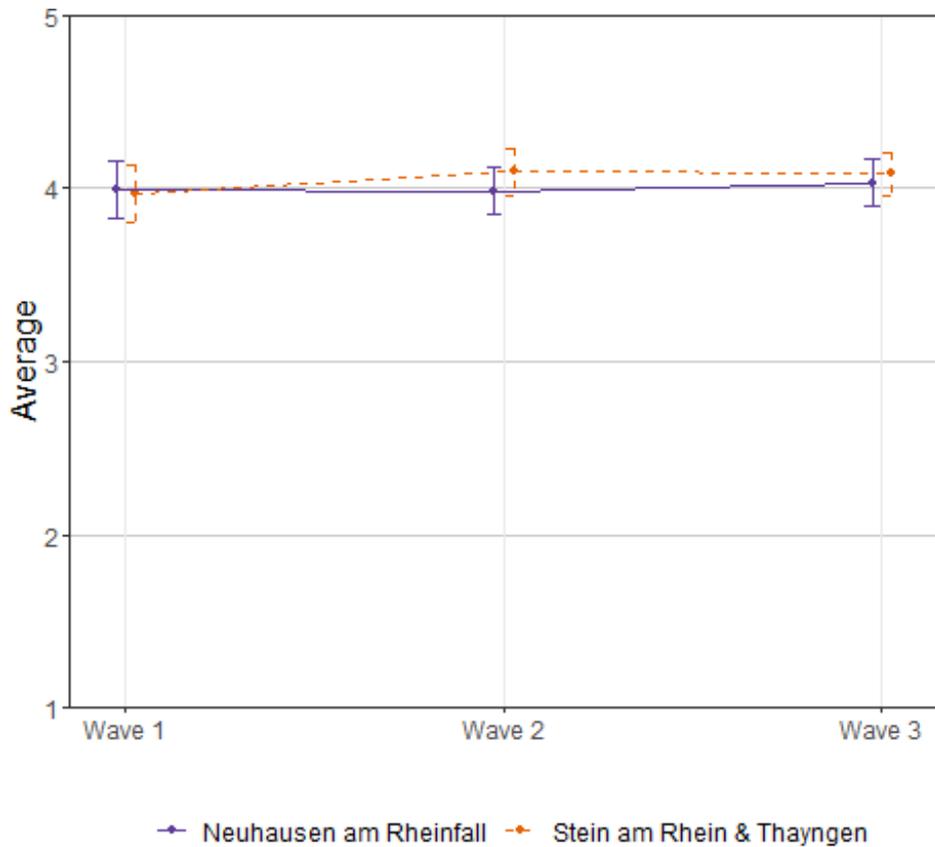


Note: Awareness about the test run was coded «yes» if the participants could answer both the question « Do you know whether tests with autonomous cars or buses are planned or already taking place in the canton of Schaffhausen?» with “Yes”, as well as the question “In which municipality in the canton of Schaffhausen do you think such tests with autonomous cars or buses are taking place?” with “Neuhausen am Rheinfall“. All other participants were coded as “No”.

Figure 4 displays the general assessment of Route 12 for the three survey waves. The average assessment was constantly at around 4 on a 5-point scale. Over two thirds of participants who were aware of the project chose the two highest categories on a scale of “pointless” to “worth-while” in all three panel waves. Public support for Route 12 thus seems to be clearly present. Compared to the first survey, the general assessment of Route 12 increased slightly, but the

change was not statistically significant, in the last two waves. In absolute numbers, the lowest two categories were chosen with around four percentage points less in the second and third waves.

Figure 4: General assessment of Route 12



Note: Answer to the question «How do you assess the autonomous bus project in Neuhausen am Rheinfall in general?» on a scale of 1 (pointless) to 5 (worthwhile).

Figure 5 displays results from the third wave on the assessment of various aspects of the self-driving shuttle Route 12. Specifically, we asked respondents about how they assess the consequences of the self-driving shuttle service on the provision of public transport, the economy, the number of accidents, the protection of the environment, general traffic and travel time on a 5-point Likert scale ranging from negative to positive. Overall, the assessment of these aspects was generally highly positive. For both the provision of public transport and the economy, a vast majority of around 70% expected the consequences to be positive. Almost 80% even expected benefits regarding the protection of the environment. Respondents views were, however, a bit more divided regarding consequences on the number of accidents and traffic – although both aspects were still rated more positively than negatively. When it comes to travel time, however, around 30% assessed the Route 12 trial to have negative consequences. This result can be explained by the rather slow travel time of the self-driving shuttle (around 25km/h).

Figure 5: Assessment of various consequences of Route 12 (N=808)

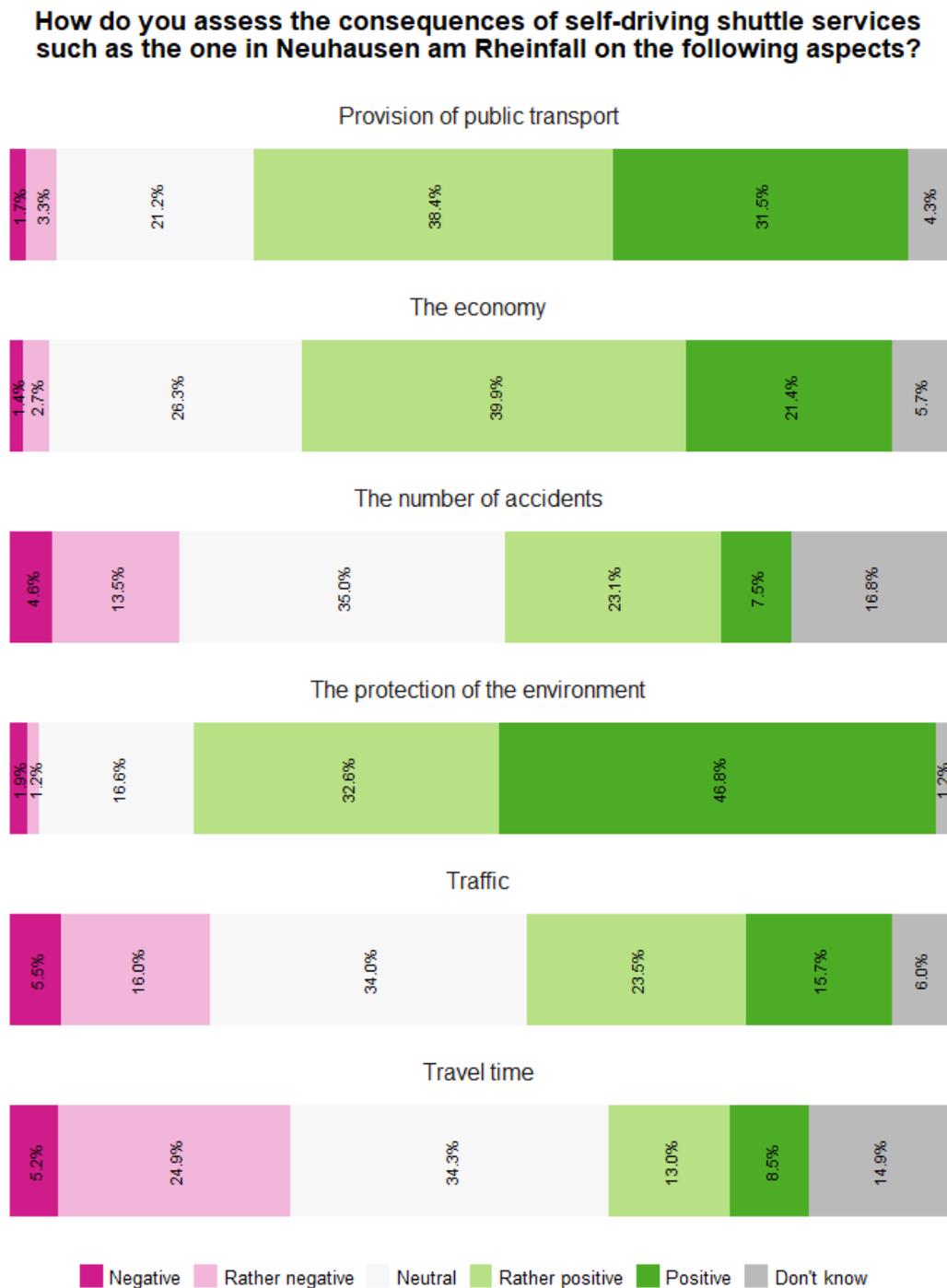


Figure 6 displays results from the third wave on the assessment of the self-driving shuttle Route 12 on different aspects regarding locational advantage and development as well as involved stakeholders. Specifically, we asked respondents about how they assess the consequences of the self-driving shuttle service on Neuhausen am Rheinfall as a business location, Swiss image, the image of Neuhausen am Rheinfall regarding new technologies and also how this would attract new businesses, the image of the involved industry partner (Trapeze), and

the provider (Verkehrsbetriebe Schaffhausen) on a 5-point Likert scale ranging from negative to positive. Overall, respondents indicated the consequences to be predominantly positive on all actors and aspects. The overall highest rating of positive consequences was regarding Neuhausen am Rheinflall as being open-minded towards new technologies.

Figure 6: Assessment of consequences of Route 12 on different stakeholders (N=808)

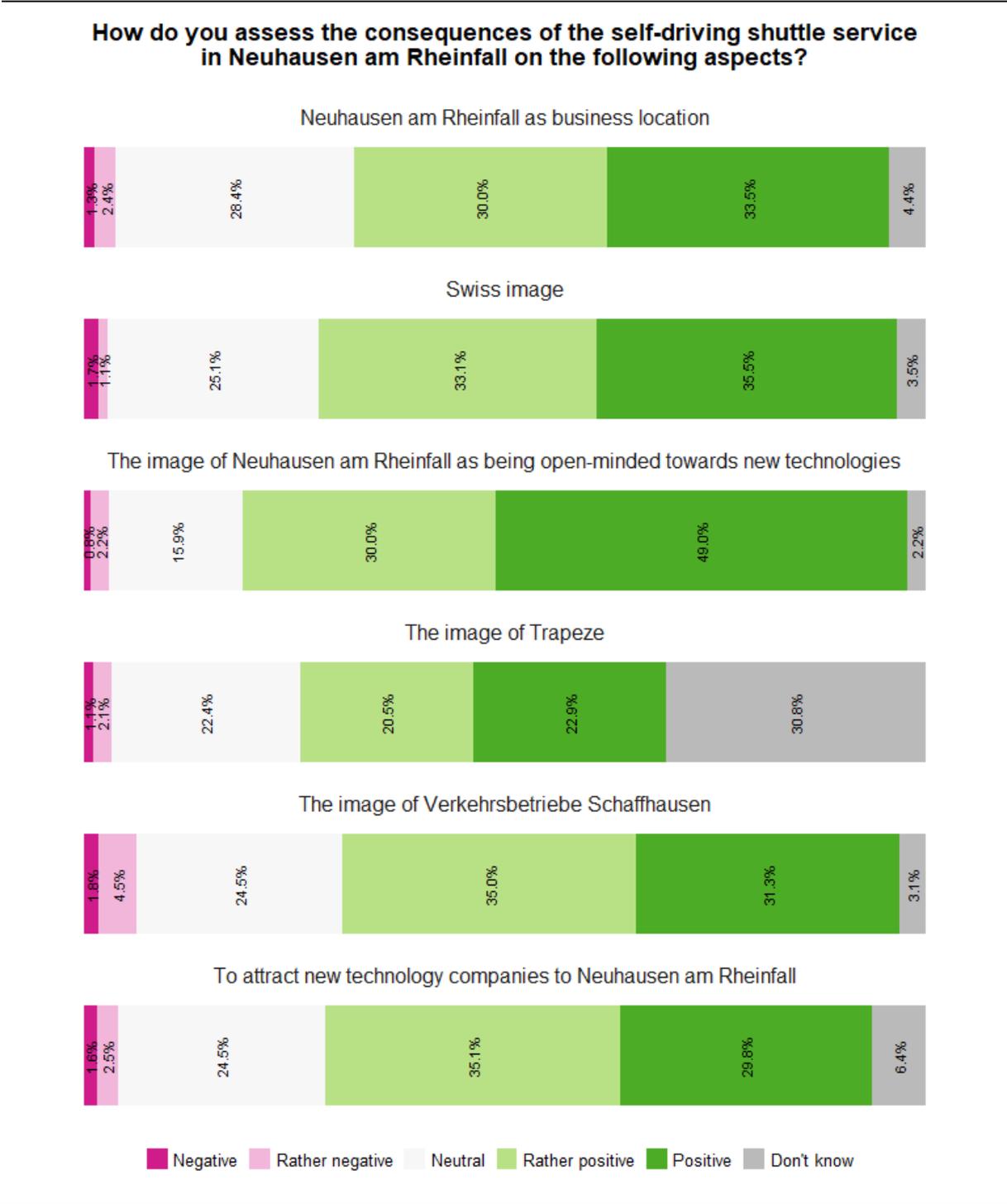


Figure 7: Assessment of consequences of Route 12 on different population groups (N=808)



Figure 7 displays results of the assessment of the self-driving shuttle service and its effect on different population groups. Specifically, we asked respondents about how they assess the consequences of the self-driving shuttle service on commuters, elderly people, people with

disabilities, people without a driving licence, residents' quality of life, the safety of children on their way to school, and tourists on a 5-point Likert scale ranging from negative to positive. The presented results appear to be somewhat ambiguous. While a vast majority of respondents agreed that such a self-driving shuttle has positive consequences for people without a driving license, residents' quality of life and tourists, respondents were somewhat more divided regarding the other aspects. While for both commuters and children's safety on their way to school a relative majority rated the consequences as being positive, respondents expected negative consequences for elderly people and people with disabilities. The reason(s) for these results can only be speculated. It might be possible that respondents do not consider the bus as being easily used by disabled and elderly people and thus do not see any benefit for them when introducing such a self-driving shuttle.

4.2 Ride Experience

Ride experience is likely to highly affect the perception of autonomous vehicles in general and Route 12 specifically. Therefore, we included questions for respondents who indicated they had already tried the self-driving bus Route 12. Overall, a vast majority of around 63% of the respondents that had already used Route 12 rated their experience as rather or very positive, whereas only 12% of this group indicated the experience as rather negative.

Figure 8 summarizes responses on the general perception of the trip as rated by the respondents. Specifically, we asked respondents to rate comfort, reliability, spaciousness, time efficiency, and usefulness of the self-driving bus on a 5-point Likert scale ranging from very poorly to very good. Overall, ride experience was predominantly positive. More than 50% of the respondents rated comfort, reliability, spaciousness and usefulness of the self-driving bus as good or very good. Only time efficiency was rated poorly by almost 45% of respondents, indicating a certain level of dissatisfaction with the speed of the Route 12 shuttle bus.

Figure 8: Ride experience (residents, N=209)



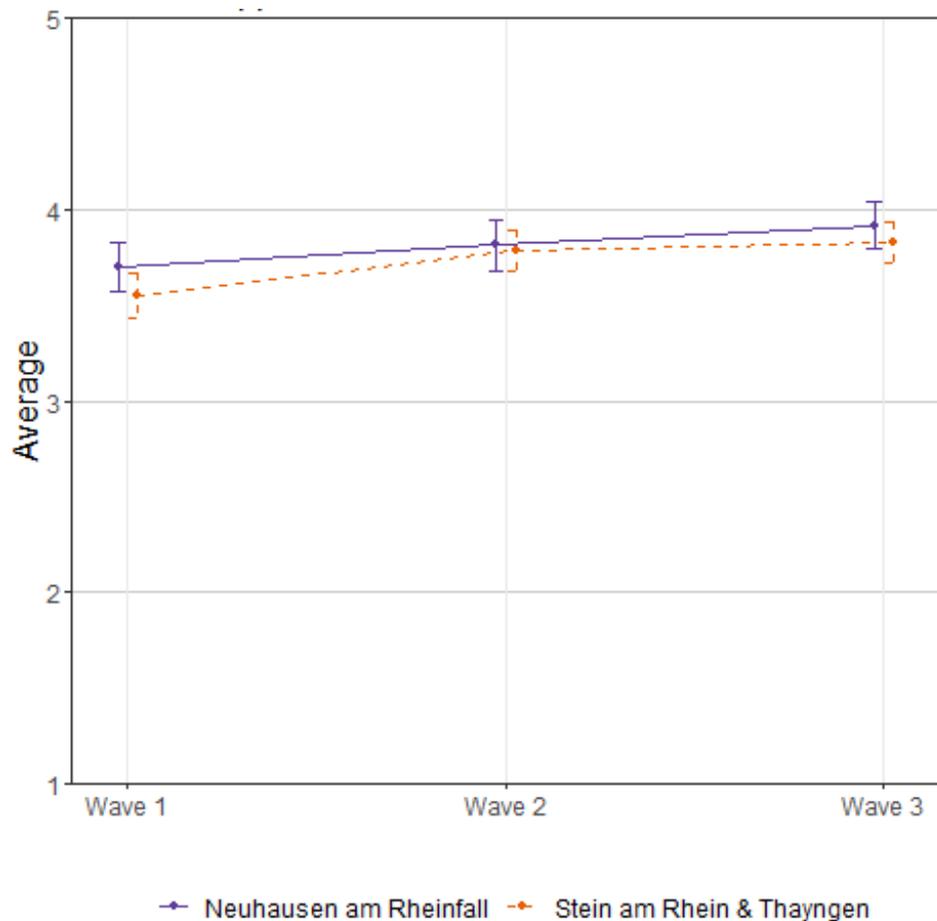
Note: Responses to the question «You have indicated that you were on the autonomous bus. How do you rate the following aspects of the trip?» on a scale from very poorly to very good.

4.3 General Perception of Autonomous Driving

This section aims to show how acceptance and concerns regarding automated driving in general change over time due to familiarity effects when residents experience the implementation of a trial (see Wicki 2020 for details). The assumption that familiarity effects will lead to an increase in acceptance levels is based on economic research, which has shown that direct experiences can affect individuals' attitudes (see, for example, Ackerberg 2003). Therefore,

differences in acceptance of automated driving in general before and during the implementation of the trial could be expected.

Figure 9: Support for test runs in Switzerland. Comparison of three survey waves (N=819).

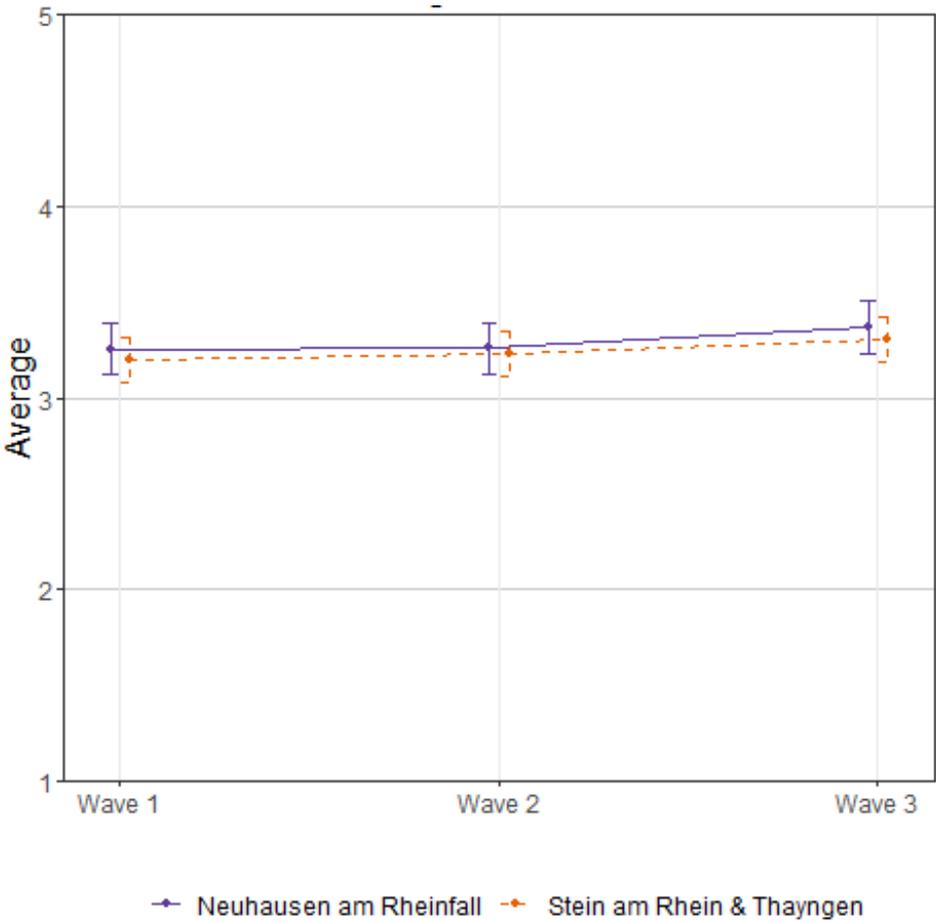


Note: Responses to the question «Autonomous cars and buses are currently being tested at various locations in Switzerland. In general: How much do you support or reject such attempts?» on a scale of 1 (totally reject) to 5 (fully support). The average represents the responses for the same individuals in both surveys. The ranges represent the 99% confidence intervals of the replies and thus the statistical margin of error.

Figure 9, Figure 10, and Figure 11 display the predictive margins of the effects of the self-driving bus service implementation in Neuhausen am Rheinflall on support for self-driving vehicle tests in Switzerland (Figure 9), confidence in self-driving vehicles (Figure 10), and support for a change in the traffic regulation act (Figure 11). The aim is to test whether familiarity with a self-driving shuttle increases positive attitudes towards automated driving in general. The effects are displayed separately for Neuhausen am Rheinflall, where the trial takes place, and the two control municipalities (Stein am Rhein and Thayngen). Results, however, do not indicate any statistically significant difference among the two groups before the implementation (wave 1) and during the ongoing trial (wave 2 and wave 3) nor any statistically significant change over time.

In Switzerland, there have been several test trials with self-driving vehicles. Figure 8 shows whether the participants in the three municipalities agree with those. Generally it can be said that a majority agrees with such tests. Comparing the results from the first to the second and third survey waves, the support for such tests slightly increased, but the change was not statistically significant. However, the average support level over all three waves remained stable at rather high levels.

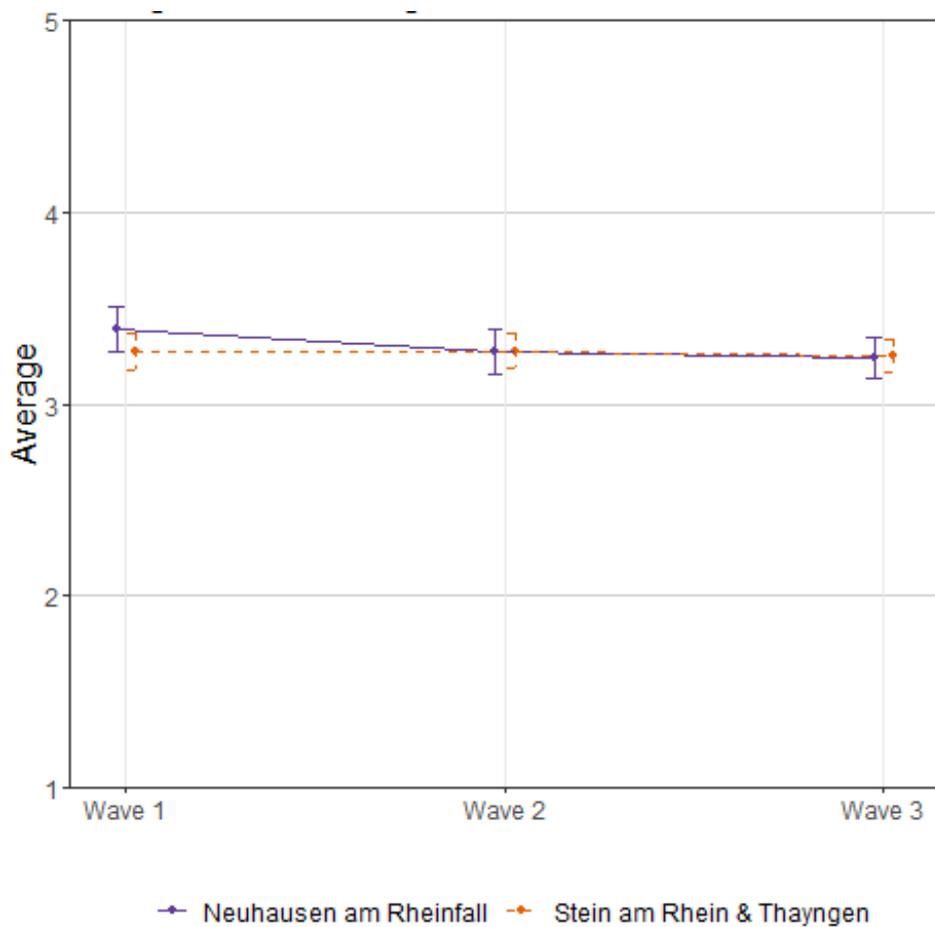
Figure 10: Confidence in self-driving vehicles. Comparison of three survey waves (N=819).



Note: Responses to the question «In general: How concerned or not concerned are you about the increasing automation of road traffic?» on a scale of 1 (very concerned) to 5 (not concerned at all). The average represents the responses for the same individuals in both surveys. The ranges represent the 99% confidence intervals of the replies and thus the statistical margin of error.

Figure 10 displays results for how confident respondents are with self-driving vehicles in general. Results are stable overall. On average, respondents stated they were confident with automated driving in general. However, some respondents still remain latently sceptical when it comes to concerns regarding self-driving vehicles.

Figure 11: Agreement to change road traffic regulation. Comparison of three survey waves (N=819).



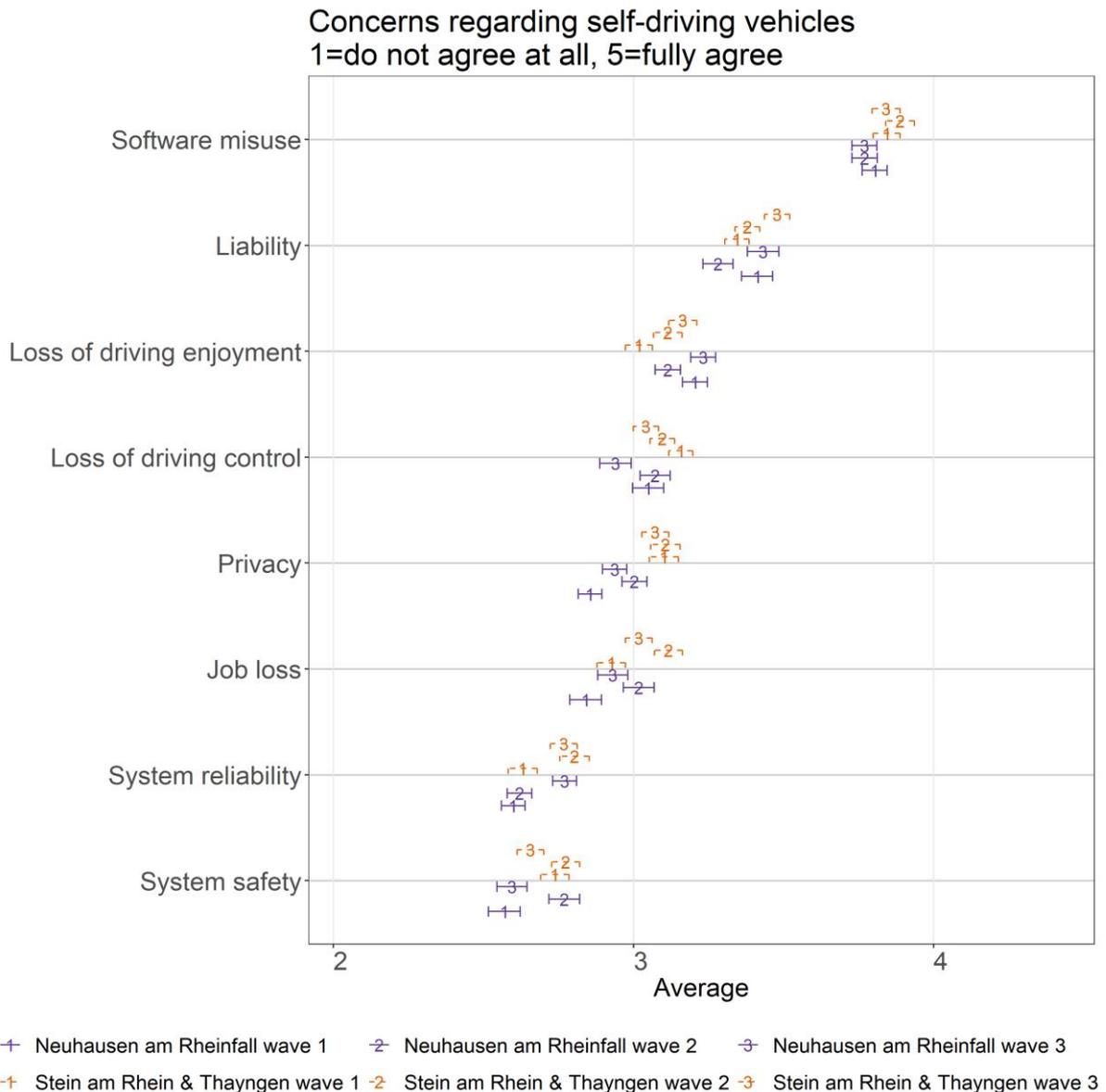
Note: Responses to the question «The use of self-driving cars and buses is currently only possible with a special permit. Should the Federal Council and Parliament amend the Road Traffic Regulations as quickly as possible in order to allow self-driving vehicles on the road or to stop them altogether?» on a 5-point Likert scale ranging from “do not allow self-driving cars and buses at all” (1), over “keep current regulation” (3), to “allow self-driving cars and buses” (5). The average represents the responses for the same individuals in both surveys. The ranges represent the 99% confidence intervals of the replies and thus the statistical margin of error.

This latent scepticism can also be seen in the question regarding how willing respondents would be to change the current road traffic regulation in order to allow self-driving vehicles in road traffic. Specifically, we measured how residents would be willing to change the current road traffic act by either allowing or restricting self-driving vehicles on regular streets – compared to the current regulation, where they are only allowed with a special permit. Figure 11 shows that the average response remained rather stable over the three survey waves. Generally, respondents were in favour of allowing self-driving cars in road traffic, but predominantly preferred to keep the current legislation.

Figure 12 shows the extent to which survey participants agreed or disagreed with the listed concerns regarding autonomous driving. The results are displayed for responses by the same respondents for all three survey waves. In order to collect respondents’ concerns regarding

autonomous driving, participants were asked to rate their concern about specific statements regarding the comprehensive introduction of autonomous cars and buses.

Figure 12: Concerns regarding autonomous driving. Comparison of three survey waves (N=819).



Note: Responses to the question «How concerned or not concerned are you about the below listed statements regarding autonomous vehicles?» on a scale from 1 (do not agree at all) to 5 (fully agree).

Overall, no patterns of significant changes in general concerns regarding AVs can be observed. These results appear to be in line with and similar to the previous three graphs. Comparing Neuhausen am Rheinfall with Stein am Rhein and Thayngen, no effect of a decrease in concerns occurs in any of the belief measures. In contrast, the only statistically significant results

regarding differences appear to occur for the measure of system reliability, where — counter-intuitively — the average decreases in Stein am Rhein and Thayngen and only to a small extent in Neuhausen am Rheinfall.

5 Conclusion

This report describes the process of data collection and presents the results for the three panel surveys that were carried out between February 2018 and October 2019 among a random sample of 8000 residents from three municipalities in the canton of Schaffhausen, Switzerland. A total of 819 respondents replied to all three panel waves, which defines the main sample of interest. The goal of this study was to identify public opinion towards the Route 12 self-driving bus trial and automated driving in general. Furthermore, the aim was to detect how acceptance changes over time when experiencing the implementation of a trial.

The results presented in this report show very high levels of acceptance for the trial in Neuhausen am Rheinfall and, to a lesser extent, automated driving in general. Such high levels of acceptance are crucial for the technology's future adoption. However, acceptance levels did not increase much with experience of the trial. This result is not surprising as these low or even non-existing familiarity effects can be explained by generally stable and high acceptance levels. However, some latent scepticism that unfolds in specific concerns towards automated driving appear to be ubiquitously and subconsciously present.

Overall, compared to the first survey wave, the results of the second and third waves turned out to be rather stable. Both public perception of Route 12 as well as concerns and views regarding autonomous driving in general only slightly changed, but not in a statistically significant manner. However, the agreement with test runs in Switzerland slightly increased.

Regarding the ride experience, both the general experience as well as aspects such as comfort and reliability were rated predominantly positive. However, effects on and experience of travel time were both rated rather negatively, which can be explained by the rather slow travel speed of the Route 12. In addition, specific events such as sudden braking or critical situations with other road users were frequently mentioned in the open box question by respondents who had tested Route 12. These issues were subsequently identified as having potential for development.

Bibliography

- Ackerberg, Daniel A. 2003. "Advertising, Learning, and Consumer Choice in Experience Good Markets: An Empirical Examination." *International Economic Review* 44(3): 1007–40. <http://dx.doi.org/10.1111/1468-2354.t01-2-00098>.
- Bundesamt für Statistik. 2015. BFS Aktuell *Pendlermobilität in Der Schweiz 2013*.
- Bundesamt für Statistik BFS. 2018. "Regionalporträts 2018: Gemeinden." <https://www.bfs.admin.ch/bfs/de/home/statistiken/regionalstatistik/regionale-portraets-kennzahlen/gemeinden/gemeindeportraets.html> (July 4, 2018).
- Bundesamt für Strassen ASTRA. 2018. "Intelligente Mobilität." <https://www.astra.admin.ch/astra/de/home/themen/intelligente-mobilitaet.html> (July 4, 2018).
- Howard, Daniel, and Danielle Dai. 2014. "Public Perceptions of Self-Driving Cars: The Case of Berkeley, California." *Transportation Research Board 93rd Annual Meeting* 14(4502): 1–16.
- Schweizerische Eidgenossenschaft. 2016. *Automatisiertes Fahren – Folgen Und Verkehrspolitische Auswirkungen. Bericht Des Bundesrates in Erfüllung Des Postulats Leutenegger Oberholzer 14.4169 «Auto-Mobilität»*. Bern.
- Sterrett, David et al. 2017. "Assessing Changes in Coverage Bias of Web Surveys in the United States." *Public Opinion Quarterly* 81(S1): 338–56.
- The American Association for Public Opinion Research. 2016. *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*. 9th edition. AAPOR. http://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf (April 21, 2017).
- Venkatesh, Viswanath, James Y L Thong, and Xin Xu. 2012. "Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology." *MIS Quarterly*: 157–78.
- Wicki, Michael. 2020. "Ambitious Mobility Policies and Public Opinion: Doomed to Fail?" ETH Zürich, Diss. ETH No. 26496.
- Wicki, Michael, and Thomas Bernauer. 2018. "Public Opinion on Route 12: Interim Report on the First Survey on the Pilot Experiment of an Automated Bus Service in Neuhausen Am Rheinfall." *ISTP Paper Series* 3. <https://doi.org/10.3929/ethz-b-000282577>.
- . 2019. "Public Opinion on Route 12: Interim Report on the Second Survey on the Pilot Experiment of an Automated Bus Service in Neuhausen Am Rheinfall." *ISTP Paper Series* 4. <https://doi.org/10.3929/ethz-b-000339708>.

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