Institute of Transport Economics
Norwegian Centre for Transport Research

Summary

Traffic safety in bus transport

An analysis of Ruter's requirements to bus companies in contracts

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Ruter has the overall responsibility for administration of the public transport service in Oslo and Viken in Norway. The main objective of the study is to examine the traffic safety consequences of the requirements that Ruter sets in the contracts with the bus operators. Ruter's direct impact on traffic safety through contracts applies in particular to cases where Ruter requires more than national and international regulations. Interviewees mentioned that there are more requirements for traffic safety in Ruter's contracts compared with those of other bus administration companies in Norway, including requirements that go beyond EU standards. In this report, however, we propose that Ruter can go even further, and also make demands on, and reward bus companies' organizational safety management (measures for safety culture, safety management system, fleet management system). We also find indications that Ruter may have an indirect impact on traffic safety through contracts. Several of the interviewees emphasized that time pressure and stress are a general challenge among bus drivers, and this may have implications for traffic safety. This was related to the requirements for punctuality and regularity. Our results indicate that buses that are poorly adapted to the roads they are used on, and roads that are poorly adapted to bus transport are an important traffic safety issue. This may be due to the fact that there is a goal of increasing the number of passengers by bus, for the sake of the environment, and that the focus is on passenger capacity in the choice of buses, while several of the interviewees emphasized that roads and infrastructure, for example in Oslo are poor adapted bus transport. We suggest that Ruter considers measures to reduce time pressure and stress, such as flexible timetables or fixed intervals between the buses instead of timetables, and that risk analyzes are carried out of the relationship between bus and road. We also suggest that Ruter should systematise the work with traffic safety, by appointing dedicated people to work with this and take a coordinating role in relation to the bus operators and others who affect the safety of bus transport. This may, for example, involve developing a system for safety learning among operators, a joint forum for traffic safety involving Ruter and the bus companies and carrying out risk analyzes.

Background and aims

Many actors are involved in the production of public transport in Oslo and Viken. Ruter has an overall responsibility and arranges services directly from Sporveien (tram and metro), and buys services (bus) through competitive tenders. The responsibility for traffic safety is formally placed with the individual bus operator who drives on behalf of Ruter. Nevertheless, there are several factors in Ruter's activities and decisions that affect traffic safety. A study carried out by the Institute of Transport Economics for Ruter in 2019 indicates that Ruter's activities could affect traffic safety in many ways, for example in the contracts with bus operators and other communication with operators (Nævestad et al. 2019a). The report generally points out that Ruter should clarify the possibilities for taking a more active role in relation to the operators' work with traffic safety, even if it is not legally required, and take a coordinating role.

The importance of Ruter for the bus operators' traffic safety has also been pointed out in other reports. In the Accident Investigation Board Norway's (AIBN) report on the head-on accident between two buses on FV. 450 at Nafstad, Ullensaker, 17 November 2017, Ruter received a safety recommendation (Safety recommendation VEI no. 2019 / 08T).

The AIBN recommends that Ruter reviews the traffic safety consequences of the requirements set out in the contracts with bus operators. The AIBN's investigation shows that even though the two buses were in accordance with the regulatory requirements both nationally and internationally, the requirements for collision safety in such types of buses are low compared to other vehicle groups. The AIBN concludes that the safety requirements set by Ruter for the bus operators in the contracts may be stricter than Norwegian and international regulations, and that Ruter can in that way influence better collision safety. (Ruter has therefore included such a requirement for collision safety in the latest tender).

Because of these two reports, Ruter needed to carry out an analysis in safety in 2020, to review the traffic safety consequences of all the requirements set in the contracts with operators. Ruter wanted to carry out an analysis, including traffic safety consequences of operational requirements, requirements for equipment, requirements for drivers, requirements for maintenance and requirements for quality systems. In addition, Ruter wanted to investigate the possibilities of setting new requirements for safety in buses beyond the minimum requirements set today.

The main objective of the present study is to review the traffic safety consequences of all the requirements that Ruter sets in the contracts with bus operators. We focus on both the consequences of requirements that are about safety, and requirements that are not about safety, such as the environment, mobility, regularity and universal design. The first types of requirements have a direct impact on road safety. The other types of requirements have an indirect impact on road safety. We also focus on requirements that have not been established yet, but which can potentially be established and thus have an effect on traffic safety.

Analytical model

In the analyzes, we have taken as our starting point the following model (Figure S.1), which is based on our previous research.

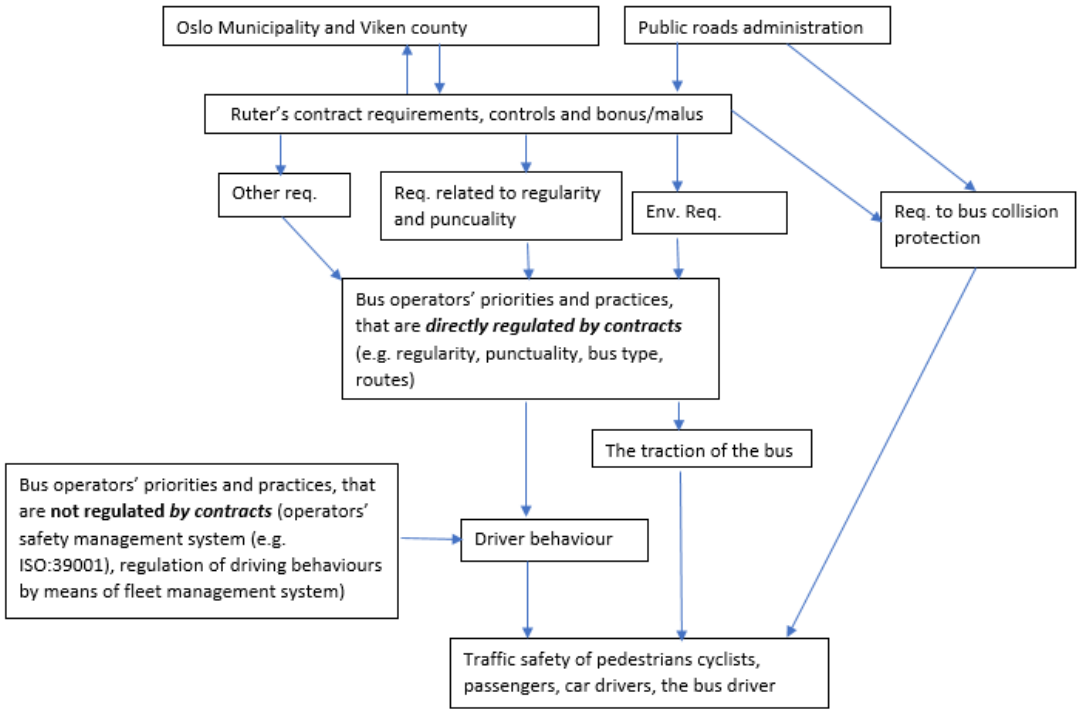

Figure S.1: "Top-down" approach to analyze possible traffic safety consequences of the requirements that Ruter sets in the contracts with bus operators, Ruter's controls that the requirements are complied with and sanctions.

The model assumes that the relationship between Ruter's impact on safety related to bus transport is mediated through a number of analytical levels. One of the main principles behind the model is that the contract requirements from Ruter are "translated" by the actors down through the system, and have consequences at the various levels, including for the bus drivers, passengers and other road users who interact with the buses.

The model has five levels:

1) Framework conditions. Ruter relates to premises set by other agencies and authorities, first to requirements from the owners in Oslo Municipality and Viken County, in addition to premises provided by, for example, the Planning and Building Agency and the Urban Environment Agency in Oslo Municipality, the Norwegian Public Roads Administration, the police, other agencies and stakeholders.

2) **Ruter.** In our previous research (Nævestad et al. 2019a), we have identified three main elements in Ruter's «system» to influence the bus operators' priorities and practices: 1) The requirements that Ruter sets in the contracts with bus operators, 2) Ruter's supervision and control that the requirements are complied with and 3) sanctions, such as fees and the bonus / malus system, which provide operators with financial incentives to comply with Ruter's requirements. Ruter is in an intermediate position: they both set premises and are set premises for.

3) The bus operators, and their priorities and practices. The operators' priorities and practices form an intermediary between Ruter and the drivers, and "translate" Ruter's requirements for the drivers.

4) The bus drivers and their behavior in traffic. Drivers' behavior (e.g. speed, driving style, attention) is a key element in the model, because it has a direct impact on road safety outcomes.

5) Road safety effects for different parties: a) The driver in case of accidents, b) passengers, c) other road users. A basic assumption in the model is that the traffic safety effects we often see are a result of premises that are set at higher levels in the model, and which have been mediated and translated down the system.

Hypotheses, data sources and approach

We test three hypotheses about how Ruter can influence traffic safety through the requirements they set in the contracts, and the system for control and sanctioning:

1) Ruter has a direct impact on traffic safety through contractual requirements for traffic safety, and controls that the requirements are complied with.
2) Ruter has an indirect impact on traffic safety through contractual requirements, for the environment, regularity, universal design, etc. and controls that the requirements are complied with.
3) Ruter may have a greater impact on traffic safety than they have today, through traffic safety measures that are currently not requested in the contracts, but which can potentially be introduced.

We have used the following data sources and methods to test the hypotheses and meet the objectives of the study:

1) Analysis of incidents and accidents: We have analyzed 797 reported bus incidents and accidents, which have occurred from October 2016 to February 2020. The incidents are originally described in free text in a spreadsheet, based on reports to Ruters Informasjons- and Coordination Center (IOSS) for monitoring and control of public transport.

2) Document review: We have examined the appendices to relevant contracts to get more information about the various contract requirements and how they are weighted in the tender process. We have also received information about this from qualitative interviews.

3) Qualitative interviews: We have conducted a total of 18 interviews, with people in Ruter, with bus operators, with trade union representatives, with employers' association representative, with a bus expert from Sweden. The topics in the interviews were the tender process and the contracts and their direct and indirect consequences for traffic safety.

4) Quantitative survey: We have conducted a quantitative survey, with a total of 1012 respondents: 232 drivers who drive for Ruter in Oslo and Viken and 780 who drive for other principals in other parts of the country. We have included the latter as a basis for comparison, and to get a better basis for our conclusions about what affects traffic safety in bus transport.

5) Literature review: We have conducted a literature study to summarize the available knowledge about the safety effects of various technical systems in buses and other relevant safety measures. We present and discuss the effects of eighteen different safety measures.

Ruter's direct influence on traffic safety

In accordance with Hypothesis 1, several of the interviewees held that Ruter has a direct impact on traffic safety, through the safety requirements they set for the operators in the contracts. Ruter's direct impact on traffic safety through contracts applies in particular to instances where Ruter requires more than national and international regulations. However, several of the interviewees found that Ruter does not demand much beyond what is required by law on traffic safety; that operators must «follow laws and rules». However, some interviewees also mentioned that there are more requirements for traffic safety in Ruter's contracts than in other bus administration companies in Norway. It was also mentioned that even though the starting point is that Ruter should only set EU requirements, Ruter still sets some traffic safety requirements for operators that go beyond this, because the EU's standard requirements seem somewhat deficient in relation to including new technology and ensure the safety of drivers. Ruter therefore requires, for example, blind spot monitoring and extra collision protection for the driver. In this way, Ruter is a pioneer, which helps to increase the safety standard in the market. This shows what kind of significance it has when Ruter sets additional requirements.

In continuation of this argument, several of the interviewees pointed out that Ruter could potentially have an even greater direct impact on traffic safety, if they had made more requirements to the operators' safety measures. The interviewees generally believed that the main focus in the contracts is on other things than safety, and that there is too little focus on safety in the tenders and contracts. Some of the interviewed operators have on their own initiative introduced a number of organizational safety measures in their companies, such as the traffic safety standard ISO: 39001, fleet management systems that focus on safe and economical driving style, systems for investigating and learning safety incidents. The operators mentioned that they write about their own company's safety work when they respond to the tenders, but they are unsure whether it is emphasized, and how much this is actually emphasized. There are no explicit requirements or criteria for this, and Ruter does not ask for documentation afterwards. The operators were therefore unsure of the extent to which their safety work is actually rewarded in the tenders. From this we can conclude that Ruter has the potential to move the standard in the market further when it comes to traffic safety, for example by setting explicit requirements for, and rewarding organizational safety management (measures aimed at safety culture, safety management systems, fleet management systems, etc.).

Ruter's indirect influence on traffic safety

In accordance with Hypothesis 2, results from the surveys and interviews show that Ruter has an indirect impact on traffic safety through existing requirements related to the environment, regularity, universal design, etc. The interviewees generally believed that the requirements for punctuality and regularity are the contractual requirements with the most important indirect consequences for road safety. They believed that this has consequences for traffic safety because drivers become stressed. The results from the survey also show that time pressure and stress are common among Norwegian bus drivers: 50% agree that they often are in a hurry to fulfil the time requirements set by the timetable, 64% agree that they experience that time pressure and deadlines can affect traffic safety, and 32% are often stressed by passengers in ways that may be detrimental to road safety. We created an index for time pressure and stress, and the drivers who drive for Ruter do not score significantly higher on the index than other drivers in Norway.

Some of the interviewees also mentioned that environmental considerations may affect traffic safety in bus transport, because this means a strong focus on regularly increasing the number of people traveling by bus and having a high capacity on the routes. It was mentioned, for example, that the roads and infrastructure in Oslo are poorly adapted to bus transport; they are often cramped and narrow. Focus on increased capacity often means that operators use buses with room for many passengers. This may possibly be the reason why we see that the variable «Bus type that does not fit the routes I drive» is important for the drivers' stress level and driving style in the multivariate analyzes (cf. Figure S.3). In accordance with this, the analyzes show that driving an articulated bus is related to a higher incidence of aggressive driving style. The multivariate analyzes also show that poor intersections and poor stops are related to time pressure, stress and accident involvement. About 20% of the drivers who drive for Ruter report that buses that are poorly adapted to the routes daily lead to dangerous situations, while 41% say the same about poor intersections. Drivers who drive articulated buses were the group that experienced this to the greatest extent. The interaction between buses and roads is therefore an important traffic safety issue. Here, Ruter has the opportunity to influence, as well as various agencies and bodies responsible for roads and infrastructure. However, this is a topic that we need more knowledge about, because the relationships are complex. The drivers' time pressure and stress are also strongly related to the influence of other road users, i.e. how often the drivers state that they have to brake abruptly to avoid hitting other road users.

Incidents and accidents

Analyzes of approximately 800 reported incidents from October 2016 to February 2020 show that "Traffic accident collision" (N = 360) is the type of incident that has been most prevalent during the period, followed by "passengers injured on board" (N = 98). The fact that collisions are the most prevalent type of incident during the period does not necessarily mean that it is this type of incident that has involved the most personal injuries. In Figure S.2, we show the types of incidents that involved the most personal injuries in the period.

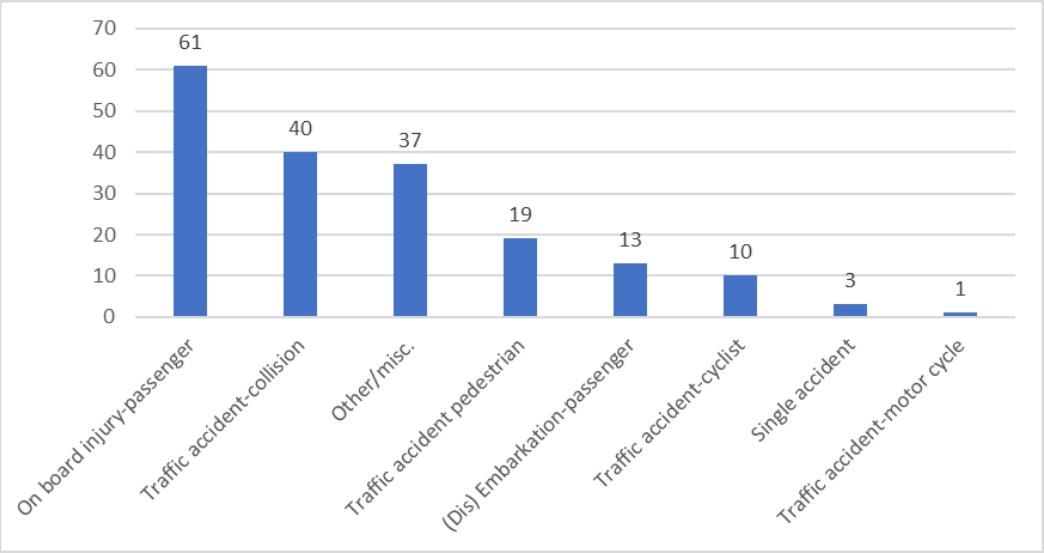

Figure S.2: The reported types of incidents that involved the most personal injuries, by occurrence. Buses driven for Ruter from October 2016 to February 2020.

Figure S.2 shows that on-board passenger injuries are the type of incident that has involved the most personal injuries. However, the number of personal injuries related to an incident does not necessarily say anything about how often a certain type of incident leads to personal injury. This is the reason why we also analyze the proportions of personal injuries in the reported types of incidents. The following types of incidents have the highest proportion of injuries: on-board injury passengers, traffic accident pedestrians, traffic accidents cyclists and boarding passengers. This indicates a lower level of protection for the persons involved in these incidents.

This may indicate that the traffic safety potential associated with measures aimed at preventing the occurrence of these incidents and their severity may be significant. Our results are in line with previous research, which also shows that injuries that do not occur in traffic accidents are a major problem in buses, i.e. injuries when falling on board the bus or falling when getting on or off.

We have also looked at the drivers' self-reported prevalence of incidents, based on data from the survey; the drivers especially have to brake hard for cyclists (46% daily) and others in the public transport lane (40% daily). The results also indicate that the drivers who drive for Ruter have a somewhat more aggressive driving style than the other drivers in the sample. We also look at drivers experiences with violence and threats. A total of 16% of drivers driving for Ruter have experienced threats from passengers during the last two years and 7% have experienced physical violence from passengers during the last two years. A total of 25% have been involved in a traffic accident (minimum property damage) during the last two years. The dangerous situation that bus drivers are most worried about is hitting vulnerable road users, followed by head-on collisions with other vehicles.

Which factors influence the drivers' accident involvement?

We have conducted multivariate regression analyzes, to investigate factors influencing drivers' accident involvement, their behavior in traffic and their perceived time pressure and stress. In Figure S.3, we summarize the strongest correlations from these analyzes. The analyzes were conducted with all the drivers in the sample (N = 1012). This means that the results apply to drivers who drive in all parts of Norway, and not just those in the sample who drive for Ruter (N = 232).

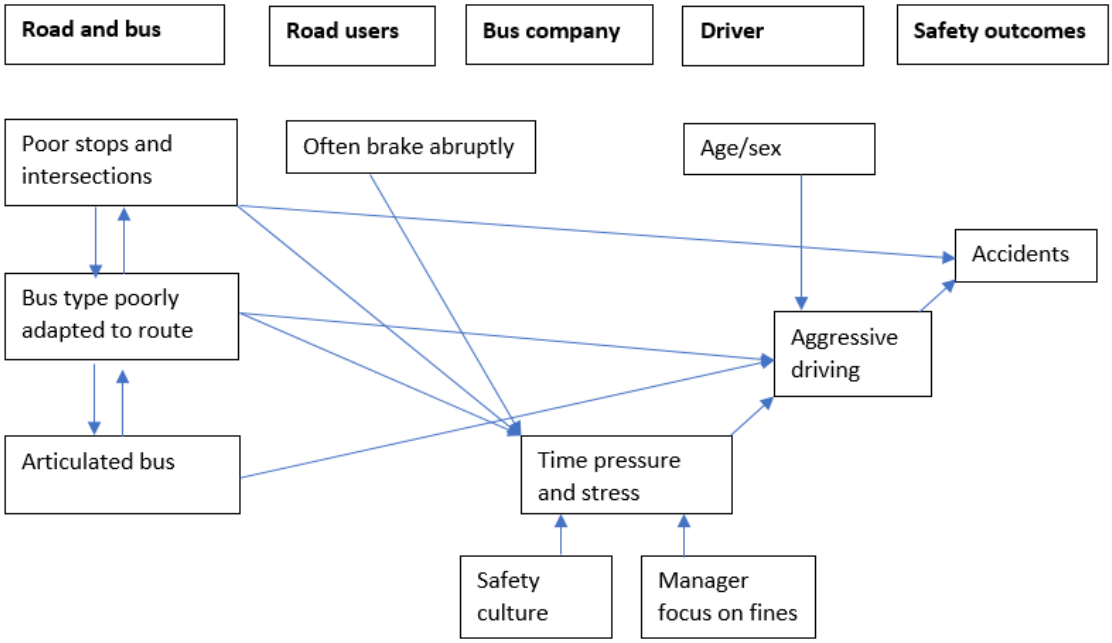

Figure S.3: Relationships in multivariate regression analyzes, where we examine factors predicting accident involvement, driving style, time pressure and stress.

Figure S.3 shows that the level of safety in bus transport is affected by an interplay between factors at several different levels: 1) The driver, 2) Bus operator, 3) Other road users and 4) The road and the bus. Accident involvement is influenced by poor intersections and poor stops and aggressive driving style. Aggressive driving style is related to age and gender, bus type that is perceived as poorly adapted to the route, articulated bus and time pressure and stress. The drivers' perceived time pressure and stress are related to poor intersections and stops, bus type that is poorly adapted to the route, that the drivers often have to brake abruptly for other road users, management focus on avoiding fees from Ruter/principals, and finally the analyzes show that a good safety culture helps reduce the stress level of the drivers.

Ruter may affect several of the factors that we see in Figure S.3. Although the results apply to bus drivers throughout Norway, they are also valid for drivers who drive for Ruter. The index for time pressure and stress largely measures stress related to timetables and deadlines, in addition to stress related to passengers. Ruter has an influence on the timetable. Ruter also influences the operators' choice of buses on the various routes. These are conditions that concern indirect effects on traffic safety, and these results support Hypothesis 2. In addition, we see that a good safety culture may reduce drivers' experience of stress. This concerns Hypothesis 3, about safety requirements that Ruter can potentially demand from the operators. The fact that Figure S.3 shows that a good safety culture can reduce the negative effect of other factors is a good argument for Ruter to set requirements for operators' safety culture measures.

In addition, Figure S.3 shows that the safety of bus transport is affected by a number of factors that Ruter does not control, such as other road users and roads and infrastructure. The latter is controlled by road owners, such as municipalities, counties and the Norwegian Public Roads Administration. Here, however, Ruter provides input and participates in accessibility committees together with the operators and others.

Which factors influence passenger injuries related to falls?

Passenger injuries related to falls inside the bus are the type of incident with the most injuries and the highest proportion of injuries. We have conducted multivariate regression analyzes, to examine factors influencing drivers' reports of passenger injuries. In Figure S.4, we summarize the strongest relationships from these analyzes. The results apply to drivers who drive in all parts of Norway (N = 1012).

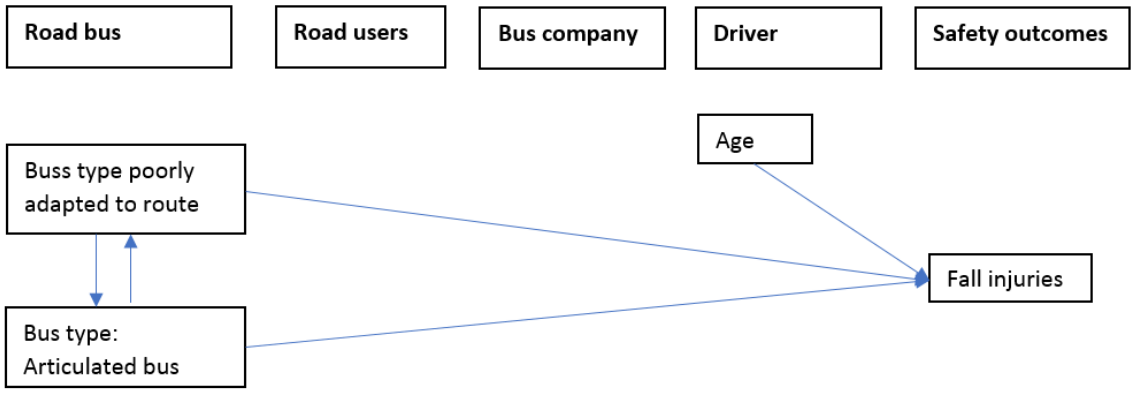

Figure S.4: Relationships in multivariate regression analyzes, examining factors predicting drivers' reports of passenger injuries related to falls inside the bus.

Figure S.4 indicates that there are three variables that affect drivers' reports of passenger injuries related to falls inside the bus: bus type that is poorly adapted to the route, which is related to articulated bus and the age of the drivers. There are more drivers under the age of 35 who report passenger injuries in the event of a fall. In the analyzes, we also tested the effects of other variables. We assumed, based on previous research, that frequent hard braking would be related to falls (cf. Figure S.5), and that this would be related to aggressive driving style, perhaps also time pressure and stress, and that this could be reduced with a good safety culture. However, our model does not support these assumptions. One would also think that the fleet management system could lead to a calmer driving style and fewer falls among the passengers, but we do not see any effect of this in the analyzes. However, our model has a low explanatory value, and this indicates that there are important causes of injuries in falls that we have not been able to capture. The data from the interviews indicate that injuries in the event of falls, for example, are related to standing passengers, often older people who, for example, get up before the bus has stopped completely when they are about to get off. The proportion of falls is higher for city buses and especially articulated buses with many standing passengers. We conclude that we do not have a good overview of the causes of injuries related to falls, or relevant measures in the present report, and this indicates an important area for future research.

Figure S.5 shows that the drivers who drive for Ruter generally state that they must brake heavily for vulnerable road users, to avoid accidents and dangerous situations.

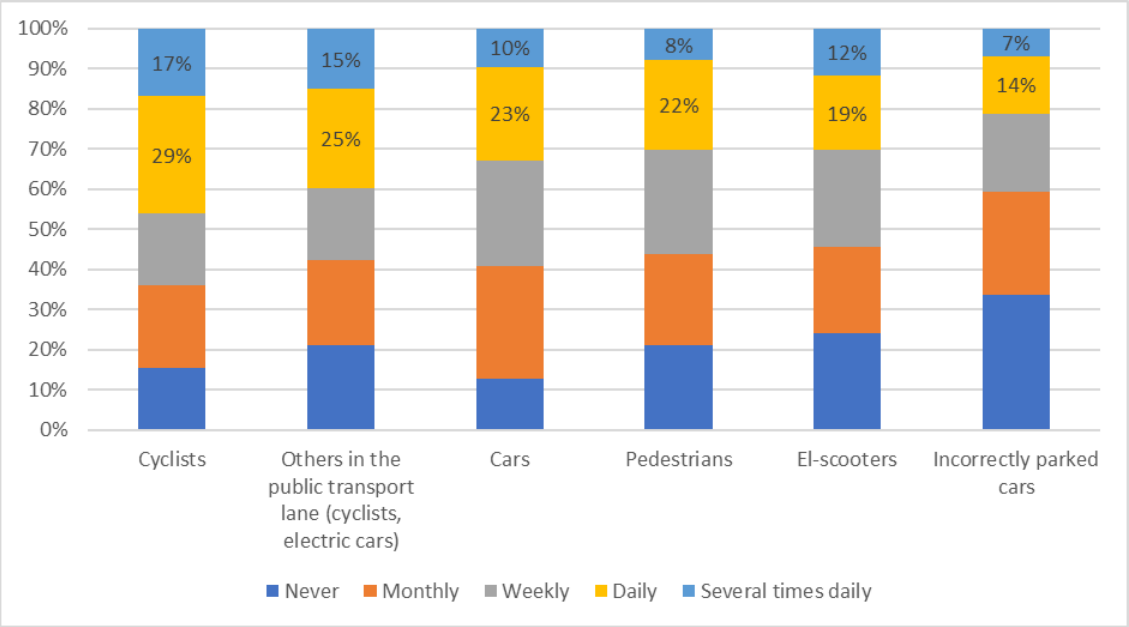

Figure S.5: «How often do you have to brake abruptly to avoid accidents and dangerous situations with… (before the corona). Drivers driving for Ruter in Oslo and Viken (N = 232).

Figure S.5 shows that 46% of the drivers who drive for Ruter must brake abruptly daily for cyclists, 40% of must brake abruptly at least daily for others in the public transport lane (e.g. electric cars and cyclists), 30% must abruptly brake at least daily for electric scooters in and around the road, 33% must brake daily for cars and 30% must brake at least daily for pedestrians

Suggested measures with direct implications for traffic safety

Our third hypothesis is that Ruter may have an impact on traffic safety through conditions that are not currently required in the contracts, but which could be required in the future and potentially have an impact on traffic safety. We have conducted a systematic literature review of measures to test this hypothesis, and assess any additional requirements that Ruter may introduce. The literature study supports hypothesis 3. The background for the literature review was that Ruter wanted to investigate the possibilities of setting new requirements for safety in buses beyond the minimum requirements set today.

Ruter's impact on traffic safety through contracts applies in particular to cases where Ruter requires more than national and international regulations. In the literature review, we conclude that there are measures aimed at organizational safety management which have a significant accident-reducing effect, but which Ruter does not require today. We have ranked 18 traffic safety measures according to knowledge of their effect and their relevance to the accident and incidents involving buses that drive for Ruter. The measures that receive the highest score are 1) Fleet management system, 2) Seat belt in Class 3 bus, 3) Safety culture measures, 4) Seat belt in Class 2 bus, 5) Blind zone warning, 6) Safety management system and 7) Collision protection for bus drivers.

The results of the survey and interviews indicate that Ruter's system (i.e. contract requirements, control and financial incentives) to influence bus operators 'practices and priorities is effective, as it influences the bus operators' focus, and their priorities and practices. This indicates that the system is effective in achieving the goals that Ruter's owners and Ruter want; for example related to the environment, regularity and punctuality, customer satisfaction. An important implication of this is that this system can also be used

to meet other desirable goals, for example related to traffic safety. We suggest the following:

1) Set clearer requirements for, and reward organizational safety measures. Based on the interviews and the literature study, we suggest that Ruter should set clearer requirements for and reward organizational safety measures. Based on the results from the literature study, we propose the following measures: A) Measures for safety culture, B) safety management system, and C) fleet management system with a focus on safety. The literature study shows that these may reduce the risk of accidents. Given that the bus operators to different degrees have such measures, introducing requirements for organizational safety management will ensure that such measures require more resources. It will probably also ensure a minimum standard for all operators and raise the quality even more.

2) Technical measures. Based on the literature study, we also propose two technical measures: A) Collision safety measures for bus drivers and B) Blind zone warning. The respondents and the interviewees were concerned about requirements for collision safety in the front of the buses, in order to increase the safety of the drivers. The interviewees were therefore grateful that Ruter now sets requirements for collision safety in a recent tender, and in this way contributes to raising the safety standard in the market. Blind zone warning is also required.

Suggested measures with indirect implications for traffic safety

1) Measures to reduce stress: flexible timetables or focusing on the interval between the buses. In the discussion of contractual requirements with indirect effects on road safety, the interviewees placed particular emphasis on the importance of the requirements for punctuality and regularity. We have seen that being a bus driver is a stressful profession (cf. figure S.3), and that time pressure and stress are related to driving style. Several of the interviewees suggested various measures to prevent this, such as the introduction of different timetables; one for rush hours and one for all other hours. Another measure that was proposed is to remove the timetable and instead just focus on maintaining a certain interval between the buses on routes. It was suggested that the drivers' stress related to arriving late or early is reduced if the focus on the buses being at the stops at given times is removed.

2) Measures to assess the interaction between road and bus: risk analyzes. The results from the interviews and the survey indicate that the interaction between road and bus has an indirect impact on traffic safety, and that these factors (choice of bus) are affected by consideration for the environment (capacity, passenger growth) and universal design (low floor buses). Since it is Ruter that seems to have the greatest influence on the choice of bus, we recommend that Ruter carries out risk analyzes of requirements for bus equipment on given routes, perhaps in connection with the start of tenders.

Ruter’s role as a «leading star» on traffic safety

Ruter is well placed to maintain an overview of how various factors affect traffic safety in bus transport, and has opportunities to influence several aspects of the operators' priorities and practices. Ruter's work with traffic safety should be systematized and Ruter should take a coordinating role in relation to the bus operators and other actors that affect safety in bus transport. In the following, we specify what it may entail.

1) People dedicated to safety work in Ruter and in the operator companies. An important premise for many of the measures we propose is that Ruter has dedicated people whose main task is to work with traffic safety, who have good competence in this, and who

follow up the operators' safety work systematically. Several of the interviewees thought that this was missing today.

2) Joint forum for traffic safety. One of the topics we discussed with the interviewees was the need and opportunities to develop a better and continuous dialogue between Ruter and the operators about traffic safety. We refer to this as a joint forum for traffic safety. Such a forum for cooperation can give the operators the opportunity to collectively record safety challenges for Ruter, and create an opportunity for Ruter to get a comprehensive picture of such challenges, and not least also to get proposals as to how they can be solved. Such a forum already exists for mobility.

3) Conduct risk analyzes related to the interaction between bus and road. Our results suggest that buses that are poorly adapted to the roads they are used on, and roads that are poorly adapted to bus transport, may be a risk factor.

4) System for learning among the operators, organized by Ruter. Ruter receives a number of data on incidents and accidents from the operators and passengers, but there is currently no system for analyzing and learning from these incidents. Fortunately, serious accidents rarely occur, and then it is important to have other data sources and indicators of safety that occur more frequently than accidents, in order to keep track of the level of safety and challenges that need to be solved. Creating a system for learning among operators, based on the common reporting system that exists today, seems to be a good idea. Reporting and learning from incidents are some of the most important elements in a good safety culture. This system exists in Ruter today, but it is apparently not used well enough. We developed analytical categories ourselves in our analyzes of 800 events in the period 2016-2020, and we recommend that these should be used as a starting point in the development of a future system for reporting and learning. A significant challenge associated with such a system, however, is the competitive situation among the operators, which may make them skeptical about sharing information that could be a competitive advantage.

5) Road safety ambassador for operators against third parties. Ruter has a unique role in relation to the external actors that the operators relate to, for example municipalities, the Norwegian Public Roads Administration, bus suppliers, etc. Here, Ruter can speak for all operators, and be a "traffic safety ambassador" in the contact with various third parties. The results indicate that Ruter already has this role, but it can be systematized and developed even more, especially if Ruter gets a dedicated person who works with traffic safety, and who works with the other measures that we recommend in the present report.

Questions for future research

1) What are the causes of injuries related to on board passenger falls and how should they be prevented? We do not have a good overview of the causes of injuries in the event of falls, or relevant measures in the present report, and this indicates an important area for future research.

2) What are the safety consequences of standing passengers on class 2 buses? We do not have a good enough overview of the causes of falls in buses, e.g. speed at which they occur. The bus drivers on class 2 buses displayed the greatest worry about passengers' lacking seat belts if they should fall in the buses. The bus operators also mentioned this. The Class 2 buses have a certain proportion of standing passengers, and these buses can be used on roads with a relatively high speed limit. The safety consequences of this should be examined in future studies.

3) Which measures are suitable to reduce bus drivers' experience of stress? The analyzes show that the stress level is high among bus drivers, and that it can have an impact on safety outcomes.

4) Aggressive driving style. We have seen that aggressive driving style is related to accidents and time pressure and stress. Future research should investigate the causes of aggressive driving style and measures that can reduce its incidence, such as work with safety culture and fleet management system.

5) Violence and threats from passengers. Violence and threats from passengers are also a source of stress for bus drivers. A total of 24% of the drivers who drive for Ruter have experienced situations where they have been scared or stressed due to aggressive passengers, 16% have experienced being threatened by passengers and 7% have experienced physical violence from passengers. This proportion is twice as large as for drivers in the rest of the country. City bus drivers represent the highest proportion who experience violence and threats.

6) The interplay between the suitability of buses and roads. We have seen that buses that are poorly adapted to the roads they are used on, and roads that are poorly adapted to bus transport can be a risk factor. These variables and the interplay between them affect accident involvement, aggressive driving style and stress. Future research should examine these relationships further.