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Frustration Free Interaction:

physiologically quantifying pain points in ADAS and Infotainment interactions for inexperienced users

Författare: Mikael Ljung Aust, Casper Wickman, Hannaneh Yazdi
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Projekt inom Trafiksäkerhet och automatiserade fordon

FFI Fordonsstrategisk Forskning och Innovation
VINNOVA Energimyndigheten TRAFIKVERKET
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1 Executive summary

This project addresses a need that emerges from two current trends. One is the increasing interaction complexity in modern vehicles, in particular for safety oriented Advanced Driver Assistance Systems (ADAS) and for many Infotainment features.

The other trend is a predicted decrease in driving skills due to reduced practice for a significant part of the population, as a large part of society is expected to move from car ownership to car sharing. A typical car sharing customer uses the car about one fifth of the time of what is typical for a private car owner. The opportunities to learn and train with ADAS and Infotainment systems are thus greatly reduced, and time between “lessons” can be quite long, meaning that “first use” type problems can be experienced over and over again.

Together, these trends point to a growing need for methods through which interaction frustration events for ADAS and Infotainment systems quickly can be identified and addressed during development. An interaction frustration event (or an interaction pain point) takes place when a user either unexpectedly gets stuck, i.e. does not understand how to continue an interaction sequence or is negatively surprised when a system influences vehicle control in an unexpected way. Being able to pinpoint and remove these during development is crucial if all users are to have full access to the safety and efficiency potential that modern ADAS and infotainment systems provide.

Looking at where we are today, it can be seen that currently used methods for locating interaction frustration events (i.e. interviews and surveys) have low time and amplitude resolution. Neither excels at locating exactly when in time frustration events occurs or how "strong” they are (not to mention that many events go undetected). Consequently, the work to identify them is a lot less efficient than it has the potential to be and involves an unnecessarily large portion of trial-and-error.

The aim of the current project was to explore other methods for evaluation of ADAS and Infotainment interaction. In particular, the potential for using physiological indicators of experienced frustration as markers for interaction pain points was to be investigated.

Initially, the project had planned for two physiology-based studies of frustration events; one in a fMRI lab (a reference study) and one in a more applied context (i.e. users interacting with in-vehicle systems). However, joint workshops with experts in interaction design and neuroimaging techniques led to the insight that this was not a viable approach. Basically, since physiological measurements can be very noisy and hard to interpret if one does not know exactly what to look for (and when), it became clear that the aim of the project should be shifted toward creating an inventory of frustration events from car owners and car sharers, and then use this inventory to identify potential behavioural frustration responses that reliably can be triggered by a task or other interactions. Once a repeatable frustration response has been identified, chances of finding reliable physiological correlates to that response increases dramatically.

With this shift of direction, the project then focused on establishing the connections necessary to reach out to both car owners and car sharers with questionnaires. Volvo Cars Market Intelligence department contributed by providing access to two large online Volvo customer communities, and Volvo’s car sharing service M provided access to car sharers. 11273 questionnaires were distributed, and 2130 responses received.

A first analysis of the questionnaire responses revealed that several frustration events were common to both groups, but also that the way each group feels about such events differ. Car owners respond more clearly in line with traditional frustration-aggression theory, i.e. frustration events lead to direct or displaced anger related to the vehicle. Car sharers on the other hand feel embarrassed rather than angry when experiencing frustration events; it seems like they blame

themselves rather than then the system/car for when things do not work as they expect them to. This is a clearly a difference worth exploring further in future studies.

After completing the survey, the learnings and experiences made in the current project were defined and harnessed into a follow-up application toward FFI called FEDBAC (approved in Sept 2020), where the survey data collected will provide the basis for the first scientific publication.

Beyond running the survey, the project has also identified a suitable PhD candidate for the FEDBAC project and prepped that candidate to the right competence level for taking on the tasks defined there. That PhD candidate is now formally admitted to the doctoral program at Karolinska.

The pre-study was coordinated by Volvo Cars (VCC) with Karolinska Institutet (KI) as partner and ran from 2019-09-01 to 2020-08-31 with a total budget of 790.000 SEK (380.000 SEK from FFI).

X=
Y=

2 Backgrund

Increasing interaction complexity in modern vehicles

This project aimed to address a methodology development need that has arised out of two current trends. The first trend is that modern vehicles are becoming more complex to interact with, in particular when it comes to understanding and using its various driver support systems.

This is problematic, because a large share of future road safety improvements is expected to come from fleet wide deployment of successively more advanced Driving Assistance Systems (ADAS) such as Adaptive Cruise Control (ACC) and Lane Keeping Aid (LKA). However, for these systems to deliver on their full safety benefit potential, they have to be trusted and used, and for that to happen, their interaction design needs to be highly intuitive. Also, their operation principles must be totally transparent to all users. Despite considerable effort on the developer side, it is safe to say that only a few drivers experience today's ADAS systems as completely intuitive in all apects.

A similar trend can be seen in the area of infotainment features, where the introduction of third-party apps in infotainment systems and collaboration with smartphone makers have blurred the line between smart phones and vehicles considerably. Similar to ADAS, these systems need further development in a car usage context to become completely intuitive in all steps.

Decrease in car user skills

At the same time as ADAS and infotainment complexity is increasing, there is a projected decrease in car user skills for a growing portion of the population. This comes as a natural by-product of the predicted move from car ownership to car sharing. Car sharing is a very efficient way of minimizing the required vehicle fleet while maintaining mobility in a given population. However, with car sharing also comes a new type of car user. Data collected in this project the car sharing service M indicates that a typical car sharing customer uses the car about one fifth of what is typical for a person who owns a car. Also, that time is not continuous in the of sense of using the car every day or every week, rather it's aggregated in blocks which a more stochastic distribution in time and spread across more than one vehicle type (e.g. taking one type of car for the summer vacation trip and another car type when shopping for furniture).

It follows that car sharers have about 80% less opportunity to learn and train with ADAS and infotainment features, compared to regular car owners. Also, time between "lessons" can be quite long, since car usage is infrequent. Consequently, M receives a number of calls to their support

line with requests to help solve what for car owners can be called first usage problems (i.e. how do I turn this particular car on, it felt like the car was steering on its own, should it do that?, etc.). Put differently, for car sharers, every car usage can be first usage all over again. Car sharers are therefore reporting interaction pain points regular car owners do not, since they don't get to practice every day the way car owners do.

A need for improved UX design evaluation tools

When these trends are taken together, they point to a growing need for methods through which frustration events during ADAS and Infotainment interaction quickly can be identified and addressed. An interaction frustration event (or pain point) takes place when a user either unexpectedly gets stuck, i.e. does not understand how to continue, or is negatively surprised when an ADAS system influences vehicle control in an unexpected way. Since frustration events may lead users to give up on understanding or using a particular system entirely, being able to locate and remove them during development is crucial if we want all users to have full access to the safety and efficiency potential which modern ADAS and infotainment systems provide.

Today, user experience design methods largely rely on self-reporting from test subjects to identify frustration events. They typically use questionnaires and/or interviews to find out when and where users get stuck or experience negative surprises. However, questionnaires and interviews do not excel at locating exactly when in time interaction frustration events occurs, nor are they very precise when to comes to how establishing how "strong" different frustration events are.

With interaction sequences becoming longer and more complex, and with users becoming less skilled, it follows that it would be highly beneficial if frustration events could be captured with higher temporal and amplitude resolution than self-reporting can provide. Also, it would be help greatly if one could develop ADAS and infotainment evaluation methods that are less interruptive and less intrusive than questionnaires/interviews. Aside from simplifying testing considerably, that would help avoid potential biasing of test participants regarding what constitutes acceptable interaction design problems.

Proposed solution: Physiological measurement of frustration peaks when interacting with ADAS and Infotainment systems

If one cannot ask test participants what they think or feel, some other way of capturing their response must be found. Also, just as with automated state capture in other human response domains (e.g. EEG, EKG, etc.) an automated capture of this type needs to be guided by an underlying conceptual or mechanism framework that can guide the data analysis, otherwise interpretation will be very difficult.

This project has largely relied on frustration-aggression theory, or the frustration-aggression hypothesis, as a conceptual framework to guide analysis. The frustration-aggression hypothesis is one of the most seminal theories within research related to aggression, and has been successively developed and applied in a variety of research domains such as psychology, sociology and medical research since the late 1930's.

Importantly, frustration in this framework is not understood as an emotion. Rather, it is viewed as an interference with something you want to achieve. This may lead to aggression either toward the tools you're using for the task, or towards something else (displaced aggression). Thus, achieving the goal must be both important and perceived as fairly easy to accomplish, otherwise there will not be a frustration event. Adapted to car usage, one could say that frustration events, or interaction pain points, happen when a user either unexpectedly gets stuck and does not understand how to continue, or is negatively surprised when a system influences vehicle control in an unexpected way.

These properties of frustration events elegantly capture what users experience during frustration events. They have no other expectation at task onset then that they would be able to use these systems easily, and then they fail. The aggression that often follows such frustration events can either be directed toward the system itself (“stupid ADAS”), or something other though still connected (“this is a crap car”) and is what may lead users to give up on using or understanding a particular technology entirely.
This notion that users experience high levels of frustration when encountering significant pain points (i.e. get stuck in their interaction with the vehicle) has lots of empirical support. For example, we know that users who have booked a car through a car fleet service and then cannot figure out how to start the vehicle once inside the car report very high frustration levels when calling customer support. We thus expect all significant pain points to generate frustration events for the users.

In terms of automating the capture of frustration events, the starting point for the project was the assumption that high levels of frustration should be possible to identify through physiological correlates. A number of previous behavioural and fMRI studies have established relationships between frustration and various interaction tasks. For example, on a neuronal level, frustration processing has been linked to the dorsal anterior cingulate cortex (dACC) and the right ventral prefrontal cortex (rvPFC) during social exclusion. It has also been linked to the amygdala, the dorsolateral prefrontal cortex and rostral ACC activity during defection or loss of social cooperation in a prisoner’s dilemma game and the right anterior insular cortex as well as the right inferior PFC, the medial PFC and ACC during omission of reward. Thus, there exists a reasonably sized background of laboratory-based research findings to draw upon when exploring how to measure frustration in an applied automotive context, using tasks that are more representative of in-vehicle interactions then the artificial frustration inducing tasks typically used in lab experiments.

Being able to use physiological measurements to localize frustration events during evaluation of various interaction designs would lay the foundation for identifying pain points with much higher temporal and amplitude resolution than today and provide a big step forward toward simplifying and speeding up the design process

3 Aim, research questions and methodology

This aim of this project was to explore the potential for using physiological indicators of experienced frustration as markers for interaction pain points when using ADAS and Infotainment interfaces. The overall research question has been:

- *To what extent is can physiological measurement be used to identify pain points / frustration moments in ADAS and Infotainment interactions?*

Of course, that general question had to be broken down into several parts. The specific research questions identified at project start thus were:

- Which physiology-based metrics are relevant for identifying frustration in users?
- What is a good reference study design that can establish the magnitude of response which can be expected for those metrics?
- Which of these metrics would be accessible in the field, i.e. with less advanced equipment then a medical grade MRI in a lab?
- How do we design and execute an applied experiment that captures frustration events in a less controlled environment than a medical grade lab?
- How to validate field measurements against lab measurements?

Starting from these research questions, a number of goals with corresponding work packages (WPs) were identified. These are described in the section below.

4 Goals

WP1 was a purely administrative work package (i.e. project lead, coordination and dissemination) so will not be further reported on here.

WP2 was tasked with defining and designing a reference MRI study that could identify frustration in users on a sufficiently resolved time scale. Design choices were to be informed by the methodologies currently using MRI measurements to establish brain correlates of expertise. To this end, a state-of-the-art review was to be carried out and perhaps more importantly, a workshop with experts in the field would be conducted.

WP3 was tasked with developing an applied experimental design that can be used for a first methodology test given the learnings from WP2. This included recruiting a suitable test population, including both inexperienced and expert users, and create a test situation where the opportunities for creating frustration are maximized and where physiological measurement is possible.

WP4 was designed to validate the applied experiment measures against lab measurements, i.e. to take the data from the applied experiment and correlate it toward the outcomes of WP2, to see if the applied experiment has resulted in meaningful output for the current research topic.

WP5 was tasked with formulating learnings and design of future studies. Given the outcomes of WP1-WP4, the design proposal for the reference study was to be revisited and updated. Similarly, the applied experiment design would be revisited and updated given the outcome of the first methodology trial, and a future, more comprehensive, study plan would be designed.

In the course of the project, it became clear that two of the work packages had to be re-defined. When holding the interaction design stakeholder and fMRI expert workshops, the discussions between these two fields of expertise that perhaps to not interact very much in daily work made it clear that before moving into an MRI lab to do studies and start looking for physiological correlates of frustration, it would be highly advantageous to establish a clear behavioral frustration response that can be reliably induced, as having that would make the MRI data analysis much easier.

Thus, the workshop participants came to the recommendation that it would be better if the current pilot project shifted focus. Instead of first doing the reference study in the fMRI lab as initially planned, it would be better to work toward finding out how drivers describe frustration when using their vehicles, to come up with a set of relevant tasks that could reliably induce frustration in an experimental setting, and then only move toward MRI studies once that was done.

With this recommended change of direction, WP3 and WP4 were no longer relevant in their original form. The project therefore decided to combine them into a single work package, tasked with establishing the relevant networks and tools required to conduct a larger customer survey. The survey was to focus on how different driver groups (in particular car owners and car sharers) define and experience frustration in vehicles, and whether there are particular pain points in their everyday experiences that can be drawn on to design tasks which induce that clear behavioural frustration response requested by the expert group before moving into the fMRI lab.

5 Resultat och måluppfyllelse

As described above, WP1 and WP2 were carried out according to initial plans. Project administration in WP1 has worked well. Finding relevant participants for, and arranging, the workshops with both interaction design experts and the right medical competence to get insights

into requirements for fMRI type studies also was done according to plan. Of course, the outcome of those workshops then led to WP3 and WP4 being redesigned.

Given the new WP3/4 design, the necessary connections to do a market survey were established. The project leveraged Volvo Cars Market Intelligence department and their work with Volvo customer communities for outreach to car owners and also Volvo's car sharing service M for outreach to car sharing customers. A questionnaire was designed (see Appendix A) and distributed to both car sharers and car owners. A little more than 11273 customers were approached and 2130 responded.

A first analysis of these results revealed that frustration events are common to both groups, but also that the way each group feels about such events differ. Car owners respond more clearly in line with traditional frustration-aggression theory, i.e. frustration events lead to direct or displaced anger related to the vehicle. Car sharers on the other hand feel embarrassed rather than angry when experiencing frustration events; it seems like they blame themselves rather than then the system/car for when things do not work as they expect them to. This is a clearly a difference worth exploring further in future studies.

WP5 has also been carried out according to plan, in the sense that the learnings and experiences made in the project have been defined and harnessed into a follow-up application toward FFI called FEDBAC (approved in Sept 2020), where the survey data collected in the pilot study will provide the basis for the first scientific publication in FEDBAC, and where updated versions of the original WP3 and WP4 in this project will be carried out instead.

While the survey can be said to have been very successful, not being able to carry out the initially planned reference brain imaging study within this project was a disappointment. However, the arguments in favor of establishing a solid behavioral response first are compelling and cannot be ignored if one wants to spend resources wisely.

Beyond running the survey, the project has also identified a suitable PhD candidate for the FEDBAC project and prepped that candidate to the right competence level for taking on the tasks defined there. That PhD candidate is now formally admitted to the doctoral program at Karolinska.

6 Dissemination and publication

Hur har/planeras projektresultatet att användas och spridas?	Markera med X	Kommentar
Öka kunskapen inom området	X	
Föras vidare till andra avancerade tekniska utvecklingsprojekt	X	
Föras vidare till produktutvecklingsprojekt		
Introduceras på marknaden		
Användas i utredningar/regelverk/ tillståndsärenden/ politiska beslut		

6 Conclusions and continued research

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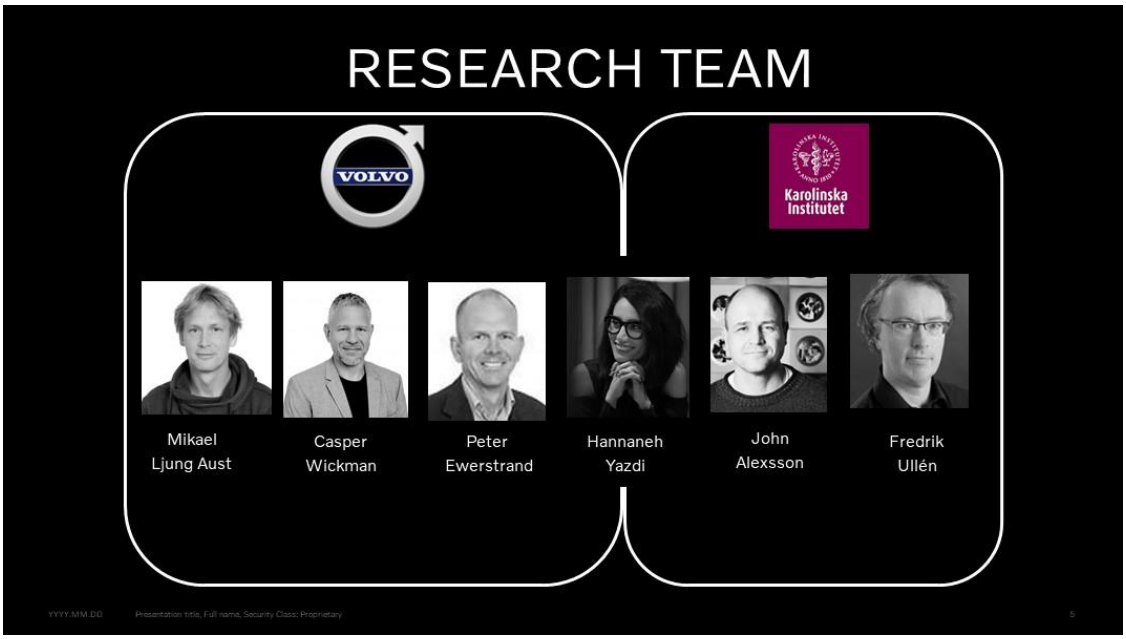
While the project did not achieve the originally expected results regarding knowledge on how to physiologically measure frustration in car users in real world interactions with modern vehicles, it did establish that this goal is still viable, though a fair bit of other work than initially planned has to be carried out before something approaching the original plan can be executed.

These insights were brought into the formulation of the newly submitted and approved FEDBAC project, which can be said to be an upscaled version of the current project where things will be done in the right order based on the insights and learnings made here.

7 Participating partners and contact persons



8 Appendix A

1. English version

Age:

- ☐ 17-24
- ☐ 25-34
- ☐ 35-44
- ☐ 45-54
- ☐ 55-64
- ☐ 65-74
- ☐ 75 years or older

Gender:

- ☐ Female
- ☐ Male
- ☐ Non-binary
- ☐ Do not want to answer

What is your highest level of education?

- ☐ Primary school or equivalent
- ☐ Vocational training or equivalent
- ☐ High school or equivalent
- ☐ Bachelor's degree or equivalent
- ☐ Master's degree or equivalent
- ☐ Doctoral degree or equivalent

What is your work situation?

- ☐ Employee
- ☐ Self-employed
- ☐ Student
- ☐ Jobseeker (unemployed)

☐ Sickness compensation

☐ Pensioner

☐ Parental leave

Which Volvo model do you drive normally? (You can choose more than one model)

☐ S60

☐ S90

☐ V40

☐ V60

☐ V90

☐ XC40

☐ XC60

☐ XC90

This section focuses on how you feel towards cars, your car preferences and your driving style. My Car Preferences Choose the response that best states how much you agree with the following statements:

	Strongly disa gree	Somewhat disagree	Somewhat agree	Strongly agree
I am enthusiastic about cars and driving	☐	☐	☐	☐
I find pleasure in a car that allows me to feel its power and performance	☐	☐	☐	☐
A quiet car that allows me to relax is the ultimate pleasure for me	☐	☐	☐	☐
A car is a means of transport rather than a source of pleasure	☐	☐	☐	☐
A car is my personal space where I can escape from the pressures of everyday life	☐	☐	☐	☐
I believe cars are complicated to operate	☐	☐	☐	☐
When I choose a car my top priority is selecting the most comfortable one	☐	☐	☐	☐
When I choose a car it is important that the car is fuel/charge efficient	☐	☐	☐	☐
I choose a car that meets my immediate needs, nothing more	☐	☐	☐	☐
I prefer a car that is smaller and easier to park, even if I get less interior space	☐	☐	☐	☐
I prefer a car that is equipped with the latest entertainment technology and equipment	☐	☐	☐	☐
I prefer a car that has the ability to completely drive itself	☐	☐	☐	☐

My driving style Choose the response that best describes your driving style:

	Never	Rarely	Sometimes	Often	Always
I disregard the speed limit on residential roads	☐	☐	☐	☐	☐
I get involved in 'races' with other drivers	☐	☐	☐	☐	☐
I become angered by another driver and chase them	☐	☐	☐	☐	☐
I stay in a highway lane that I know will be closed until the last minute before, forcing my way into the other lane	☐	☐	☐	☐	☐
I miss a 'give way' sign and narrowly avoid colliding with traffic having right of way	☐	☐	☐	☐	☐
I attempt to pass someone that I had noticed to be signalling a left/right turn	☐	☐	☐	☐	☐
I underestimate the speed of an incoming vehicle when overtaking/attempting to pass them	☐	☐	☐	☐	☐
I fail to notice that pedestrians are crossing when turning into a side street from a main road	☐	☐	☐	☐	☐
Intending to drive to destination A, I 'wake up' finding myself in destination B because the latter is my more usual destination	☐	☐	☐	☐	☐
I realise that I have no clear recollection of the road along which I have been travelling	☐	☐	☐	☐	☐
I switch on one thing, such as headlights, when I meant to switch on something else, such as wipers	☐	☐	☐	☐	☐
I forget where I parked my car	☐	☐	☐	☐	☐

This section focuses on positive driving experiences where you may be in a state of flow while driving. Flow is when you feel good and your mind isn't wondering, you can concentrate without making any effort. ●My mind isn't wandering. I am totally involved in what I am doing and I am not thinking of anything else. I feel good... I am less aware of myself and my problems ●I can concentrate without effort ... I never think of it... ●I am so involved in what I am doing... I don't see myself as separate from what I am doing For each of the driving situations, mark how likely they will contribute to your experience of flow.

	1 Strongly disagree	2	3	4 Neither agree nor disagree	5	6	7 Strongly agree
Driving on a road without any bicyclists/pedestrians/children	☐	☐	☐	☐	☐	☐	☐
Driving in nice weather	☐	☐	☐	☐	☐	☐	☐
Driving in daylight	☐	☐	☐	☐	☐	☐	☐
Driving when I feel refreshed and energetic	☐	☐	☐	☐	☐	☐	☐
Driving with no large vehicles in front of me, allowing clear vision ahead	☐	☐	☐	☐	☐	☐	☐
Driving when there are no construction signs or obstacles on the road	☐	☐	☐	☐	☐	☐	☐
Driving when there is no traffic	☐	☐	☐	☐	☐	☐	☐
Driving in a low speed area	☐	☐	☐	☐	☐	☐	☐
Driving when passengers are silent and/or very calm	☐	☐	☐	☐	☐	☐	☐
Driving when I am alone in the car	☐	☐	☐	☐	☐	☐	☐
Driving in a familiar area where I know exactly how to reach my destination	☐	☐	☐	☐	☐	☐	☐
Being fully aware of how to operate the systems in the car (e.g. navigation, pairing your phone)	☐	☐	☐	☐	☐	☐	☐
When the car functions as I expect it to	☐	☐	☐	☐	☐	☐	☐
Driving without having any vehicles close behind	☐	☐	☐	☐	☐	☐	☐
Driving when others are driving respectfully (e.g. someone allows me to pass smoothly)	☐	☐	☐	☐	☐	☐	☐
Listening my favourite music while driving	☐	☐	☐	☐	☐	☐	☐
Knowing I don't have to be at my destination in a specific time	☐	☐	☐	☐	☐	☐	☐
Driving when I am excited about my destination (e.g. visiting a friend)	☐	☐	☐	☐	☐	☐	☐
Driving along a scenic route (e.g. country-side road)	☐	☐	☐	☐	☐	☐	☐
When the car is sparkling clean	☐	☐	☐	☐	☐	☐	☐
When I know the car has been serviced and is in good condition	☐	☐	☐	☐	☐	☐	☐

This section focuses on negative driving experiences where you may be in a state of frustration while driving. Tell us about the most frustrating situation you have ever experienced while driving?

_____

_____

_____

_____

What emotions did you feel in the situation you just described?

	1 Strongly disagree	2	3	4 Neither agree nor disagree	5	6	7 Strongly agree
Angry	☐	☐	☐	☐	☐	☐	☐
Disappointed	☐	☐	☐	☐	☐	☐	☐
Sad	☐	☐	☐	☐	☐	☐	☐
Stressed	☐	☐	☐	☐	☐	☐	☐
Anxious	☐	☐	☐	☐	☐	☐	☐
Bored	☐	☐	☐	☐	☐	☐	☐
Afraid	☐	☐	☐	☐	☐	☐	☐
Helpless	☐	☐	☐	☐	☐	☐	☐
Tired	☐	☐	☐	☐	☐	☐	☐
Stupid	☐	☐	☐	☐	☐	☐	☐
Irritated	☐	☐	☐	☐	☐	☐	☐
Annoyed	☐	☐	☐	☐	☐	☐	☐
Embarrassed	☐	☐	☐	☐	☐	☐	☐
Unmotivated	☐	☐	☐	☐	☐	☐	☐

For each of the driving situations, mark how likely they will contribute to your frustration:

	1 Strongly disagree	2	3	4 Neither agree nor disagree	5	6	7 Strongly agree
Driving on a road with bicyclists/pedestrians/children	☐	☐	☐	☐	☐	☐	☐
Driving when it rains heavily	☐	☐	☐	☐	☐	☐	☐
Driving in darkness/night	☐	☐	☐	☐	☐	☐	☐
Driving when I feel sleepy and tired	☐	☐	☐	☐	☐	☐	☐
Driving behind a big truck and not able to have full vision	☐	☐	☐	☐	☐	☐	☐
Driving in a construction zone	☐	☐	☐	☐	☐	☐	☐
Being in a traffic jam	☐	☐	☐	☐	☐	☐	☐
Driving on a fast moving highway	☐	☐	☐	☐	☐	☐	☐
Driving when passengers are noisy	☐	☐	☐	☐	☐	☐	☐
Driving when the car is full of passengers	☐	☐	☐	☐	☐	☐	☐
When I am driving in an unfamiliar area and have problems reaching my destination	☐	☐	☐	☐	☐	☐	☐
Being unsure of how to operate the systems in the car (e.g. navigation, pairing your phone)	☐	☐	☐	☐	☐	☐	☐
When the car does not function as I expect it to	☐	☐	☐	☐	☐	☐	☐
Driving when there is a vehicle close behind	☐	☐	☐	☐	☐	☐	☐
Careless driving by others (e.g. someone changes lanes without indicating)	☐	☐	☐	☐	☐	☐	☐
Hearing loud and annoying noises while driving	☐	☐	☐	☐	☐	☐	☐
When I'm running late to my destination	☐	☐	☐	☐	☐	☐	☐
Driving when I am not happy about going to my destination (e.g. unpleasant appointment)	☐	☐	☐	☐	☐	☐	☐
Driving in or around a crowded city centre	☐	☐	☐	☐	☐	☐	☐
When the car is dirty	☐	☐	☐	☐	☐	☐	☐
When the car does unpredictable things (e.g. when a system doesn't work)	☐	☐	☐	☐	☐	☐	☐

How frustrated do you become when using the following features/functions in a Volvo vehicle?

	1 Not frustrated at all	2	3	4	5	6	7 Extremely frustrated	I don't know /use
Operating the touch screen	☐	☐	☐	☐	☐	☐	☐	☐
Using the voice system (performance, ability to recognize commands)	☐	☐	☐	☐	☐	☐	☐	☐
Pairing a mobile phone to the car using Bluetooth	☐	☐	☐	☐	☐	☐	☐	☐
Using the navigation system (routing, find addresses, etc)	☐	☐	☐	☐	☐	☐	☐	☐
Adjusting the seat	☐	☐	☐	☐	☐	☐	☐	☐
Opening/closing the trunk	☐	☐	☐	☐	☐	☐	☐	☐
Using the self-parking system	☐	☐	☐	☐	☐	☐	☐	☐
Switching Driver profiles	☐	☐	☐	☐	☐	☐	☐	☐
Locating the car	☐	☐	☐	☐	☐	☐	☐	☐
Locking/unlocking the car	☐	☐	☐	☐	☐	☐	☐	☐
Using cruise control	☐	☐	☐	☐	☐	☐	☐	☐
Adjusting the mirrors	☐	☐	☐	☐	☐	☐	☐	☐
Fuelling the car	☐	☐	☐	☐	☐	☐	☐	☐
Using the lane assist feature	☐	☐	☐	☐	☐	☐	☐	☐
Putting the car in park mode	☐	☐	☐	☐	☐	☐	☐	☐

2. Swedish version

Ålder:

- ☐ 17-24
- ☐ 25-34
- ☐ 35-44
- ☐ 45-54
- ☐ 55-64
- ☐ 65-74
- ☐ 75 år eller äldre

Kön:

- ☐ Man
- ☐ Kvinna
- ☐ Icke-binär
- ☐ Vill inte svara

Vilken är din arbetssituation?

- ☐ Anställd
- ☐ Egenföretagare
- ☐ Student
- ☐ Arbetssökande (arbetslös)
- ☐ Sjukpensionär
- ☐ Pensionär
- ☐ Föräldraledig

Vilken är din högsta utbildningsnivå?

- ☐ Grundskola eller motsvarande
- ☐ Yrkesutbildning eller motsvarande
- ☐ Gymnasium eller motsvarande
- ☐ Kandidatexamen eller motsvarande
- ☐ Master-/magisterexamen eller motsvarande
- ☐ Doktorsexamen eller motsvarand

Vilken modell av volvo kör du normalt? (Du kan välja mer än en modell)

- ☐ S60
- ☐ S90
- ☐ V40
- ☐ V60
- ☐ V90
- ☐ XC40
- ☐ XC60
- ☐ XC90

Nedan följer några påståenden om bilkörning och bilar. Vänligen ange hur mycket du instämmer med följande påståenden:

	Instämmer inte alls	Instämmer huvudsaklige n inte	Instämmer i stor utsträ ckning	Instämmer helt
Jag är verkligen entusiastisk över bilar och körning	☐	☐	☐	☐
Jag tycker om när bilen ger känslan av kraft och prestanda	☐	☐	☐	☐
En tyst bil som får mig att slappna av är den största njutningen för mig	☐	☐	☐	☐
Jag anser att en bil är ett transportmedel snarare än en källa till nöje	☐	☐	☐	☐
Jag ser min bil som mitt personliga utrymme där jag kan fly från vardagen	☐	☐	☐	☐
När jag köper en bil väljer jag den som låter mig köra så ekonomiskt som möjligt	☐	☐	☐	☐
Jag anser att bilar är komplicerade att använda	☐	☐	☐	☐
När jag väljer min bil prioriterar jag den mest bekväma bilen	☐	☐	☐	☐
Jag vill att min bil ska vara utrustad med den senaste underhållningstekniken och utrustningen	☐	☐	☐	☐
Jag föredrar en bil som är mindre och lättare att parkera även om jag får mindre innerutrymme	☐	☐	☐	☐
När jag köper en bil väljer jag den som uppfyller viktigaste mina behov, men inte mer	☐	☐	☐	☐
Jag skulle inte ha något emot en bil som har förmågan att köra själv helt ut	☐	☐	☐	☐

Nedan beskrivs ett antal situationer och sinnesstämmningar man kan uppleva vid bilkörning. Vänligen markera hur ofta du upplever följande:

	Aldrig	Sällan	Ibland	Ofta	Alltid
Jag bortser från hastighetsgränsen på en bostadsväg	☐	☐	☐	☐	☐
Jag kan inte låta bli att "tävla" med andra förare i trafiken	☐	☐	☐	☐	☐
Jag blir förargad av andra förare och följer efter dem	☐	☐	☐	☐	☐
Jag stannar kvar i en motorvägsfil som jag vet kommer att vara stängd tills sista minuten innan jag tvingar mig in i det andra körfältet	☐	☐	☐	☐	☐
Jag missar lämna-företrädes-skyltar och är nära att kollidera med andra fordon	☐	☐	☐	☐	☐
Jag försöker köra förbi bilar som signalerar vänster eller högersväng framför mig om det är möjligt.	☐	☐	☐	☐	☐
Jag underskattar hastigheten på mötande fordon när jag gör en omkörning.	☐	☐	☐	☐	☐
Jag uppmärksammar inte att fotgängare korsar vägen när jag svänger in på en sidogata.	☐	☐	☐	☐	☐
Jag sätter mig i bilen för att köra till en ny plats men upptäcker att jag, utan att tänka på det, av gammal vana har kört dit jag brukar köra	☐	☐	☐	☐	☐
Jag inser att jag inte har ett tydligt minne av vägen som jag just har kört på	☐	☐	☐	☐	☐
Jag slår på en funktion som tex strålkastarna när jag tänkte slå på något annat som tex vindtrutetorkare	☐	☐	☐	☐	☐
Jag glömmer var jag lämnade min bil på parkeringen	☐	☐	☐	☐	☐

Nu ska vi fokusera på en positiv upplevelse man kan ha under körning, låt oss kalla den flow. Flow kan beskrivas som: - "Jag är helt fokuserad på det jag gör och jag tänker inte på något annat. Det känns bra... jag tänker inte på mig själv och mina problem". - "Att koncentrera sig känns lika lätt som att andas... jag tänker inte på det." - "Jag är så inne i det jag gör... det känns som jag fullständigt går upp i det." För varje körsituation nedan vill vi veta hur viktiga dessa faktorer är för din upplevelse flow under körning.

	1 Inte alls viktigt	2	3	4 Neutral	5	6	7 Mycket viktigt
Att det inte finns cyklister / fotgängare / barn på vägen jag kör på	☐	☐	☐	☐	☐	☐	☐
Att köra i fint väder	☐	☐	☐	☐	☐	☐	☐
Att köra i dagsljus	☐	☐	☐	☐	☐	☐	☐
Att köra när jag känner mig utvilad och energisk	☐	☐	☐	☐	☐	☐	☐
Att köra med total uppsikt där jag kan se vägen framåt	☐	☐	☐	☐	☐	☐	☐
Att köra där det inte finns några vägarbeten/skyltar eller andra föremål på vägen	☐	☐	☐	☐	☐	☐	☐
Att köra när det inte är mycket annan trafik	☐	☐	☐	☐	☐	☐	☐
Att köra i områden med låg hastighet/hastighetsbegränsning	☐	☐	☐	☐	☐	☐	☐
Att köra när passagerarna är tysta och/eller väldigt lugna	☐	☐	☐	☐	☐	☐	☐
Att köra när jag är ensam i bilen	☐	☐	☐	☐	☐	☐	☐
Att köra i ett område jag känner till och där jag exakt vet hur jag når min destination	☐	☐	☐	☐	☐	☐	☐
Att vara helt medveten om hur man använder alla tillgängliga system i bilen (t.ex. navigering, parning av din telefon och etc)	☐	☐	☐	☐	☐	☐	☐
Att min bil fungerar som jag förväntar mig att den skall göra	☐	☐	☐	☐	☐	☐	☐
Att köra när inga andra bilar följer tätt bakom mig	☐	☐	☐	☐	☐	☐	☐
Att köra när trafikanter runt mig visar respekt (t.ex. när någon låter mig passera smidigt)	☐	☐	☐	☐	☐	☐	☐
Att lyssna på min favoritmusik under körning	☐	☐	☐	☐	☐	☐	☐
Att veta att jag inte måste passa en viss tid	☐	☐	☐	☐	☐	☐	☐
Att köra när jag ser fram emot att nå destinationen (t.ex. för att träffa en god vän)	☐	☐	☐	☐	☐	☐	☐
Att köra på en väg in en vacker omgivning(t. ex. på landet)	☐	☐	☐	☐	☐	☐	☐

Att köra när min bil är nytvättad och skinande ren	☐	☐	☐	☐	☐	☐	☐
Att köra när min bil nyss har servats och är i bra skick	☐	☐	☐	☐	☐	☐	☐

Detta avsnitt handlar om negativa körupplevelser där du kan upplevt t ex frustration under körning
Vänligen berätta om den mest frustrerande situation du varit med om som bilförare:

Vilka känslor upplevde du i den situationen du just beskrivit?

	1 Instämmer inte alls	2	3	4 Neutral	5	6	7 Instämmer helt och hållet
Arg	☐	☐	☐	☐	☐	☐	☐
Besviken	☐	☐	☐	☐	☐	☐	☐
Ledsen	☐	☐	☐	☐	☐	☐	☐
Stressad	☐	☐	☐	☐	☐	☐	☐
Orolig	☐	☐	☐	☐	☐	☐	☐
Uttråkad	☐	☐	☐	☐	☐	☐	☐
Rädd	☐	☐	☐	☐	☐	☐	☐
Hjälplös	☐	☐	☐	☐	☐	☐	☐
Trött	☐	☐	☐	☐	☐	☐	☐
Dum	☐	☐	☐	☐	☐	☐	☐
Irriterad	☐	☐	☐	☐	☐	☐	☐
Förargad	☐	☐	☐	☐	☐	☐	☐
Generad	☐	☐	☐	☐	☐	☐	☐
Omotiverad	☐	☐	☐	☐	☐	☐	☐

För varje körsituation nedan vill vi veta hur viktiga dessa faktorer är för din upplevelse av frustration under körning:

	1 Inte alls viktigt	2	3	4 Neutral	5	6	7 Mycket viktigt
Att köra på en väg med cyklister / fotgängare / barn	☐	☐	☐	☐	☐	☐	☐
Att köra när det regnar kraftigt	☐	☐	☐	☐	☐	☐	☐
Att köra i mörker / natt	☐	☐	☐	☐	☐	☐	☐
Att köra när jag känner mig sömnig och trött	☐	☐	☐	☐	☐	☐	☐
Att köra bakom en stor lastbil och inte har full uppsikt/syn på vägen framåt	☐	☐	☐	☐	☐	☐	☐
Att köra där det är vägarbeten/skyltar (eller andra föremål) på vägen	☐	☐	☐	☐	☐	☐	☐
Att köra i kraftiga köer	☐	☐	☐	☐	☐	☐	☐
Att köra på motorväg där trafiken rullar på i hög hastighet	☐	☐	☐	☐	☐	☐	☐
Att köra när mina passagerare högljudda	☐	☐	☐	☐	☐	☐	☐
Att köra när min bil är full av passagerare	☐	☐	☐	☐	☐	☐	☐
Att köra i områden jag inte är bekant vid och har problem att hittar min destination	☐	☐	☐	☐	☐	☐	☐
När jag är osäker på hur man använder funktionerna i bilen (t.ex. navigering, parning av din telefon och etc)	☐	☐	☐	☐	☐	☐	☐
När min bil inte fungerar som jag förväntar mig att den skall göra	☐	☐	☐	☐	☐	☐	☐
Att köra när en annan bil ligger väldigt nära bakom mig	☐	☐	☐	☐	☐	☐	☐
Vårdslös körning av andra bilförare (t.ex. när någon byter fil utan att använda blinkers)	☐	☐	☐	☐	☐	☐	☐
Att höra höga och störande ljud under körning	☐	☐	☐	☐	☐	☐	☐
Att köra och veta att jag inte kommer fram i tid	☐	☐	☐	☐	☐	☐	☐
Att köra när jag inte är nöjd avseende vart jag är på väg (t.ex. till en obehagligt möte)	☐	☐	☐	☐	☐	☐	☐
Att köra i en stads centrum när det är mycket trafik	☐	☐	☐	☐	☐	☐	☐
Att köra när min bil är smutsig	☐	☐	☐	☐	☐	☐	☐
När min bil gör oförutsägbara saker (t.ex. fel i systemet)	☐	☐	☐	☐	☐	☐	☐

Framkallar nedanstående funktioner i din Volvo frustration hos dig, och i så fall hur mycket?

	1 Inte alls frustrerande	2	3	4	5	6	7 Extremt frustrerande	Använder ej / ingen åsikt
Använda pekskärmen	☐	☐	☐	☐	☐	☐	☐	☐
Använda röststyrningen (förmåga att känna igen kommandon etc)	☐	☐	☐	☐	☐	☐	☐	☐
Para ihop mobiltelefon till bil med Bluetooth	☐	☐	☐	☐	☐	☐	☐	☐
Använda navigationssystemet (hitta adresser, vägval osv.)	☐	☐	☐	☐	☐	☐	☐	☐
Justera min stol	☐	☐	☐	☐	☐	☐	☐	☐
Öppna bakluckan med fotrörelse	☐	☐	☐	☐	☐	☐	☐	☐
Använda självparkeringssystemet	☐	☐	☐	☐	☐	☐	☐	☐
Växla förarprofiler	☐	☐	☐	☐	☐	☐	☐	☐
Att hitta bilen	☐	☐	☐	☐	☐	☐	☐	☐
Låsa / låsa upp min bil	☐	☐	☐	☐	☐	☐	☐	☐
Använda farthållaren	☐	☐	☐	☐	☐	☐	☐	☐
Justera sidospeglarna	☐	☐	☐	☐	☐	☐	☐	☐
Tanka bilen	☐	☐	☐	☐	☐	☐	☐	☐
Använda körfältsassistans	☐	☐	☐	☐	☐	☐	☐	☐
Lägga växeln i parkeringsläge (automat)	☐	☐	☐	☐	☐	☐	☐	☐