Penn State University

IST521 Human-Computer Interaction

Spring 2024

How Will Human Drivers with Different Driving Styles Interact with Aggressive Automated Vehicles?

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Submission Date: April 30th, 2024

Abstract

Automated vehicles (AVs) are perhaps the most promising technologies aiming to improve the safety of human-driven vehicles (HVs) and enhance traffic efficiency. In our project, we aim to address one of the important yet commonly neglected aspects of HV-AV interaction: the design of AVs' aggressive driving styles. We aim to conduct a laboratory experiment to analyze drivers' behavior and their thinking when they are interacting with aggressive AVs. Several daily driving scenarios will be designed on a driving simulator. We will ask participants (N=4) to drive as in reality, where they will interact with AVs exhibiting different driving styles. During their driving process, we will record their behavior and ask them to retrospect and think aloud about their thoughts while interacting with different AVs. Hierarchical Task Analysis will be conducted to determine how human drivers with different driving styles will interact with aggressive AVs. Based on our interview data, we will also decode participants' attitude towards AVs to determine the best driving styles of AVs that help human drivers on the road. The results show that human drivers are more likely to drive safely and feel better when they are interacting with AVs whose driving aligns with their own driving style. Our study will contribute to understanding human drivers' behavior under different circumstances, providing behavioral evidence and advice for traffic safety regulation.

Contents

1. Introduction

Automated vehicles (AVs) are one of the most promising technologies that are introduced to improve traffic safety, reduce human errors and provide a better traffic environment (Fagnant & Kockelman, 2015; Jing et al., 2021). The Society of Automobile Engineers defined five levels of automation (SAE, 2018), ranging from level 0: no automation to level 5: full automation. In our study, we identify AVs as vehicles that are equipped with automation systems that can perform all the dynamic driving tasks on a sustainable basis; they have a Level 3 or higher driving automation level. There will be a long transition period where human drivers in conventional vehicles share the road with AVs in the mixed traffic (Litman, 2020). To guarantee both human drivers and AVs social benefits, AVs should drive in a way that blends seamlessly, safely, and cooperatively (Chater et al., 2018).

However, recent research has reported that the introduction of AVs may encounter many challenges on roads in human-AV interaction (Y. M. Lee et al., 2021). On the one hand, it is hard to program AVs to predict human behaviors based on what AVs can sense, they usually make real time adjustments. On the other hand, it is also difficult to expect human drivers to get used to AVs driving styles due to their programmed defensive driving behavior (Hancock et al., 2019). Due to AVs defensive driving style and no retort in kind, they may be considered as an ideal target for bullying (Hancock et al., 2019; Moore et al., 2020), where human drivers may have violent behaviors to cause AVs' damage or impede AVs operation with other vehicles (Liu et al., 2020). The aggressive behavior towards AVs has been a concern that many researchers paid attention to (Liu et al., 2022; Ma & Zhang, 2021, 2023; T. Zhang et al., 2019). One of the solutions that they came up with is to redesign the driving style of AVs to make it more human like or even aggressive that human drivers may easily get used to (Hang et al., 2021; Reddy et al., 2022; Y. Zhang et al., 2023). These studies showed that aggressive behavior of AVs make human drivers more likely to follow traffic rules and not take advantage of AVs. However, it is still not clear how the manipulation behavior of human drivers when interacting with aggressive AVs and what made their behavior change. To explore the behavior differences of human drivers with different driving styles when interacting with aggressive AVs, we designed a laboratory experiment with a think aloud process with 4 participants to answer the research questions:

1. whether drivers with different driving styles behave differently when interacting with aggressive AVs?
2. If so, what may be the reasons that cause their behavior differences?

Our qualitative investigation of these questions is unique in two ways. First, the design of our study was distinct from its peer research since we applied task analysis when considering drivers behavior where previous studies focused on questionnaires and from driving tactical level. Second, most studies explored the HV-AV interaction questions based on scales that were predesigned, but in our study, we used "think aloud" verbal protocol analysis to leave participants more space to

express what they are thinking. It can help us to get a comprehensive understanding of what users think while they are driving.

2. Related Work

2.1. HV-AV interaction

Many researchers have used the three-level hierarchy of strategic, tactical, and control tasks to model drivers' driving tasks in manual driving (Michon, 1985; Ranney, 1994). The strategic level concerns general trip planning. The tactical level involves driving negotiation in common scenarios by developing strategies, such as gap acceptance at intersections, while the control level is related to immediate vehicle control inputs, such as acceleration and deceleration. To date, behavioral studies of the impact of AVs on HV driver performance in mixed traffic have focused mainly on drivers' control-level performance in simple car-following scenarios. This control-level performance does not require complex decision making from human drivers in HVs. Researchers have found that HV drivers drive more smoothly and have extended time-to-collision (TTC) when following AVs than HVs, indicating that AVs contribute to fewer traffic accidents and more stable traffic flow (Mahdinia et al., 2021; Rahman & Abdel-Aty, 2018). By contrast, most accidents happen in situations which require human drivers to make decisions in a short period of time, like yielding to other vehicles from other lanes (Favarò et al., 2017). Previous behavioral studies focused mainly on simple car-following scenarios that only required drivers' control level performance, whereas accident analyses focused mainly on more complex car following scenarios (e.g., intersections) that required complex decision making from human drivers. Therefore, it is important to conduct behavioral studies to understand, in complex driving scenarios that require drivers' decision making at the tactical level, how the HV-AV interactions differently influence drivers' decision making compared to HV-HV interactions.

2.2. AV's driving styles

AVs' driving style is the way the AV was pre-designed to drive, which remains consistent and hard to change when AV interacts with different vehicles. Current research on automated vehicles suggested that the impact of AVs' driving styles could mitigate human drivers over trust in vehicle automation (Price et al., 2019). When talking about human drivers interacting with AVs, most present AVs are programmed as defensive (Hancock et al., 2019; Y. M. Lee et al., 2021) which behaviorally differs from what human drivers are accustomed to, creating an issue of incompatibility. AVs may be "overly constrained by the formal rules of required behavior that are encoded within their logic" (Hancock et al., 2019). Due to their limited understanding of human behavior, implicit traffic rules, and informal communication, AVs must adopt a cautious and risk-averse approach to avoid collisions. However, this risk-averse style may hinder the interpretability of their intentions, leading to unexpected reactions that confuse and endanger human road users (Schwarting et al., 2019).

Because of the adverse effect of the defensive driving styles of AVs, some research on AVs tries to focus on the redesign of AVs' driving performance and decision making. AVs are expected to behave similarly to human-driven vehicles. To this end, the behaviors and characteristics of human drivers should be considered in the automated driving design. If AVs' driving behaviors are considered more aggressive similar to human's driving styles, it would be easier for human drivers to interact with surrounding AVs and predict their behaviors, particularly with regard to multi-vehicle cooperation (Li et al., 2019). For the present study, most research on AV's aggressive driving styles focuses on AVs' manipulation level and its impact on human drivers' decision making (Hang et al., 2021; J. Lee et al., 2019; Reddy et al., 2022). However, understanding users' expectations and constantly improving AVs' driving styles is one of the key points that is unexplored.

2.3. Human drivers' driving styles

Different from AVs' driving style, which is consistent and predictable, human drivers' driving style is defined as a person's preferred way of driving, overtime, a person's driving style develops into their driving habits. When encountering different situations, human drivers' driving styles may not fully predict their decision making (Kleisen, 2011). Previous research has investigated AV drivers' driving styles and found that drivers' driving styles significantly influence their subjective feelings, decision making, and takeover performance (Ma & Zhang, 2021). As AVs are mostly programmed to drive defensively, it is unclear whether the alteration of AVs' driving styles into aggressive influence drivers' driving performance and their subjective evaluation. A survey study that investigated public attitudes towards AVs found aggressive drivers are more open to AVs than other groups of drivers and the researchers speculate that it is because aggressive drivers think they can take advantage of AVs more easily than human drivers (Tennant et al., 2016).

In terms of human drivers' driving styles, most research mentioned its influence on drivers' subjective feelings along with driving behaviors (Y. M. Lee et al., 2021; Ma & Zhang, 2021). Ma & Zhang (2021) found that in HV-AV interaction, when human drivers' driving styles align with AVs' driving styles, human drivers feel more trust and comfortable. Koo et al. (2016) conducted a simulator study and found that engaging autonomous actions from partial AVs increased AV drivers' anxiety and alertness and made them drive more slowly. Lee et al. (2021) investigated drivers' subjective feelings in HV-AV interaction. They found that drivers who rated their subjective feelings (e.g., anger, irritation) negatively were more likely to make aggressive decisions in HV-AV interaction than drivers who did not rate their feelings negatively. These studies focused on human drivers interacting with AVs and reported that subjective feelings may influence HV drivers' decision-making and driving behavior. However these studies predesigned the AVs' driving styles as defensive, and they did not utilize verbal protocol analysis (VPA) to get information from human drivers about what they really think about the driving performance of AVs.

3. Methodology

To answer the research questions presented in the introduction, empirical studies were conducted in a lab space provided by professor Yiqi Zhang from IE department. The dataset was taken and was conducted for the Human-Computer Interaction (IST 521) course at The Pennsylvania State University. More information about the participants, apparatus, materials, experimental design, and procedure are highlighted in this section. An in-person observation experiment was conducted to understand the behavior of drivers with different driving styles when they are interacting with automated vehicles in various driving environments.

3.1. Participants

Because

Since we did not get the approval from the Institutional Review Board at Pennsylvania State University, We kindly asked students in IST 521 if they are interested in volunteering in automated vehicle driving and meet our requirements to have at least 2 years of driving experience. A total of 4 participants (3 males and 1 female) responded and met our requirements. They have an average of 4 years of driving experience in the US. Two of the participants were identified as aggressive drivers and two participants were identified as defensive drivers using aggressive driving scales (ADS) developed by Krahé and Fenske (2002).

3.2. Apparatus

We want to thank Professor Yiqi Zhang from the Industrial Engineering and Manufacturing Department for providing the driving simulator for us to finish our research. The driving scenarios in this study were programmed with a driving simulator (STISIM Drive® M300WS-Console) and recorded via Open Broadcaster Software (OBS) (shown as Fig.1). The driving simulator consisted of a Logitech Momo® steering wheel with force feedback (Logitech Inc., Fremont, CA), a throttle pedal, and a brake pedal. The driving scenarios were presented on a 27-inch LCD with 1920×1200-pixel resolution. The vehicles that participants interacted with were programmed to represent the driving styles of an AV and an HV and in different scenarios via STISIM Drive Open Module (OM).

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Fig 1. STISIM Driving Simulator

3.3. Materials

Aggressive Driving Scale (ADS). This 24-item scale for assessing aggressive driving behaviors was developed by Krahé and Fenske (2002) and validated by Zhang et al.(2016) . Participants were asked to report the frequency with which they engaged aggressive behaviors by rating each statement on a 5 point scale ranging from 0 (never) to 4 (very often). Every participant was pre-screened using the ADS to determine whether their driving style was aggressive, moderate, or defensive. Drivers were classified as aggressive when ADS $\geq$ 30 for male drivers and ADS $\geq$ 21 for female drivers, and defensive when ADS $\leq$ 23 for male drivers and ADS $\leq$ 13 for female drivers (Krahé, 2005; Krahé & Fenske, 2002).

3.4. Experimental Design

The experiment is a between-subject design with drivers' driving styles as a between-subject variable (aggressive vs. defensive). Each participant was required to experience all three scenarios where they will interact with automated vehicles with aggressive driving style. The first trial was an "AV coming from right scenario", or Scenario 1 (shown as Fig 2.), participants were asked to continue straight when they meet this intersection, where an AV is coming from right at the same time in a four-way stop sign. The second trial was an "AV-coming from left scenario", or Scenario 2 (shown as Fig 3.), participants were asked to continue straight in an intersection with a two-way stop sign where AVs coming from left. The speed limit for the first two scenarios were identified as urban scenarios with a speed limitation of 35 mph which was posted on the road. The third scenario was a "highway scenario", which we refer to as Scenario 3, where participants were asked to continue straight on the highway. An AV will turn on its left merge indicator to cut-in (shown as Fig. 4). The speed limit for the highway scenario was 65 mph. In urban scenarios (Scenario 1 and 2), the speeding alarm is triggered when the speed exceeds 38 mph, whereas the trigger is set to 75 for the highway scenario (Scenario 3). We note that we do not have the data for Scenario 1 with one of the participants (P4) as they were recruited prior to our redesign of the experiment. ✓

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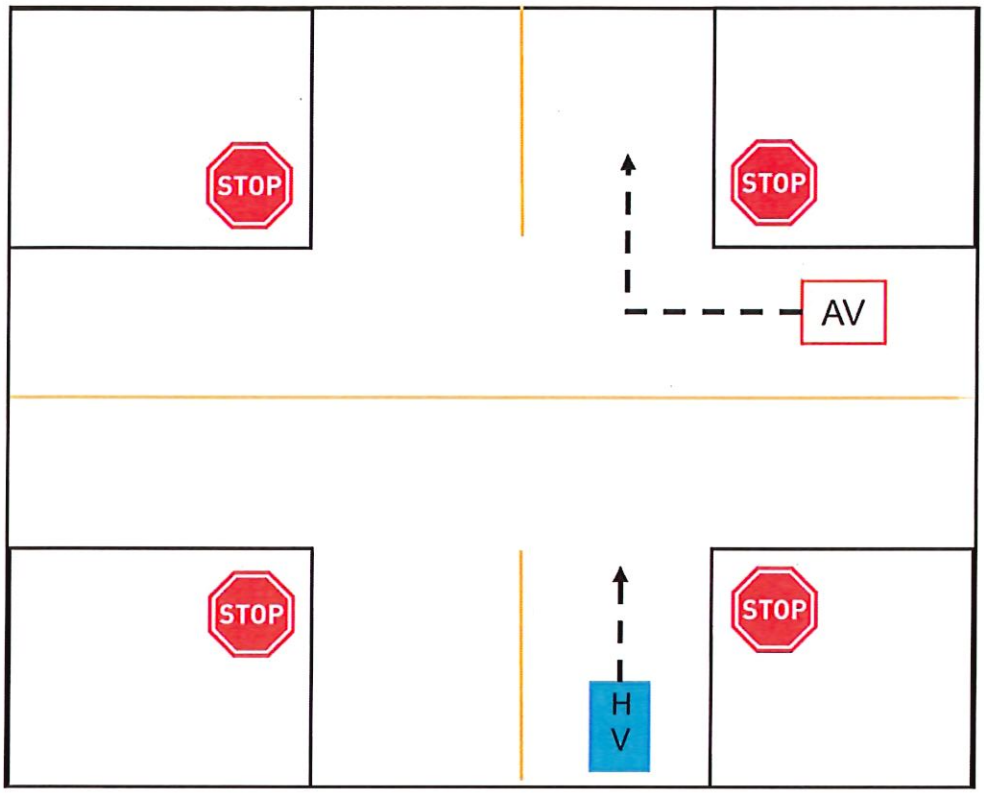

Fig 2. AV coming from the right scenario (Scenario 1).

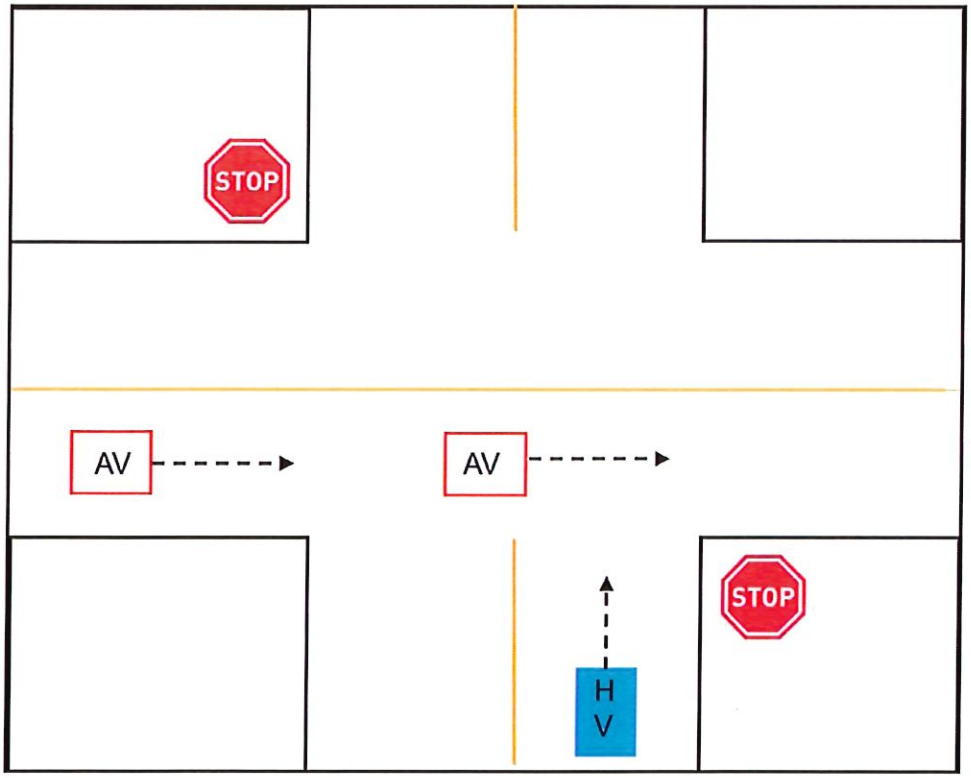

Fig 3. AVs coming from the left scenario (Scenario 2).

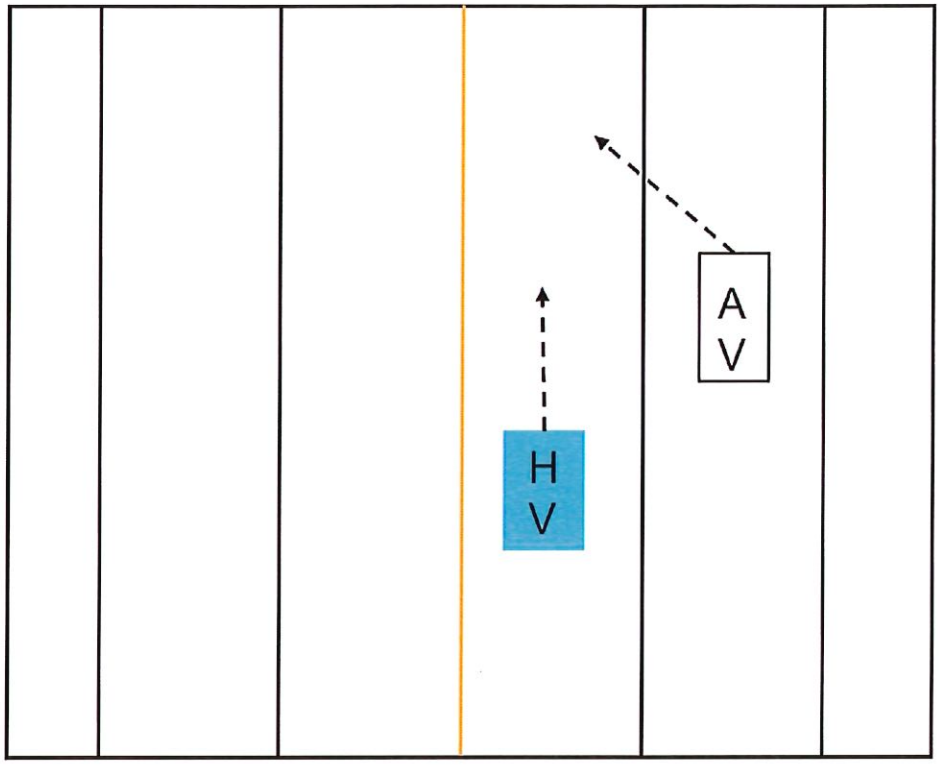

Fig 4. Highway merging scenario (Scenario 3).

The driving behavior of the automated vehicles was pre-designed (shown in Table 1.), we designed their driving behavior adopted from previous studies on aggressive AVs (J. Lee et al., 2019; Reddy et al., 2022).

Table 1. Values of Driving Indicators for AVs.

Environment	Indicators	Aggressive AV
Urban	Average speed (mph)	35
	Acceleration (ft/s^2)	6.38
	Deceleration(ft/s^2)	-7.14
	Desired car-following time gap (s)	3.5
Highway	Average speed (mph)	65
	Acceleration (ft/s^2)	3.57
	Deceleration(ft/s^2)	-6.56

3.5. Procedure

Participants who agreed to participate in our experiment were invited to our lab to finish the experiment. They were informed that the data that we collected will only be used in the IST 521 class project and we made sure to protect their privacy as much as possible. They were first asked to finish the ADS score to identify their driving styles. After that, they will finish a 10-minute test drive to help them get familiar with the driving simulator (shown in Fig. 5). They were informed to follow the voice instruction from the driving simulator and follow the speed limit on the road. If they exceed the speed limit by 10 mph, an auditory warning will be activated to alert them. The 3 formal experiment trials will need to be finished after the test drive. After getting the consent from our participants that we will record their driving behavior while they are driving, a camera will be used to record their driving during their driving process. They will need to watch their driving video to retrospect what they were thinking while driving when they finished the driving trials. All the retrospective from the participants will be recorded. The experiment procedure is shown in Fig. 6.

Fig 5. Participant driving the simulator

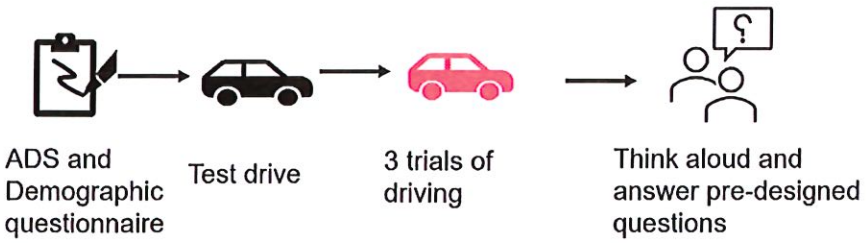

Fig 6. Experiment procedure

3.6. Data analysis

For the recording videos that we collected while participants were driving, we analyzed their driving behavior and procedure using HTA. For the voice recording of their recalls, we decoded their recall and concluded the attitude from drivers with different driving styles to aggressive automated vehicles. The think-aloud transcripts are shown in Appendix A.

4. Results

4.1. Hierarchical task analysis

In this section, we provide the hierarchical task analysis (HTA) for our simulation tasks, specifically, each subsection corresponds to one scenario from Scenario 1 to Scenario 3.

4.4.1. HTA for Scenario 1

Table 2 and Fig. 7 show the HTA for Scenario 1. The participant will drive through two intersections, with the first one having an AV coming from the right side, and merge into the traffic.

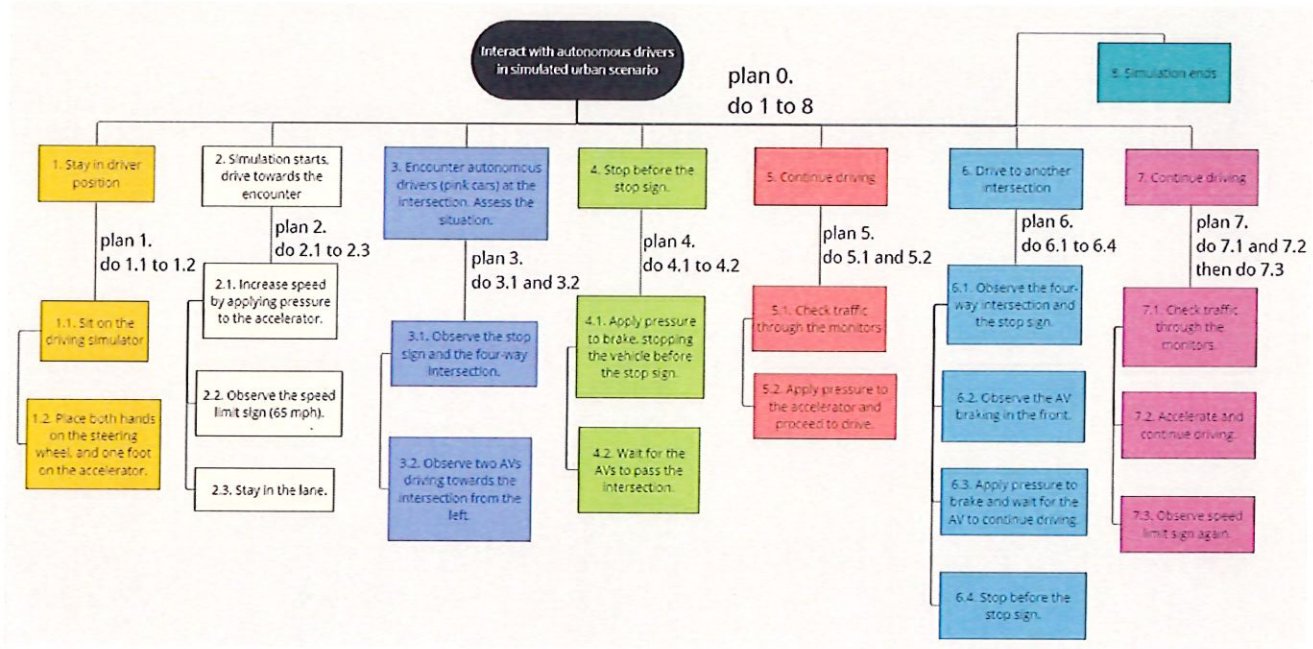

Fig 7. Diagram of our HTA on the driving simulation task in Scenario 1

Table 2. Hierarchical task analysis for the simulated encounter (Scenario 1) between a human driver and an autonomous driver.

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0. Interact with an autonomous driver in simulated urban scenario (Plan 0: do 1--2--3--4--5--6–7)

1. Stay in driver position (Plan 1: do 1.1--1.2)

   1.1. Sit on the driving simulator.

   1.2. Place both hands on the steering wheel, and one foot on the accelerator.

2. Simulation starts, drive towards the intersection (Plan 2: do 2.1--2.2--2.3)

   2.1. Increase speed by applying pressure to the accelerator (starting from zero mph).

   2.2. Observe the speed limit sign (35 mph in this section).

   2.3. Stay in the lane.

3. Encounter an autonomous driver (pink car) at the intersection. Assess the situation. (Plan 3: do 3.1 and 3.2)

   3.1. Observe the stop sign and the three-way intersection.

   3.2. Observe the AV driving towards the intersection from the right.

4. Stop before the stop sign. (Plan 4: do 4.1--4.2)

   4.1. Apply pressure to brake, stopping the vehicle before the stop sign.

   4.2. Wait for the AV to turn towards the same direction.

5. Drive after the AV (Plan 5: do 5.1 and 5.2, then do 5.3 and 5.4)

   5.1. Check traffic through the monitors.

   5.2. Apply pressure to the accelerator to match the speed of the AV.

   5.3. Stay at a steady pace behind AV.

   5.4. Maintain awareness of the AV's movements and adjust driving accordingly.

6. Drive to another intersection (Plan 6: do 6.1--6.2--6.3--6.4)

   6.1. Observe the four-way intersection and the stop sign.

   6.2. Observe the AV braking in the front.

   6.3. Apply pressure to brake and wait for the AV to continue driving.

   6.4. Stop before the stop sign.

7. Continue driving (Plan 7: do 7.1 and 7.2, then do 7.3)

   7.1. Check traffic through the monitors.

   7.2. Accelerate and continue driving.

   7.3. Observe speed limit sign again.

8. Simulation ends

Table 3 details the time each participant (P1-P3) spent at stop signs, measured from when the brakes were applied to when acceleration resumed, spanning Subtasks 4.1 to 5.2 and 6.3 to 7.2. In this scenario, Participant 1 (P1), characterized as aggressive, and Participant 2 (P2), defensive, completed the entire task in a comparable timeframe. However, Participant 3 (P3), also defensive, spent slightly more time overall. Notably, P3 exhibited the shortest duration at the first stop sign, a result of late braking, which may indicate insufficient situational awareness during Subtask 3. All instances of speeding alarms were triggered during Subtask 7 (both 7.2 and 7.3), occurring after the AV in front had increased its distance. This pattern of behavior suggests that participants, regardless of their driving style or the presence of speed limit signs, are prone to exceed speed limits—up to 40 mph—when there is a substantial gap ahead, suggesting a common tendency to speed in open road conditions.

Table 3. Data for each participant (P1-P3) on Scenario 1

Participant	Total completion time	Time spent on first stop sign	Time spent on second stop sign	Triggered speeding alarms
P1	127s	10.35s	11.41s	Twice at Subtask 7
P2	128s	11.64s	13.05s	Once at Subtask 7
P3	133s	6.14s	15.08s	Twice at Subtask 7
P4	N/A			

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Fig 8. Participant interacting with AV in Scenario 1.

4.4.2. HTA for Scenario 2

Table 4 and Fig. 9 show the HTA for Scenario 2. This scenario is similar to the first one, with two AVs coming from the left and driving past the first intersection.

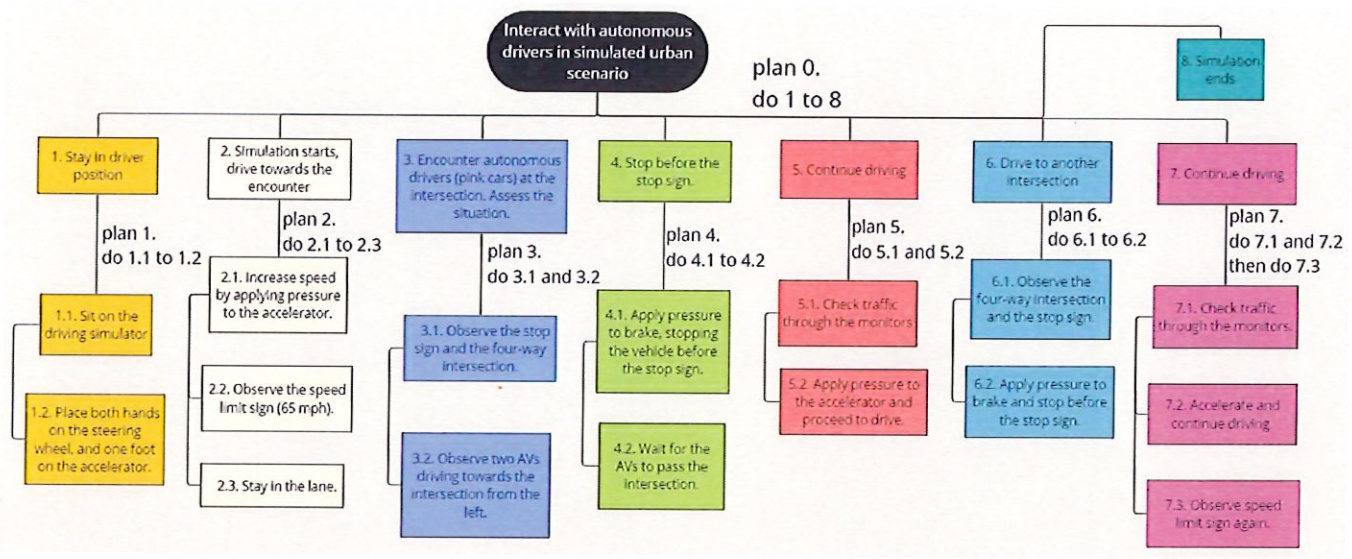

Fig 9. Diagram of our HTA on the driving simulation task in Scenario 2

Table 4. Hierarchical task analysis for the simulated encounter (Scenario 2) between a human driver and an autonomous driver.

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0. Interact with an autonomous driver in simulated urban scenario (Plan 0: do 1--2--3--4--5--6–7)

1. Stay in driver position (Plan 1: do 1.1--1.2)

   1.1. Sit on the driving simulator.

   1.2. Place both hands on the steering wheel, and one foot on the accelerator.

2. Simulation starts, drive towards the intersection (Plan 2: do 2.1--2.2--2.3)

   2.1. Increase speed by applying pressure to the accelerator (starting from zero mph).

   2.2. Observe the speed limit sign (35 mph in this section).

   2.3. Stay in the lane.

3. Encounter autonomous drivers (pink cars) at the intersection. Assess the situation. (Plan 3: do 3.1 and 3.2)

   3.1. Observe the stop sign and the four-way intersection.

   3.2. Observe two AVs driving towards the intersection from the left.

4. Stop before the stop sign. (Plan 4: do 4.1--4.2)

4.1. Apply pressure to brake, stopping the vehicle before the stop sign.

4.2. Wait for the AVs to pass the intersection.

5. Continue driving (Plan 5: do 5.1 and 5.2)

5.1. Check traffic through the monitors.

5.2. Apply pressure to the accelerator and proceed to drive.

6. Drive to another intersection (Plan 6: do 6.1--6.2)

6.1. Observe the four-way intersection and the stop sign.

6.2. Apply pressure to brake and stop before the stop sign.

7. Continue driving (Plan 7: do 7.1 and 7.2, then do 7.3)

7.1. Check traffic through the monitors.

7.2. Accelerate and continue driving.

7.3. Observe speed limit sign again.

8. Simulation ends

Table 5 presents the data for each participant (P1-P4). Notably, P3 (defensive) spent considerably more time than others, attributed to their consistently lower speed during the session. In contrast, P1 spent the least amount of time at each stop sign. This aligns with their aggressive profile previously identified. Analysis of time allocation reveals that Participant 4 (P4, classified as aggressive) spent a significant portion of their time at the first stop sign to Subtask 4.2, which involves waiting for a second AV to pass. Despite this, P4 still achieved the shortest overall completion time. The triggering of only two total alarms across the scenario indicates that participants had effectively updated their mental models regarding the speed alarm and the task environment, likely through learning from earlier tasks and the test drive.

Table 5. Data for each participant on Scenario 2

Participant	Total completion time	Time spent on first stop sign	Time spent on second stop sign	Triggered speeding alarms
P1	119s	5.18s	7.76s	Once at Subtask 7
P2	119s	10.29s	10.91s	Once at Subtask 5.2
P3	153s	11.71s	9.48s	None
P4	118s	26.18s	10.9s	None

Fig 10. Participant interacting with AVs in Scenario 2.

4.4.3. HTA for Scenario 3

Table 6 and Fig. 11 show the HTA for Scenario 3. We note that the merging behavior programmed for the AV in this scenario works as follows: the AV activates its turn signal and accelerates when the distance to the vehicle ahead is 100 feet; it then begins to merge into the adjacent lane once the distance exceeds 150 feet.

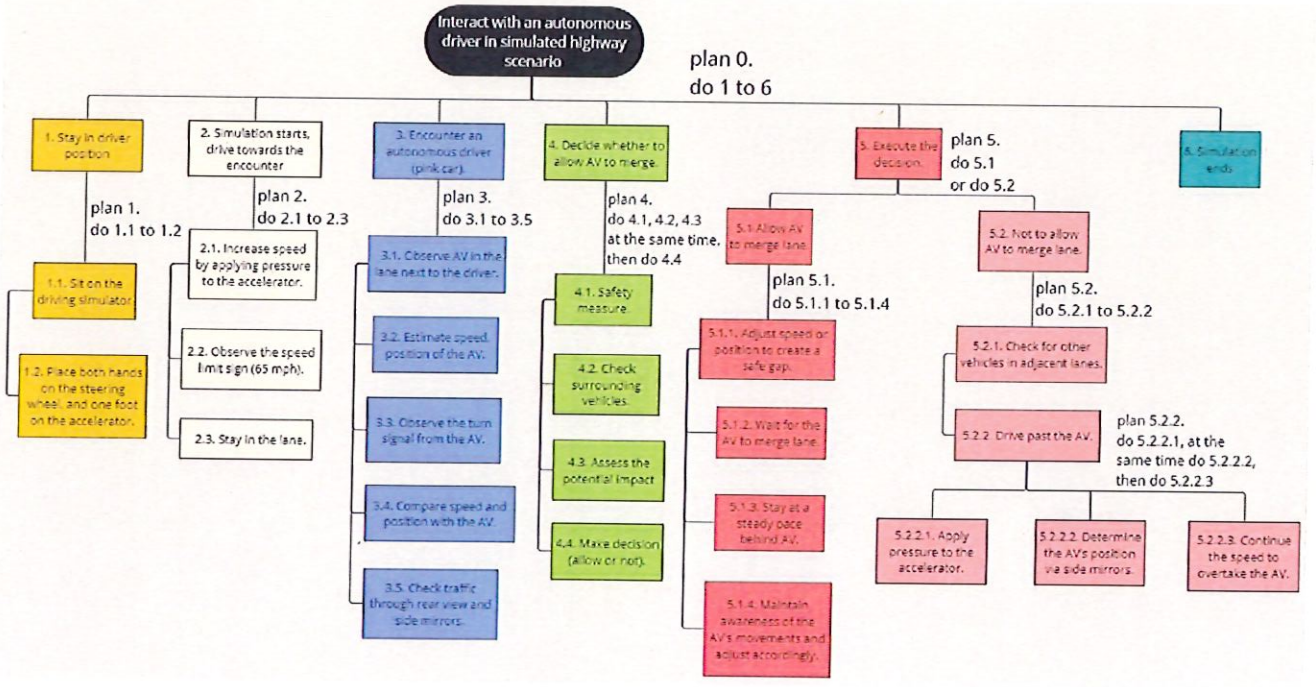

Fig 11. Diagram of our HTA on the driving simulation task in Scenario 3

Table 6. Hierarchical task analysis for the simulated encounter (Scenario 3) between a human driver and an autonomous driver.

0. Interact with an autonomous driver in simulated highway scenario (Plan 0: do 1--2--3--4--5--6)

1. Stay in driver position (Plan 1: do 1.1--1.2)

1.1. Sit on the driving simulator.

1.2. Place both hands on the steering wheel, and one foot on the accelerator.

2. Simulation starts, drive towards the encounter (Plan 2: do 2.1--2.2--2.3)

2.1. Increase speed by applying pressure to the accelerator (starting from zero mph).

2.2. Observe the speed limit sign (65 mph in this section).

2.3. Stay in the lane.

3. Encounter an autonomous driver (pink car). Assess the situation. (Plan 3: do 3.1--3.2--3.3--3.4--3.5)

3.1. Observe AV in the lane next to the driver.

3.2. Estimate speed, position of the AV.

3.3. Observe the turn signal from the AV to change to the driver vehicle's lane.

3.4. Compare the current speed and position of the driver vehicle with the AV.

3.5. Check traffic through rear view and side mirrors.

4. Decide whether to allow AV to merge. (Plan 4: do 4.1, 4.2, 4.3 at the same time, then do 4.4)

4.1. Safety measures.

4.2. Check surrounding vehicles.

4.3. Assess the potential impact on the driver's own vehicle and needs.

4.4. Make decisions (allow or not).

5. Execute the decision. (Plan 5: do 5.1, **or** do 5.2)

5.1. Allow AV to merge lanes. (Plan 5.1: do 5.1.1--5.1.2--5.1.3--5.1.4)

5.1.1. Adjust speed or position to create a safe gap for the AV.

5.1.2. Wait for the AV to merge lanes.

5.1.3. Stay at a steady pace behind AV.

5.1.4. Maintain awareness of the AV's movements and adjust driving accordingly.

5.2. Not to allow AV to merge lanes. (Plan 5.2: do 5.2.1--5.2.2)

5.2.1. Check for other vehicles in adjacent lanes.

5.2.2. Drive past the AV. (Plan 5.2.2: do 5.2.2.1, at the same time do 5.2.2.2, then do 5.2.2.3)

5.2.2.1. Apply pressure to the accelerator.

5.2.2.2. Determine the AV's position via side mirrors.

5.2.2.3. Continue the speed to overtake the AV.

6. Simulation ends

Table 6 outlines the data for each participant (P1-P4). The "time for AV to merge" is measured from the initiation of the turn signal to the completion of the lane change when the signal is turned off (Subtask 3.3 to 5.1.2). Among the participants, we observe that only P4 (aggressive) chose to overtake the AV, which resulted in the triggering of three speeding alarms in the process, suggesting an impatience or lack of trust in the AV's merging speed and decisions.

Table 7. Data for each participant on Scenario 3

Participant	Total completion time	Decision on Subtask 4	Time for AV to merge	Triggered speeding alarms
P1	112s	Allow merging	5.83s	None
P2	130s	Allow merging	5.36s	None
P3	119s	Allow merging	5.99s	None
P4	103s	Overtake	N/A	Three times at Subtask 5.2.2.3
mean	116s ?		5.73s ?	

Fig 12. Participant interacting with AV in Scenario 3.

4.2. Think aloud verbal protocol analysis

After participants indicated their willingness and confidence to share the data in each scenario, we asked them to describe their behavior and thought when making the decisions when interacting with aggressive AVs (we did not notify them the vehicles they were interacting with are aggressive AV. We just told them the pick cars are vehicles with automation systems.). We did a thematic analysis for the responses from the 4 participants. We analyzed the attitude differences of aggressive and defensive drivers. The following paragraphs were concluded from participants' voice transcripts:

Attitude differs from drivers with different driving styles: Our transcript showed that aggressive drivers were more concerned and sensitive of AVs' aggressive behavior, P1 stated, " He turned his signal on and immediately merged ... Normally you wait, like, I mean, if you're being courteous, then you know, you're supposed to signal and let people have the time to process.", similar concern was also presented from another aggressive driver P4, "It (the AV) took forever to go.... it just wasn't straightening out it just felt weird". While for defensive human drivers, they reported that they did not tell any difference between the aggressive AV and other normal human-driven vehicles. For example, P2 said, "So I noticed they're just going way faster than I am, but I wouldn't really consider it aggressive ... I think it depends on the road state. So, if it's relatively open, I don't mind them being a bit more aggressive in their driving, just less chances for them". Similar thoughts from P3 were, "I mean just usually you assume you know that kind of scenario happening where you will assume every car kind of follow the rule so they have a stop sign they will stop I have stopped I stopped then ... That's like regular vehicle behavior ".

Manipulation of the driving simulator: When driving in the simulator, some participants said that the driving simulator is harder to manipulate compared with real cars which may be one of the underlying reasons that causes their behavior differences. P3 said, "I think that for the actual car. The brake it's like when you just lightly tap it. It slows down fast. Yeah, so when I'm here it's like (very hard to control)". Similar response was also reported from P1, "I felt like the brakes were really spongy like it's a very American simulator. I'd rather have a German car so it's a lot more precise. If that makes any sense."

Concerns of the application of AVs' behavior in varied scenarios: Although the design of our scenarios were carefully considered and compared with the previous report and study, some participants still showed their concerns that the AVs' behavior may cause some inconvenience if the situation changes. P1 said, "if I don't know the area and I'm not using GPS, or even if I am using GPS, like, if it's unfamiliar, or if there's bad weather conditions. Yeah, bad weather conditions, or if it's just like dusk. Or if I'm tired, you know, I mean, sometimes, like, that's just a human condition, like, you do drive tired sometimes. So, you have to stay a little more alert there. Yeah. Also, if I'm on a road trip, like if I'm on a road trip, and I'm making a good pace. I don't want to be merging back and forth. I'll just stay in the right lane. I'll set my automatic cruise control

on it's just the lane keeping cruise control. It doesn't drive for me, but it does brake and stop. And I mean, that just makes it a lot easier. It removes the cognitive load from me to not have to do that you know.". P3 also stated that "And usually people don't merge that aggressively unless they're in a rush or something. But yeah, I thought the behavior was a little strange."

5. Discussion & Future work

Based on the results of our project, the following points can be drawn:

Alignment of AV and Driver Styles: Our study's findings align with existing research suggesting that drivers prefer AV driving styles that are similar to their own, as seen in Ma & Zhang (2023). The retrospective think aloud VPA indicates that aggressive drivers were more aware of and sensitive to the AV's aggressive behaviors, while defensive drivers did not perceive much difference between the AV and HV. This difference in perception may suggest the need for AV driving styles to adapt to human expectations to promote road safety and efficiency.

Behavioral Changes and Safety Implications: The aggressive behavior displayed by some participants, specifically P4 in Scenario 3, who chose to overtake the AV and triggered speeding alarms, raises questions about the safety implications of AVs adopting more aggressive driving styles. Future research should assess the balance between human-like AV behavior and safety. One of the possible directions would be exploring the use of predictive analytics to adjust AV responses to individual driver behavior without compromising safety standards.

Impact of Simulator Design: Participants' comments on the driving simulator's controls affecting their driving behavior hint at a broader issue of how simulation design might influence user interaction with AVs. This indicates a need for improvement of our simulation to refine simulator accuracy or cross-validate findings with real-world experiments, ensuring that the results and insights are representative of actual driving conditions.

Complexity of Scenarios: The concerns raised by participants during the think aloud section about the potential challenges posed by AVs in varying conditions point to the need for future research to investigate AV performance across a wider range of scenarios, including complex urban environments or varying weather conditions. This could help develop more robust AV systems that can handle the unpredictability of real-world driving.

Based on our research report, we aimed to recruit more participants and incorporate more things related to participants' trust and risk perception towards the aggressive AVs to see how the adjusted driving styles of AVs may influence human drivers' decision making to mitigate the driving road rage and improve traffic safety.

6. Conclusion

For this project, we conducted a qualitative study that provides insights into how human drivers with different styles interact with aggressive automated vehicles (AVs), using Hierarchical Task Analysis (HTA) and think-aloud verbal protocols. Our findings indicate that drivers respond more predictably and safely when the AV's behavior aligns with their own driving styles, enhancing their comfort and trust in AVs.

The use of HTA and think-aloud protocols enriches our understanding of driver-AV interaction by systematically analyzing driving tasks and revealing drivers' real-time cognitive processes. These methodologies contribute to the field by detailing the influence of AV driving styles on human drivers, informing the development of AV technology and potential regulatory frameworks for safer, more efficient mixed traffic environments. We hope that this study lays a foundation for further exploration of AV behaviors and driving styles, aiming to improve the adaptiveness of automated driving systems.

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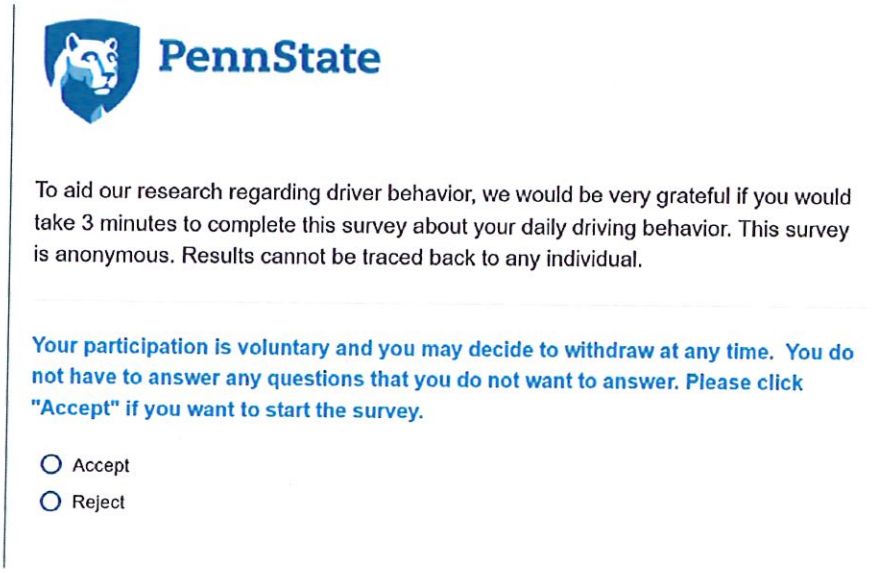
Appendix A. Aggressive Driving Scale



PennState

To aid our research regarding driver behavior, we would be very grateful if you would take 3 minutes to complete this survey about your daily driving behavior. This survey is anonymous. Results cannot be traced back to any individual.

Your participation is voluntary and you may decide to withdraw at any time. You do not have to answer any questions that you do not want to answer. Please click "Accept" if you want to start the survey.

- ○ Accept
- ○ Reject

Your responses will be confidential and only used for appropriate means of our project. (You should have had US driver license for at least 2 years.)

Please indicate your actual driving behavior with the following questionnaire.

0: Never; 1: Hardly Ever; 2: Occasionally; 3: Often; 4: Very Often

How often do you become angered by another driver and give chase with the intention of giving him/her a piece of your mind?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you stay in a lane that you know will be closed ahead until the last minute before forcing your way into the other lane?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you overtake a slow driver on the inside?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you pull out of a junction so far that the driver with right of way has to stop and let you out?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you cross a junction knowing that the traffic lights have already turned against you?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you drive so close to the car in front that it would be difficult to stop in an emergency?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you get angry at being overtaken and accelerate while the other driver is overtaking you?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you sound your horn to indicate your annoyance to another driver?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you race away from traffic lights with the intention of beating the driver next to you?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you become angered by a certain type of driver and indicate your hostility by whatever means you can?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you disregard the speed limit on a residential road?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you swear under your breath at other drivers?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you disregard the speed limit on a motorway?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you get so annoyed by another driver passing you on a fast road blowing his horn that you might chase him?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you try to get the better of other drivers?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you take a chance to arrive on time?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you try to edge another car off the road?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you make rude signs at other motorists when you were provoked?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you swear out loud at other drivers?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you get into fights with other drivers?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

If the driver behind you has his/her lights shining in your mirror, how often do you try to pay him back in some way?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you flash your headlights at other drivers to make faster progress?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

How often do you get so annoyed at another driver that you pull in front of him, braking suddenly to show him/her your annoyance?

Never	Hardly Ever	Occasionally	Often	Very Often
0	1	2	3	4

Appendix B. Transcripts for retrospective VPA

This appendix provides the transcripts for our think-aloud retrospective VPA with four participants, transcribed via Otter.ai and manual adjustments.

Participant 1

The following is the transcript for the recording with our first participant (P1), where Speaker 1 is the participant and Speaker 2 is the interviewer.

Speaker 1 0:21
Apparently my nose was itching.

Speaker 1 0:30
oh the first thing is that I feel like the simulator is constraining. If like when I was trying to take left hand turns left and right I felt like like these weren't sufficient to actually show me the full peripheral vision when I was driving

Speaker 2 0:47
so you cannot see the very left or very right and that's a problem

Speaker 1 0:51
Yeah. Most of the cars were like super cars so I found that somewhat unrealistic

Speaker 2 1:06
Okay. What about this car we're seeing this car

Speaker 1 1:15
so I don't know if it's a limitation of the simulator or because like what the angles for the lines because we talked about the lines on the road

Speaker 1 1:27
I thought I got into an accident there that was you at the camera

Speaker 2 1:31
yeah I was at the camera

Speaker 1 1:37
I felt like the brakes were really spongy

Speaker 1 1:50
like it's very American simulator I'd rather German car so it's a lot more precise. If that makes any sense.

Speaker 2 1:56
Do you think that the vehicles from your front are in front of you, is their actions real? I mean do you think they're too aggressive or something

Speaker 1 2:12
I felt like the they took very aggressive lane merges. I thought lane merges were very aggressive I saw so when I was on the highway the first time I noticed that there was a pink car in front of me and he made a very aggressive merge in front of a car in front of him

Spreaker 2 2:39
we'll see that

Speaker 1 3:03
I thought it was strange how the simulator had two different roads with a two way stop sign in the middle of a city most of the time there will either be traffic lights, or a four way stop sign, so I thought that that was not realistic. I think that was on the second or this well.
Yeah see? Right here yeah normally there's a four way stop sign okay in a situation or or traffic lights so I thought that that was unrealistic. Here I was I was a little bit apprehensive because I couldn't see my sides when I was going through the intersection you know and because it wasn't a four way intersection I didn't,
I had less confidence going through the intersection both because of visibility like normally you can look around and then you can see like behind you and start right I didn't so I was again the rig is constraining the the simulator itself is constraining

Speaker 2 4:05
so when you see these we can come back this. When you see these two we see these two actually there are two pink cars coming from left to right, yeah right there, what do you think of their behavior? And do you have intention to get rid of them? Or come across the intersection before before them?

Speaker 1 4:38
No, no, I don't. I don't try to. I drive pretty pretty defensively Yeah.

Speaker 1 5:19
also getting the warnings I guess in the city it gives you a warning at three and on the highway it gives you a warning at nine? Yeah. So

Speaker 2 5:31
I think that's that's because the speed limit for highway and for urban is different. Yeah. So when people manipulate the simulator, they may like accelerate differently

Speaker 1 6:10
Yeah, again, the signs, were just all off. Completely confusing. So I drove on the on the

Speaker 2 6:20
You mean assign on the very right?

Speaker 1 6:22
Yeah cause it had a sign over the over the um

Speaker 2 6:32
Yeah I get you. Do you notice that or not? The speed limit sign

Speaker 1 6:40
Yeah, I did.

Speaker 2 6:54
So you see that vehicles from merging lane. So do you think that vehicles behavior aggressive?

Speaker 1 7:04
Yeah.

Speaker 2 7:06
So why do what made you think it's aggressive? He

Speaker 1 7:08
turned his signal on and immediately merged. Like, it was like an immediate like, normally you wait, you wait, like, I mean, if you're being courteous, then you know, you're supposed to signal and let people have the, you know, time to process. But I mean, it was like, one blink, and then he merged, and he merged really quickly. So I mean, it was a very sharp angle and he merged

Speaker 2 7:29
the GPS that if you don't consider about the constraint of the GPS, will you merge the lane to let the vehicle to cut in lane, merge to the left lane?

Speaker 1 7:39
Yeah, if I were driving, I'd probably be driving all the way far under the far left lane, or as far left as I could just as a general rule. That's, that's driving etiquette in Europe. Just just I mean, I see you're here to stay in the left as far left as you can.

Speaker 2 7:56
Okay. You just want to try to keep further distance with the vehicle right?

Speaker 1 8:03
Well, from any vehicle, right. Oh, yeah. I mean, you want to just create a bubble around yourself, and also not impede the flow of traffic. Okay. So if I'm not exiting, and I have multiple lanes. Well, I mean, I guess it depends, too. Like, if I'm, if I'm like on a leisurely drive, then maybe I won't go all the way to the far left lane.
Or, if I'm not using GPS, and I'm not I'm unfamiliar with the area, then maybe I'll stay in the right lane. So it just depends.

Speaker 2 8:37
You will stay in the right lane with a very slow speed.

Speaker 1 8:41
Yeah. Yeah, if I'm in if I don't, if I don't know the area, you know, and I'm not using GPS, okay. Or even if I am using GPS, like, if it's unfamiliar, or if there's like bad weather conditions. Yeah, bad weather conditions, or if it's just like dusk. Or if I'm tired, you know, I mean, sometimes, like, that's just a human condition, like, like, you do drive tired sometimes.
So you got to stay a little more alert there. Yeah. Also, if I'm on a road trip, like if I'm on a road trip, and I'm making good pace. I don't want to be merge like I'll be listening to an audiobook or something. I don't want to be merging back and forth. I'll just stay in the right lane. I'll set my automatic cruise control on it's just the lane keeping cruise control.
It doesn't doesn't drive for me, but it does braking and stopping. And I mean, that just makes it a lot easier. It removes the cognitive load from me to not have to do that you know.

Speaker 2 9:43
Yeah. Okay. Any comments about the experiment? Or any suggestions? Okay.

Participant 2

The following is the transcript for the recording with our second participant (P2), where Speaker 1 is the participant and Speaker 2 is the interviewer.

Speaker 1 0:21

Yeah, I mean, here, I'm not really thinking about too much. I just noticed the speed limit there. So I'm trying to match it as the since it's like, pretty crowded street with like parked cars, I'm not trying to go too fast.

Speaker 1 0:39
These like urban areas. So sometimes I'll dip below. I try not to go over.

Speaker 1 0:48
Like sometimes I end up going over

Speaker 1 0:55
here, I noticed the three way intersection. And I see that pink car hit the stop sign first. So let them go first. Up there second. So let it pass. And after that I'm just matching the speed of the cards so that we kind of keep this gap

Speaker 2 1:17
Do you think will you think that pink cars behavior in this in situations, aggressive?

Speaker 1 1:27
I wouldn't say aggressive, I've seen worse behavior in urban streets. So I'm kind of used to people just taking the intersection as if there was as if it was their intersection.

Speaker 1 1:43
So I usually like to keep distance, matching their speed instead of trying to catch up. I see that when I was trying to match their speed, I ended up speeding, so I just tone it back down.

Speaker 1 2:02
So I noticed they're just going way faster than I am but I wouldn't really consider it aggressive.

Speaker 1 2:40
Here, same deal. I'm just looking for a speed limit sign. I see the 35 and try to match the 35.

Speaker 1 2:50
Not really noticing anything here. Same kind of mentalities with if it's an urban street that I don't want to speed too fast or too slow.

Speaker 2 3:00
So before you enter the intersection, will think your views are hidden by those by those like blocks. And also do you think your view are limited by the simulator? Left and right view

Speaker 1 3:20
So for left and right view, maybe a little bit because it's just not what I'm used to. But I think with like a little bit of adjustment I would have been fine.
For um that point. I didn't actually see the second thing car I only saw the first one. So I was a little confused.

Speaker 1 3:40
I also noticed that since it's they don't have a stop sign, they just they just go so I just waited until all the traffic passed. So that one passed but then I didn't see that one like at all. But

Speaker 2 3:53
Do you think their behaviors Okay?

Speaker 1 3:56
The behavior is a little weird because if they're going the same speed as the first pink car then I think I would it would have been more visible but they kind of did like a weird slowdown as well. And I wasn't really expecting that.

Speaker 1 4:16
Here I'm not really thinking about too much. Just continuing

Speaker 1 4:35
normally, in like an urban setting like this, it's pretty um congested streets. I don't even get to hit 35 miles an hour usually. But since the roads are relatively empty, I just kept pace and kept going.

Speaker 1 4:56
I imagine it would have been different if there were like, some cars behind me
Since then I would have to go a little bit faster like over the speed limit, because people tend to speed in areas that are familiar with

Speaker 1 5:14
it's the highway driving one?

Speaker 2 5:16
Yeah it's the highway

Speaker 1 5:18
so the speed limit sign, so pushing to 65, I heard the instructions there to stay in the lane, so I'm not trying to make any lane changes.

Speaker 1 5:32
When I'm highway driving, I tend to shift my hands down. So I know it's gonna be a longer stretch of road.

Speaker 1 5:43
Here, I noticed the car on the right side lane.
I don't really think too much of it. I assume they're just traveling because they're in the they're in the far right lane. So that just means they're just going to stay in that lane. Usually, unless you meet somebody who's going slower than you in front.

Speaker 1 6:02
I was watching them to make sure here, so he noticed I slowed down a little bit after they put on the turn signal. And then after that, I just kept pace.

Speaker 2 6:13
What do you think of that vehicles behavior?

Speaker 1 6:16
I think they needed to keep the turn light on a little bit longer before they made that merge. And usually people don't merge that aggressively unless they're in a rush or something. But yeah, I thought the behavior is a little, little strange.

Speaker 1 6:33
Wouldn't call it aggressive, though, it's just why would you, it was just confusing to me. Because there's no need to do that.

Speaker 2 6:43
What is What do you think if they're pretty defensive vehicle? What would he do in that kind of situation?

Speaker 1 6:50
Because the offensive vehicle, I think they would have waited for me to pass and then make the merge in because at the speed I was going initially, I would have passed them eventually.
But to me, it seemed like they sped up and then made the merge here. So if they were really a defensive driver, they would have just waited for you to pass.

Speaker 2 7:11
Do you prefer the vehicle to be more aggressive or defensive?

Speaker 1 7:16
I think it depends on the road state. So if it's relatively open, I don't mind them being a bit more aggressive in their driving just less chances for them

Speaker 2 7:26
as long as they do not interact with you.

Speaker 1 7:29
Yeah. Essentially.

Speaker 2 7:30
As long as they don't make you swear.

Speaker 1 7:33
Yeah yeah yeah, as long as they're not like potentially putting either of us in danger that I don't really care too much about whether they drive faster or slower. Yeah

Speaker 2 7:50
Okay, pretty good. I think that's it.

Participant 3

The following is the transcript for the recording with our third participant (P3), where Speaker 1 is the participant and Speaker 2 is the interviewer.

Speaker 1 0:01
About what?

Speaker 2 0:05
Then do now watch the screen while driving. Speak out what your thinking was driving. Also, I'm going to ask you some questions.

Speaker 1 0:12
Okay. This is uh very beginning?

Speaker 2 0:16
Yeah, this is the first experiment. It's not the test drive. So we just start from experiment

Speaker 1 0:27
This is not the first I think this is after. After the highway driver. Cause I said I was

Speaker 2 0:39
no the highway is a test drive. This is the first formal drive.

Speaker 1 0:45
Oh okay.

Speaker 1 0:48
You want me to say what?

Speaker 2 0:51
So you here you inter.. actually, there's that's a vehicle we perceive that...

Speaker 1 0:57
I wanted to stop.

Speaker 2 0:59
You want the car to stop, right? Because you see the stop sign

Speaker 1 1:02
I wanted to stop. It's just the brake. I mean, I couldn't control the

Speaker 2 1:06
You feel like it's hard to brake.

Speaker 1 1:09
I think that for the actual car. The brake it's like when you just lightly tap it. It slows down fast. Yeah, so when I'm here it's like..

Speaker 2 1:26
let's just go back a little bit. So while you see the vehicle What is What do you think about that vehicles behavior?

Speaker 1 1:38
That vehicle stopped

Speaker 2 1:41
Yeah because there's a stop sign. You think the behavior is okay for that vehicle?

Speaker 1 1:46
Yeah. I think yeah

Speaker 2 1:47
That's like a regular vehicle behavior. You think it's fine for you? okay

Speaker 1 1:54
And then that car should to go by first from my understanding

Speaker 2 1:59
yeah okay.

Speaker 1 2:04
Oh, that's for the speed limit

Speaker 1 2:12
I think I often went above

Speaker 1 2:19
here I did better. That stop sign I did better

Speaker 2 2:25
okay. yeah yeah yeah

Speaker 1 2:29
And then I also found out for the... paddle?

Speaker 1 2:38
Oh, so one of the reasons I often went above this the limits is the same as the brake. I couldn't. I couldn't feel the paddle. It's like...

Speaker 2 2:48
I gotcha. Yeah. It takes time to get used to it. Yeah.

Speaker 2 3:11
let's start from...

Speaker 1 3:24
this uh I. I think I was a lil...

Speaker 2 3:32
this one you did better, right? Yeah.

Speaker 1 3:34
I did better but too slow

Speaker 2 3:44
Maybe it hasn't because you're distracted?

Speaker 1 3:47
Maybe?

Speaker 2 3:50
Or do you think it is because you triggered the alert previously, so you want to make you drive slower? Is that sort of thing?

Speaker 1 4:02
maybe I think I kind of like have the speed limit on my mind. And I also knew that the paddle I mean, and the break, I'm not able to control them.

Speaker 1 4:17
So you stopped actually very earlier, from the stop sign

Speaker 1 4:22
because of the break. I I've always felt like it took some time to fully stop.

Speaker 2 4:26
oh so you want to stop earlier?

Speaker 1 4:30
Yeah... No, it's not that I wanted to stop earlier. I wanted to stop at that stop sign.

Speaker 2 4:35
Oh I got you

Speaker 1 4:36
just I couldn't control it that well. That's why I made the vehicle stop earlier. I had the time.

Speaker 2 4:48

Do you think uh what do you think of these two vehicles? So while you stopping You actually stopped ahead of time. Is there any reasons because of the behavior of these two vehicles?

Speaker 1 5:01
No I just saw the stop sign yeah

Speaker 2 5:02
okay, so you.. you actually did not pay attention to that two vehicles, Did you?

Speaker 1 5:08
Oh I think I did see them but not as much as when I saw the stop sign ahead.

Speaker 1 5:24
cuz I think uh usually

Speaker 1 5:27
I think while you're while you are driving when it's important like if there's a stop sign and need to stop and then maybe you can see what the situation is there. because there are always cars like

Speaker 2 5:48
so you think the sign matters more than the vehicles coming right?

Speaker 1 5:55
I mean if their car crash of course you do pay attention right. I mean just usually you assume you know that kind of scenarios happening where you will assume every car kind of follow the rule so they have a stop sign they will stop I have stopped I stopped then

Speaker 2 6:24
let's see that again.

Speaker 1 6:33
here?

Speaker 2 6:33
yeah, yeah, I want you to make an assessment of those two vehicles coming from left to right

Speaker 1 6:44
you mean...

Speaker 2 6:46
These two cars coming from left to write just judge them or just to make comments or leave some words What do you think of their behavior?

Speaker 1 6:58
I think they just they drove on their way it's good

Speaker 2 7:02
It's fine just yeah. Okay, we'll skip to the next

Speaker 1 7:20
highway

Speaker 1 7:33

think I also try once that I didn't move the... I didn't adjust the wheel. And I just felt like my car went to the right lane which means it's not straight

Speaker 2 7:52
it is straight because there's some angles there's some degrees that you actually did not place your steering at the correct probably at the correct angle

Speaker 1 8:02
I don't think it'd be actual driving experience when you do things like that, constantly adjust I mean if the road is

Speaker 2 8:13
probably if you're in a manual car, I'm not sure if they're like to create it in 2015 or earlier than that the vehicles made you probably need to adjust it I'm not sure.

Speaker 2 8:31
so you see the vehicles coming on your right

Speaker 1 8:32
on? Yeah, right. I think that car also turn to my lane. And then I kind of slow down

Speaker 1 8:55
yeah, that car turn to my lane. because because I knew that I had enough distance. So I didn't change to the left lane. I just kind of like slow down a little bit.

Speaker 2 9:11
Do you think that car aggressive?

Speaker 1 9:15
No, I don't think so.

Speaker 2 9:16
Do you think, okay, that's just a normal as it's like usually

Speaker 1 9:19
a usual one change another lane they change. It's not like they... also mean that car signaled right? yeah.

Speaker 2 9:30
Yeah okay.

Speaker 1 9:33
even better than some vehicles on the highway in actual life. Some cars they even don't signal

Speaker 2 9:47
Okay. That makes sense. That car is even better right? Got you

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Participant 4

The following is the transcript for the recording with our fourth participant (P4), where Speaker 1 is the interviewer and Speaker 2 is the participant.

Speaker 1 0:00

Okay. I'm gonna go through this. This was your driving

Speaker 2 0:26
Is this the first trial?

Speaker 1 0:27
Yeah

Speaker 2 0:48
I stopped very early

Speaker 2 1:01
It took forever to go

Speaker 2 1:37
...cars

Speaker 1 2:21
Okay we gonna do this one more time

Speaker 2 2:33
with a different trial?

Speaker 1 2:35
Yeah, and just recall whatever you think, anything

Speaker 2 2:55
This part of the lane I felt like while driving like it just wouldn't stay straight and it just like I had to like keep using the steer roll to straighten it out, it just wasn't straightening out it just felt weird

Speaker 2 3:15
like the steering wheel straight I don't know why the wheels are turning

Speaker 2 3:30
yeah if this person trying to make uh trying to merge lane, too slow

Speaker 2 3:41
That's me trying to get past him

Speaker 2 3:59
and I can't tell if I'm in the middle of the lane or I'm on the right hand side

Speaker 2 4:20
This part has a lot of speeding at this point

Speaker 1 4:31
okay uh one more time just a minute

Speaker 2 5:09
This is probably where I'm speeding

Speaker 2 5:22
Just me increasing speed so I can get in front of him

Speaker 2 5:34
So I feel like why am I steering the wheel so much when it should be just going straight

Speaker 2 5:52
and that car still hasn't merged to another lane

Speaker 2 6:04
I think I'm speeding just to give it space to actually merge lanes

Speaker 1 6:16
Okay, okay, that's it. Thank you

Speaker 2 6:19
No problem
