



Consent

Consent to participate in a research study: Modeling Bi-directional Trust Between Humans and Automated Vehicles

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Co-investigator: Hebert Azevedo-Sa, Ph.D. Student, Robotics Institute, University of Michigan

Invitation to participate

We invite you to participate in a research study to model how trust between people and Automated Vehicles (AV) develops as more experience is gained with AVs.

Description of subject involvement

If you agree to be part of the research study, you need to watch some videos and answer survey questions. Survey

responses will be logged through Qualtrics while you participate in the experiment. Researchers will review this data, but it will not be released to anyone not involved in the investigation of the study.

Compensation

You will receive \$1.80 through Amazon Mechanical Turk for participating in this study.

Benefits

You may not receive any direct benefit for participating, but we hope this study will contribute to the improvement of AVs technology in the future.

Risks and discomforts

Your participation will incur minimal risk, meaning there will be no additional risks than those ordinarily encountered in daily life.

Confidentiality

We plan to publish the results of this study but will not include any information that would identify you. There are some reasons why people other than the researchers may need to see the information you provided as part of the study. This includes organizations responsible for making sure the research is done safely and properly, namely the University of Michigan. To keep your information safe, the researchers will anonymize all data collected during the test and will not

collect any sensitive information about you.

Data and Storage

All data logged from experiment participation will be anonymous and stored on password-protected certified secure locations only. These storage locations have been approved by the University of Michigan IT. Data will be kept for a maximum of 3 years. All data will be kept secure, confidential, and private. Data will be available only to the research team via a secure password.

Since you are enrolling in this research study through the Amazon Mechanical Turk (MTurk) website, we need to let you know that information gathered through Amazon MTurk is not completely anonymous. Any work performed on Amazon MTurk can potentially be linked to information about you on your Amazon public profile page, depending on the settings you have for your Amazon profile. Any linking of data by MTurk to your ID is outside of the control of the researcher for this study. We will not be accessing any identifiable information about you that you may have put on your Amazon public profile page. We will store your MTurk worker ID separately from the other information you provide to us. Amazon Mechanical Turk has privacy policies of its own outlined for you in Amazon's privacy agreement. If you have concerns about how your information will be used by Amazon, you should consult them directly.

Voluntary nature of the study

Participating in this study is completely voluntary. Even if you decide to participate now, you may change your mind and stop at any time. If you decide to withdraw early, none of your data will be used in the study.

Contact information

If you have questions about this research, you may contact Hebert Azevedo-Sa (**azevedo [at] umich [dot] edu**).

As part of their review, the University of Michigan Institutional Review Board Health Sciences and Behavioral Sciences has determined that this study involves no more than minimal risk and is exempt from on-going IRB oversight. [UM IRB # HUM00192470].

Consent

By advancing to the next page, you are agreeing to be in the study. Be sure that all the questions are answered and that you understand what you are being asked to do. You may contact the researcher if you think of a question later.

IMPORTANT:

Some questions on this survey are attention checkers.

Please, pay attention to the questions. Your payment will depend on the consistency of your answers.

Instructions / Preliminary Questions

Instructions

In this survey, you will:

1. Compare and rate how difficult it is for an Automated Vehicle (AV) to execute some driving tasks in different scenarios, based on your own experience, knowledge, and expectations about AVs.
2. Watch videos of a simulated AV performing a set of those driving tasks in different scenarios; and
3. Rate your trust in that same AV to execute another driving task, based on the videos you will have watched.

Each task will be described with a sentence and a figure. You will rate the difficulty of the tasks considering two distinct capabilities of the AV:

- **Sensing** – The accuracy and precision of the sensors used to map the environment where the AV is located and perceive elements within that environment, such as other vehicles, people, and traffic signs.
- **Processing** – The speed and performance of the AV's computers that use the information from sensors to

calculate the trajectories and the steering, acceleration, and braking needed to execute those trajectories.

(In simpler terms, the AV technology provides capabilities similar to those of a human driver: when driving, people use their vision and hearing to perceive what is around them, and then process this information to make quick decisions, like how much to press the gas or the brake pedals; or how much to turn the steering wheel.)

IMPORTANT:

We consider trust to be generally defined as “*the attitude that an agent will help one achieve her/his goals in a situation characterized by uncertainty and vulnerability.*” (Lee and See, 2004)

Therefore, when asked to rate your trust in the AV to execute a task, you should indicate (on a scale from 1 to 7) how much you disagree or agree with the sentence:

“I believe that the AV would successfully execute the task.”



You may come back to this page at any time during the survey by clicking the [←] button on the bottom-left corner of the question blocks.

Preliminary Questions

Please indicate whether you have used the following driving assistance systems, and if so, how much.

	Not sure	Never	Once	Occasionally	Frequently
Cruise Control	<input type="radio"/>				
Adaptive Cruise Control	<input type="radio"/>				

	Not sure	Never	Once	Occasionally	Frequently
Lane Departure Warning Systems	<input type="radio"/>				
Forward Collision Warning Systems	<input type="radio"/>				
Traffic Sign Recognition System	<input type="radio"/>				
Night Vision and Pedestrian Detection	<input type="radio"/>				
Parking Assistance Systems	<input type="radio"/>				

How do you rate yourself, regarding your knowledge about Automated Vehicles (AVs)?

- Not at all (knowledgeable about AVs)
- Slightly (knowledgeable about AVs)
- Moderately (knowledgeable about AVs)
- Very (knowledgeable about AVs)
- Extremely (knowledgeable about AVs)

Observations

Please observe the following 4 driving tasks and descriptions.

Task:

Park, moving forward, in an empty space.

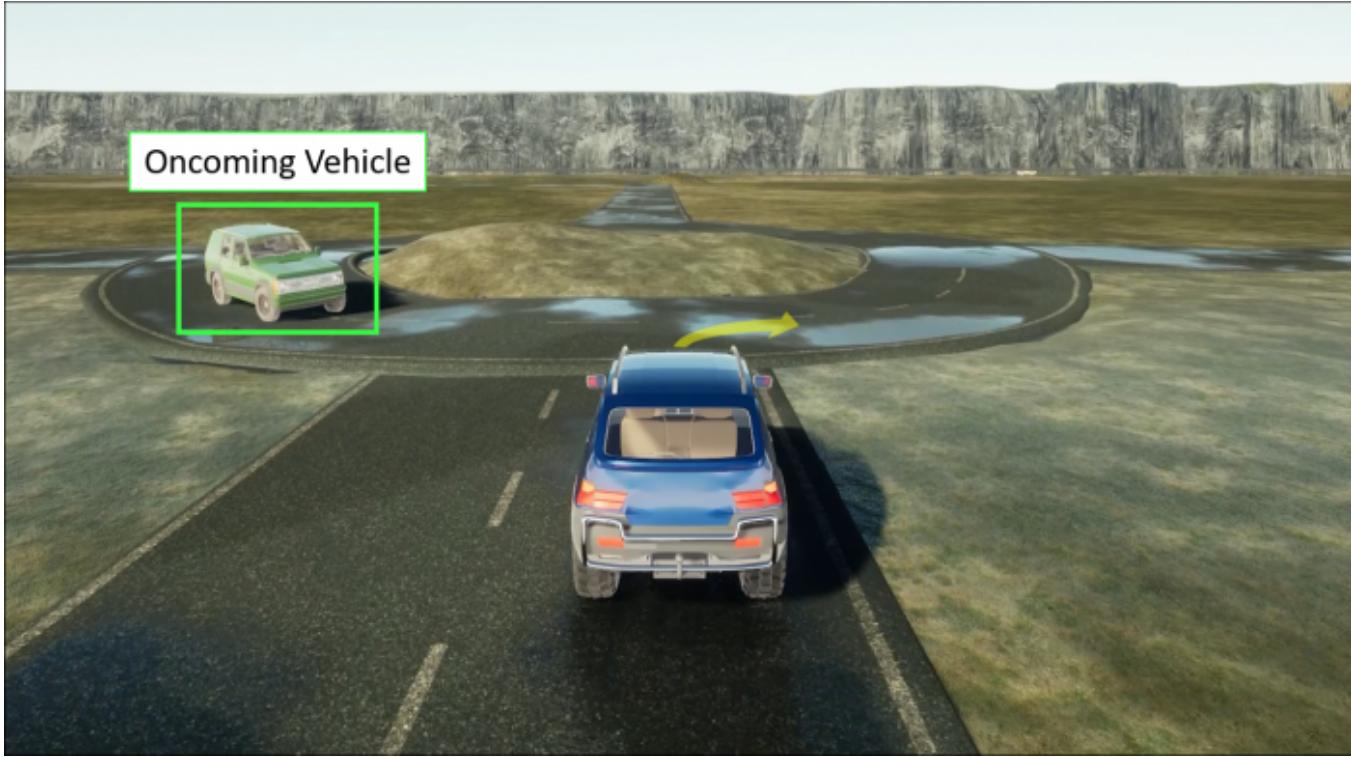
**Task:**

Park parallel to curb in a space between cars.



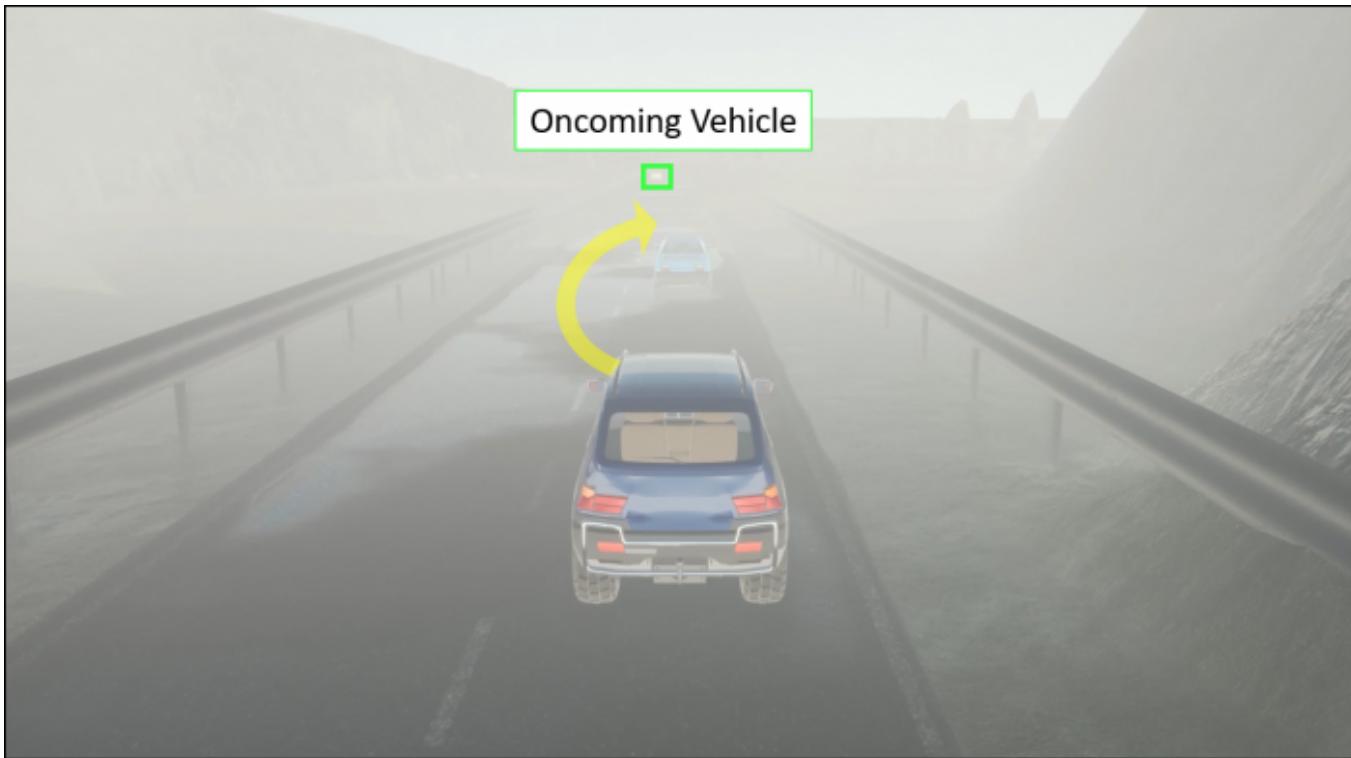
Task:

When reaching a roundabout, check left for oncoming traffic and complete the right turn when safe.



Task:

When navigating on a two-way road behind a vehicle and in foggy weather, check for oncoming traffic and pass when safe.



Sensing Capabilities

Based on your knowledge, experience, and expectations, please drag and place the described tasks, ranking them from **easiest to hardest**, considering the level of **sensing capabilities** required of the AV for the execution of the tasks:

(Memory refresher: sensing capabilities refer to the accuracy and precision of the sensors used to map the environment where the AV is located and perceive elements within that environment, such as other vehicles, people, and traffic signs.)

Park, moving forward, in an empty space.

When navigating on a two-way road behind a vehicle in foggy weather, check for oncoming traffic and pass when safe.

When reaching a roundabout, check left for oncoming traffic and complete the right turn when safe.

Park parallel to curb in a space between cars.

Please indicate, on a continuous scale, the level of **sensing capabilities** required of the AV for executing the tasks:
(Obs.: The tasks are the same as above. Here, **lower levels** indicate that the task is **easier**, while **higher levels** indicate that the task is **harder**.)



When navigating
on a two-way
road behind a
vehicle in foggy
weather, check
for oncoming
traffic and pass
when safe.



Park parallel to
curb in a space
between cars.





When reaching
a roundabout,
check left for


oncoming traffic
and complete
the right turn
when safe.

Park, moving

forward, in an
empty space.

Processing Capabilities

Based on your knowledge, experience, and expectations,
please drag and place the described tasks, ranking them
from **easiest to hardest**, considering the level of **processing
capabilities** required of the AV for the execution of the tasks:

(Memory refresher: processing capabilities refer to the speed and performance of the AV's computers that use the information from sensors to calculate the trajectories and the steering, acceleration and braking needed to execute those trajectories.)

When navigating on a two-way road behind a vehicle in foggy weather,
check for oncoming traffic and pass when safe.

When reaching a roundabout, check left for oncoming traffic and complete the right turn when safe.

Park, moving forward, in an empty space.

Park parallel to curb in a space between cars.

Please indicate, on a continuous scale, the level of **processing capabilities** required of the AV for executing the tasks:

(Obs.: The tasks are the same as above. Here, **lower levels** indicate that the task is **easier**, while **higher levels** indicate that the task is **harder**.)



Park parallel to
curb in a space
between cars.

When reaching
a roundabout,
check left for
oncoming traffic
and complete
the right turn
when safe.

Park, moving
forward, in an
empty space.



When navigating
on a two-way
road behind a
vehicle in foggy
weather, check

for oncoming
traffic and pass
when safe.



Videos / Trust rating 1

Please observe a video of the simulated AV executing the following task.

Task:

Park, moving forward, in an empty space.

Parking forwards on free space



Did the AV successfully execute the previous task?

Yes

No

Task:

Park, moving forward, in an empty space.

Parking forwards on free space



Did the AV successfully execute the previous task?

Yes

No

Considering **all** videos you have already observed, how would you rate your trust in the AV to execute the following task:

Park parallel to curb in a space between cars.



Very Low Trust	Slightly Low Trust	Slightly Medium Trust	Slightly High Trust	Very High Trust
<input type="radio"/> 1	2	3	4	5

Considering **all** videos you have already observed, how would you rate your trust in the AV to execute the following task:

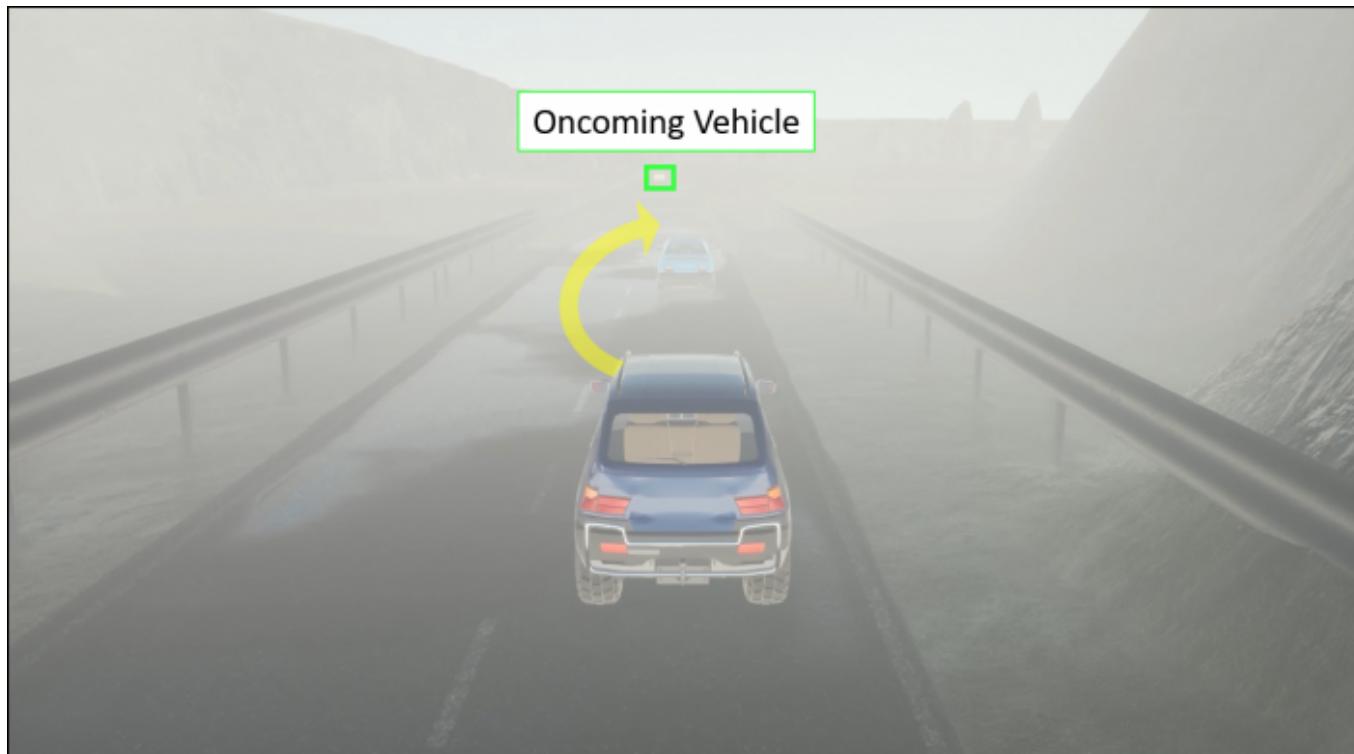
When reaching a roundabout, check left for oncoming traffic and complete the right turn when safe.



Very Low Trust	Slightly Low Trust	Slightly Medium Trust	Slightly High Trust	Very High Trust
1	2	3	4	5

Considering **all** videos you have already observed, how would you rate your trust in the AV to execute the following task:

When navigating on a two-way road behind a vehicle in foggy weather, check for oncoming traffic and pass when safe.



Very Low Trust	Low Trust	Slightly Low Trust	Medium Trust	Slightly High Trust	High Trust	Very High Trust
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2

3

4

5

6

7

Videos / Trust rating 2

Please observe a video of the simulated AV executing the following task.

Task:

Park parallel to curb in a space between cars.

Parallel parking between cars



Did the AV successfully execute the previous task?

Yes

No

Task:

Park parallel to curb in a space between cars.

Parallel parking between cars



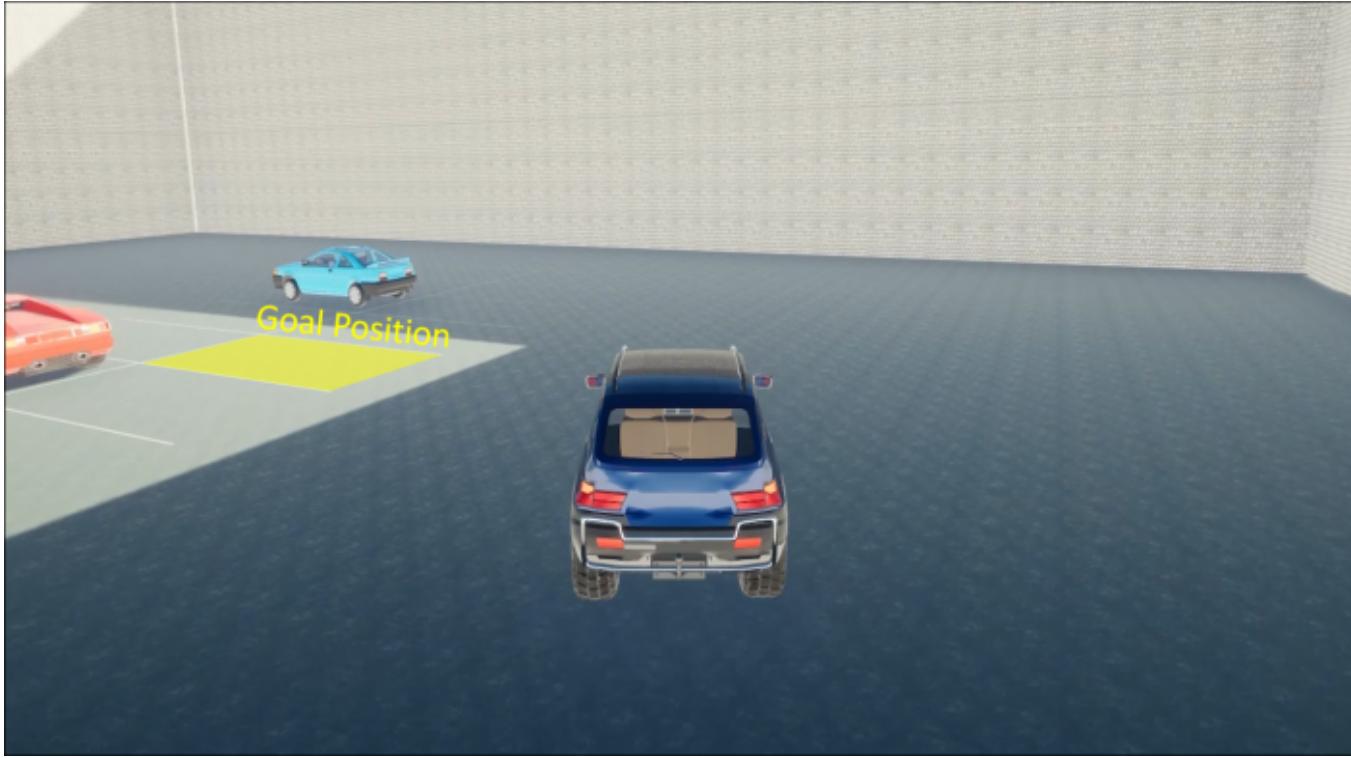
Did the AV successfully execute the previous task?

Yes

No

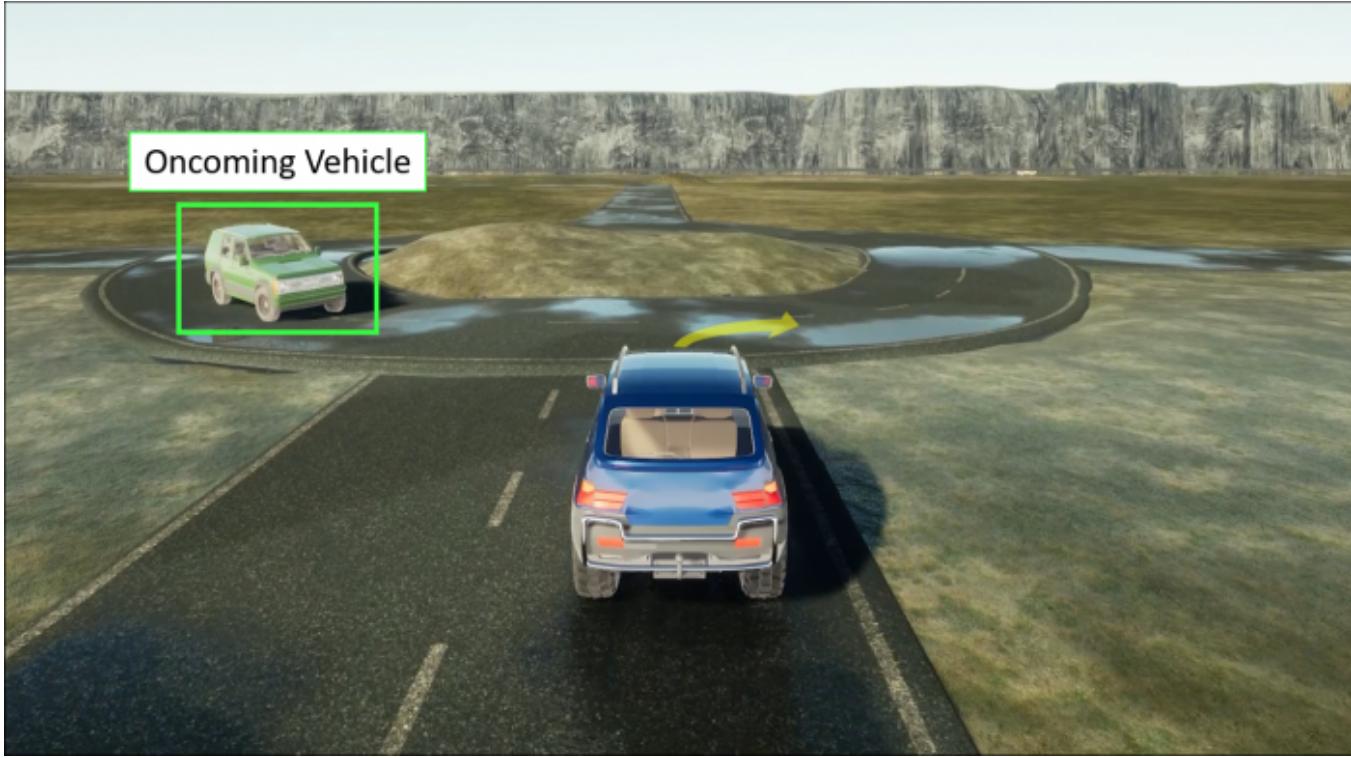
Considering **all** videos you have already observed, how would you rate your trust in the AV to execute the following task:

Park, moving forward, in an empty space.



Considering **all** videos you have already observed, how would you rate your trust in the AV to execute the following task:

When reaching a roundabout, check left for oncoming traffic and complete the right turn when safe.



Considering **all** videos you have already observed, how would you rate your trust in the AV to execute the following task:

When navigating on a two-way road behind a vehicle in foggy weather, check for oncoming traffic and pass when safe.



Videos / Trust rating 3

Please observe a video of the simulated AV executing the following task.

Task:

When reaching a roundabout, check left for oncoming traffic and complete the right turn when safe.

Roundabout



Did the AV successfully execute the previous task?

Yes

No

Task:

When reaching a roundabout, check left for oncoming traffic and complete the right turn when safe.

Roundabout



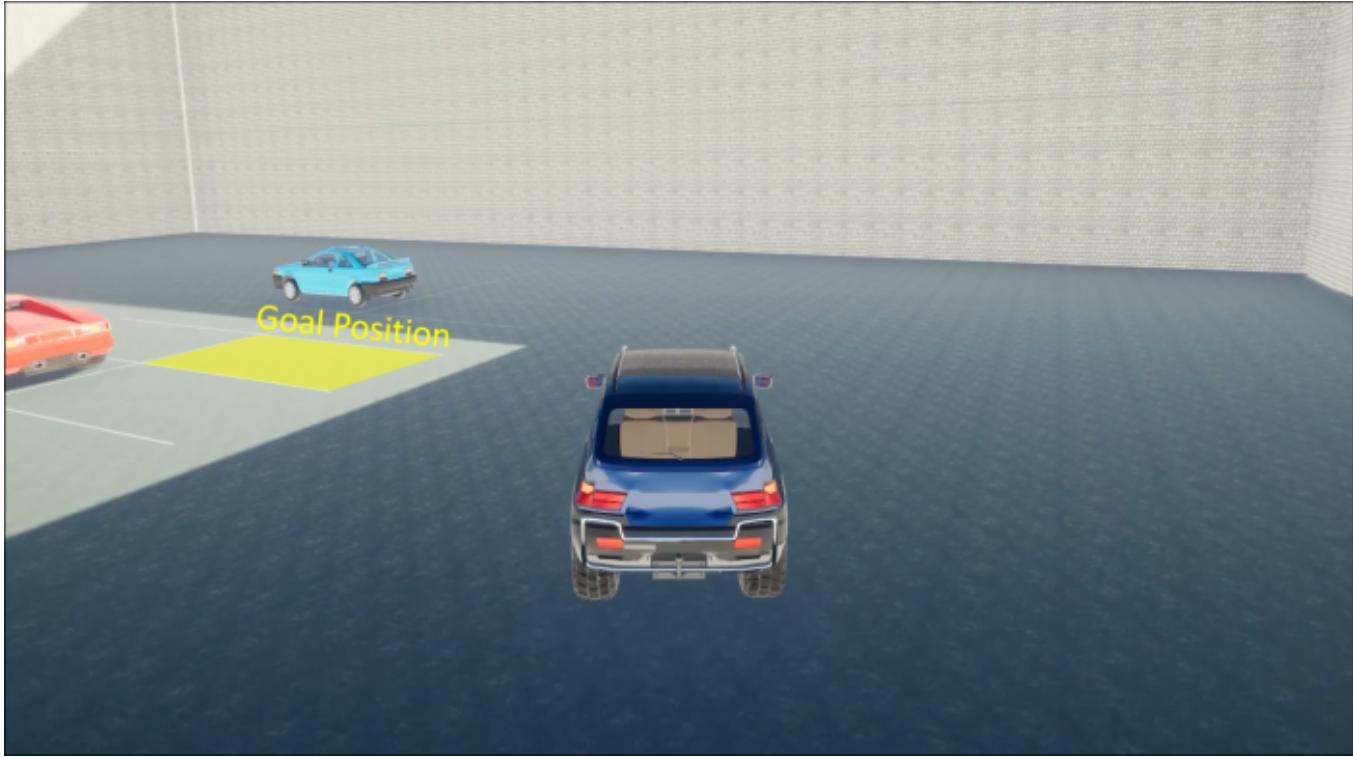
Did the AV successfully execute the previous task?

Yes

No

Considering **all** videos you have already observed, how would you rate your trust in the AV to execute the following task:

Park, moving forward, in an empty space.



Considering **all** videos you have already observed, how would you rate your trust in the AV to execute the following task:

Park parallel to curb in a space between cars.



Considering **all** videos you have already observed, how would you rate your trust in the AV to execute the following task:

When navigating on a two-way road behind a vehicle in foggy weather, check for oncoming traffic and pass when safe.



Videos / Trust rating 4

Please observe a video of the simulated AV executing the following task.

Task:

When navigating on a two-way road behind a vehicle in foggy weather, check for oncoming traffic and pass when safe.

Passing in foggy weather



Did the AV successfully execute the previous task?

Yes

No

Task:

When navigating on a two-way road behind a vehicle in foggy weather, check for oncoming traffic and pass when safe.

Passing in foggy weather



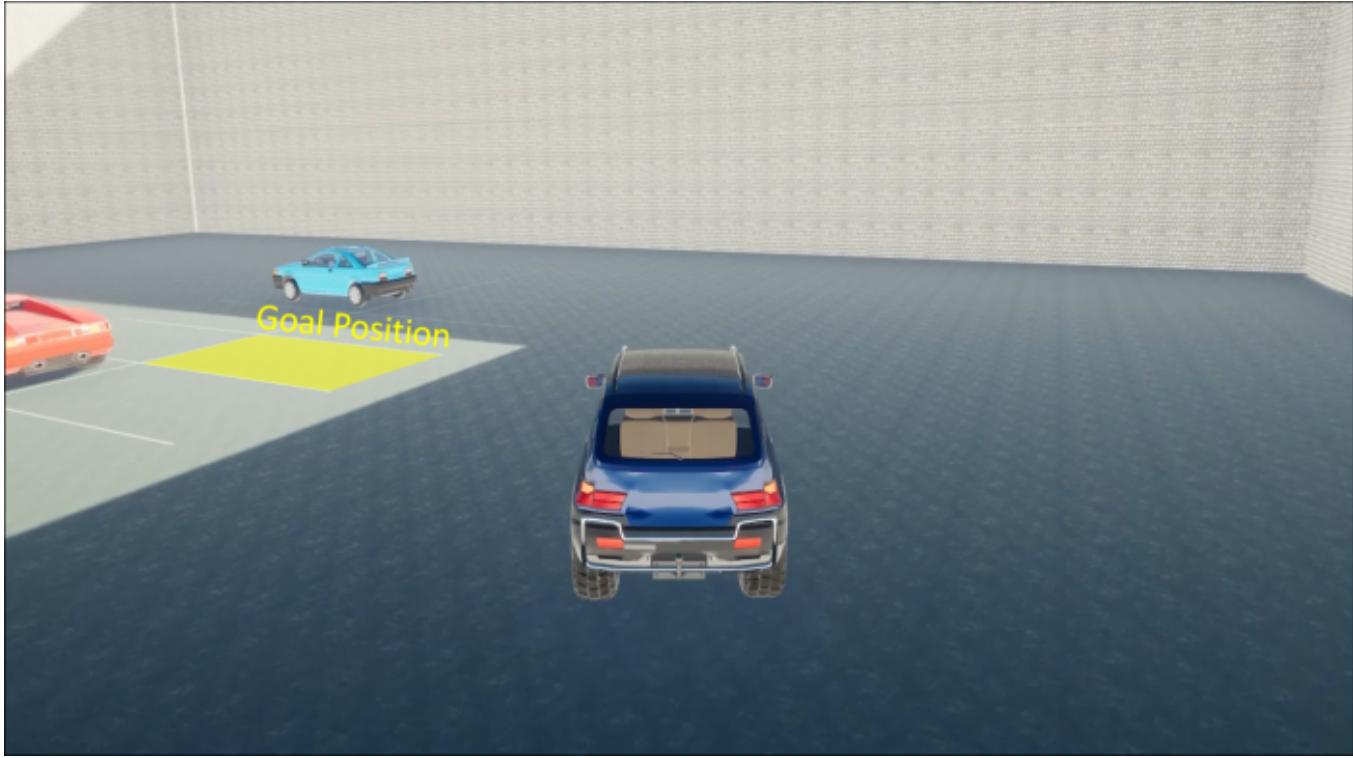
Did the AV successfully execute the previous task?

Yes

No

Considering **all** videos you have already observed, how would you rate your trust in the AV to execute the following task:

Park, moving forward, in an empty space.



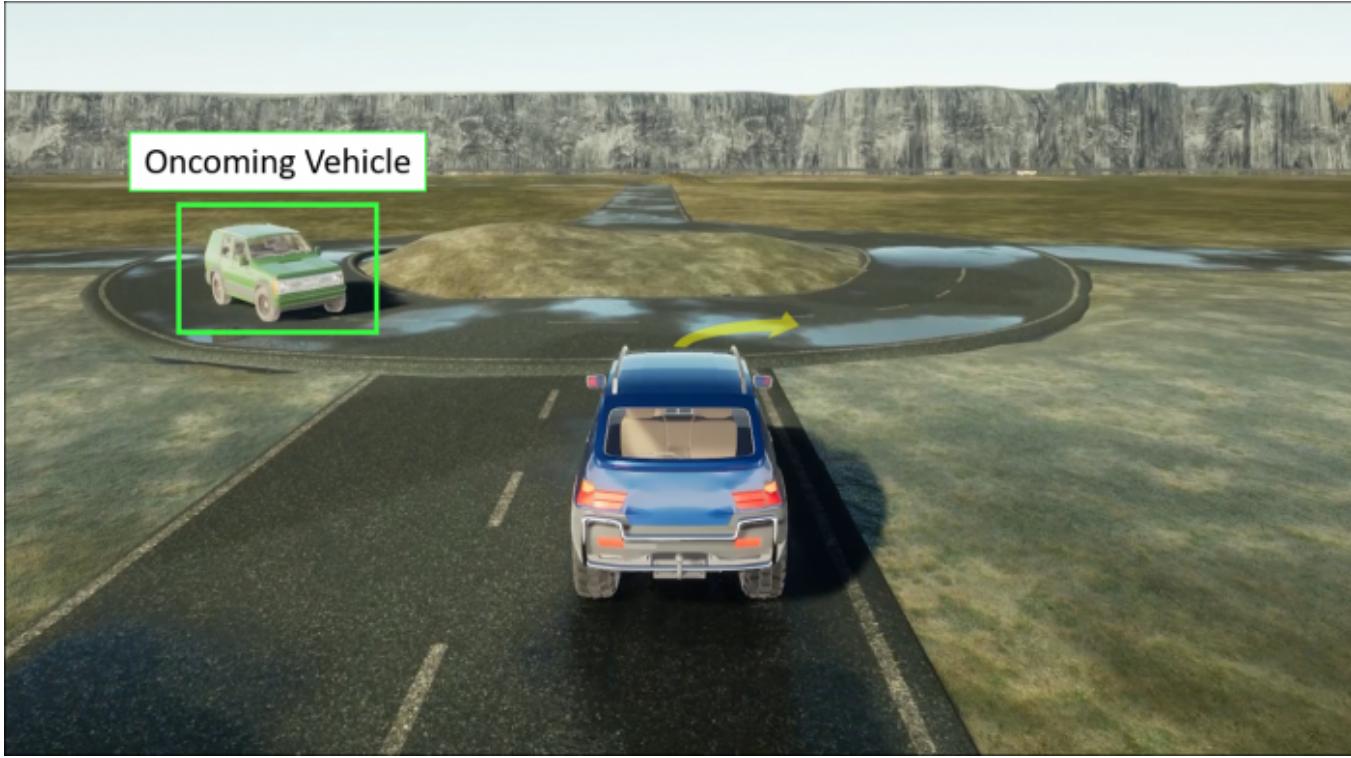
Considering **all** videos you have already observed, how would you rate your trust in the AV to execute the following task:

Park parallel to curb in a space between cars.



Considering **all** videos you have already observed, how would you rate your trust in the AV to execute the following task:

When reaching a roundabout, check left for oncoming traffic and complete the right turn when safe.



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