AUTONOMOUS CARS

Changing Roles and Responsibilities

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Executive Summary

Understanding the public opinion across various cultures is critical as autonomous vehicles are being developed by companies for an international group of stakeholders.

Open Roboethics Institute and Korea Transport Institute partnered together to understand the difference between public perception towards semi-automated vehicles across American and South Korean population. Some key findings are:

49% of US participants

prefer that the driver can **intervene in the actions of the automated breaking system** as opposed to 36% of the South Korean Participants.

33% of US participants

thought that a car owner should be able to **refuse safety related software updates for a long time**, whereas, 37% of the Korean participants disagreed.

49% of US participants

prefer that the driver can **intervene in the actions of an automated read-collision avoiding system** as opposed to 43% of the South Korean Participants.

46% of South Korean participants

were **in favor of third party programmers releasing software updates**, whereas, 48% of the US participants did not agree with this program.

The results of our study demonstrate that there is a level of contention between individual autonomy and safety when it comes to critical automated safety features of a car. To some extent, the responses to the questions about whether a driver should be able to override such features of a car vary across different automated feature presented. However, a there is a significant number of individuals with

opposing views on whether drivers should be able to override such automated features across both of the US and South Korean participants. This hones into a critical design question facing the automotive industry, which is whether and how to design automated safety features that a driver can override. In addition, our survey result demonstrates a degree of the public's skepticism about third party software updates across both participant groups. With the high level of reliance automated cars will have on software updates to improve various features of a car, governance framework for autonomous cars will need to consider issues of liability, individual autonomy and trade-offs involving public safety.

ABOUT ORI

The Open Roboethics Institute (ORI) is an international roboethics think tank founded in 2012.

Our objective is to enable robotics and artificial intelligence (AI) technology stakeholders to work together to understand, inform and influence the role of robotics and AI in society. Headquartered at Vancouver, Canada, ORI consists of an interdisciplinary and international group of expert volunteers passionate about developing open approaches to roboethics.

Website: www.openroboethics.org

ABOUT KOTI

The Korea Transport Institute (KOTI) is an official research agency for the government of the Republic of Korea.

The mission of KOTI is to provide recommendations and alternatives for the nation's transport policy and to create the optimal transport system through specialized research and technical innovations, while positioning itself as one of the world's leading transport research institutions.

Website: www.english.koti.re.kr

Introduction

The public perception towards autonomous vehicles varies across different cultures.

It is valuable to understand the sensitivity of different issues across cultures as autonomous vehicle manufactures have an international group of stakeholders and policy makers are currently working to create national and international guidelines for these vehicles. The purpose of this work is to investigate some of the nuanced yet important shift in public perception across two different nationalities — people who are currently living in South Korea versus the people who are United States' residents.

In an online survey we explore the public perception on two different topics:

The trade-off between giving individual drivers more autonomy versus enforcing the use of automated safety features in semi-automated cars that without human intervention have a higher chance of avoiding traffic accidents.

The notion of software update can pose autonomy and liability issues that manually driven cars do not have.

The results for the eight questions is illustrated for the participants from the US and South Korea. Overall, the South Korean participants thought that a human should not intervene when a safety critical automated feature is executing its function compared to the participants from the US who preferred to take over control when a critical safety decision is being made.

Terminology

AUTONOMOUS VEHICLE

Society of Automotive Engineers (SAE) has defined six levels of automated vehicles from level 0 (no automation) to level 5 (full automation).

In this survey, we have focused on level 3 — conditional automation. In this level, the vehicle has many automated features. However, the drivers must be able to take over control whenever it is required. Semi-autonomous vehicles are used to refer to cars that are not fully automated.

The building blocks of level 3 automated driving systems are expected to be extensions and integration of automation technologies that are familiar to the public today. This includes technologies such as automated emergency braking system, which is a feature that is already available in newer models of cars — including Hyundai Elantra, Audi A6, Mercedes-Benz E-class, and BMW 5 series — and have reached the public via TV commercials[1]. These automated features of a car, as foundational elements of a level 3 system, help highlight elements of potential issues that relate to level 3 systems. Therefore, this survey leverages the public's growing familiarity with these automated features to raise foreseeable issues of level 3 automated cars.

[1] For a sample commercial demonstrating auto emergency braking with pedestrian detection in Hyundai Elantra: https://www.youtube.com/watch?v=bS19g7Va6jg

Who participated?

DEMOGRAPHICS

1252
AMERICAN PARTICIPANTS

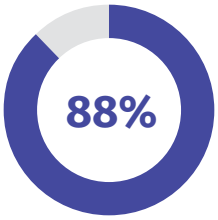
53% female

47% male

AGE GROUP DISTRIBUTION

- 21% 18-29 years old
- 26% 30-44 years old
- 23% 45-60 years old
- 30% 60+ years old

5+ YEARS OF DRIVING EXPERIENCE



500
SOUTH KOREAN PARTICIPANTS

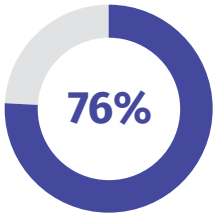
50% female

50% male

AGE GROUP DISTRIBUTION

- 18% 18-29 years old
- 23% 30-39 years old
- 24% 40-49 years old
- 24% 50-59 years old
- 10% 60+ years old

5+ YEARS OF DRIVING EXPERIENCE



What did we find?

KEY FINDINGS

Agree Disagree

49%
US participants

36%
South Korean participants

The driver can intervene in the actions of the automated breaking system

49%
US participants

43%
South Korean participants

The driver can intervene in the actions of an automated read-collision avoiding system

33%
US participants

37%
South Korean participants

A car owner should be able to refuse safety related software updates for a long time

48%
US participants

46%
South Korean participants

In favor of third party programmers releasing software updates

What did we find?

OVERRIDING SAFETY CRITICAL FEATURES

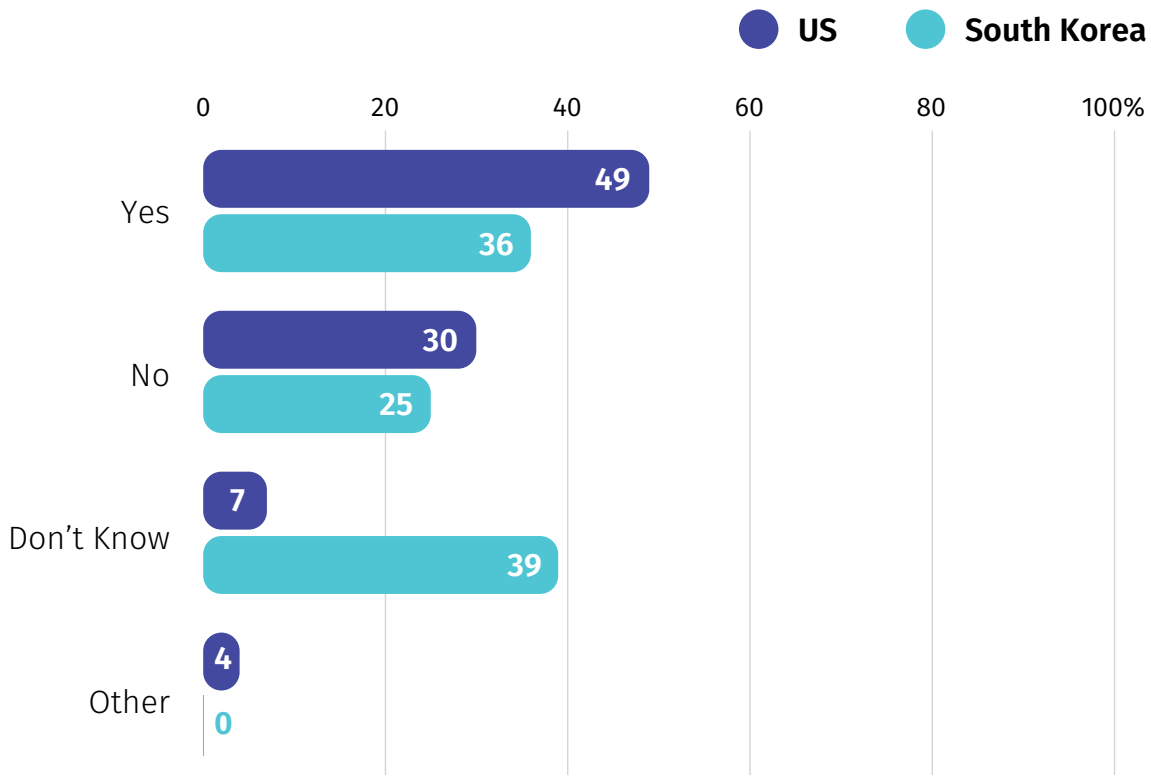
The first set of four questions have been designed to address cases where individual drivers may want to override safety critical features (variations of automated braking) of automated vehicles.

While all four questions described sensible automated features that help quickly respond to safety critical situations, the way in which a car behaved varied.

Q1. A car equipped with automated emergency braking is able to detect situations where hard braking is required to avoid colliding with an object in front of the vehicle. It will brake at the last possible moment but with enough distance to stop safely.

Imagine a case where the car detects a safety hazard and automatically engages the emergency braking feature.

Should a driver be able to override this automation feature (e.g., by stepping on the gas pedal), even if it means there will be a higher risk of collision?

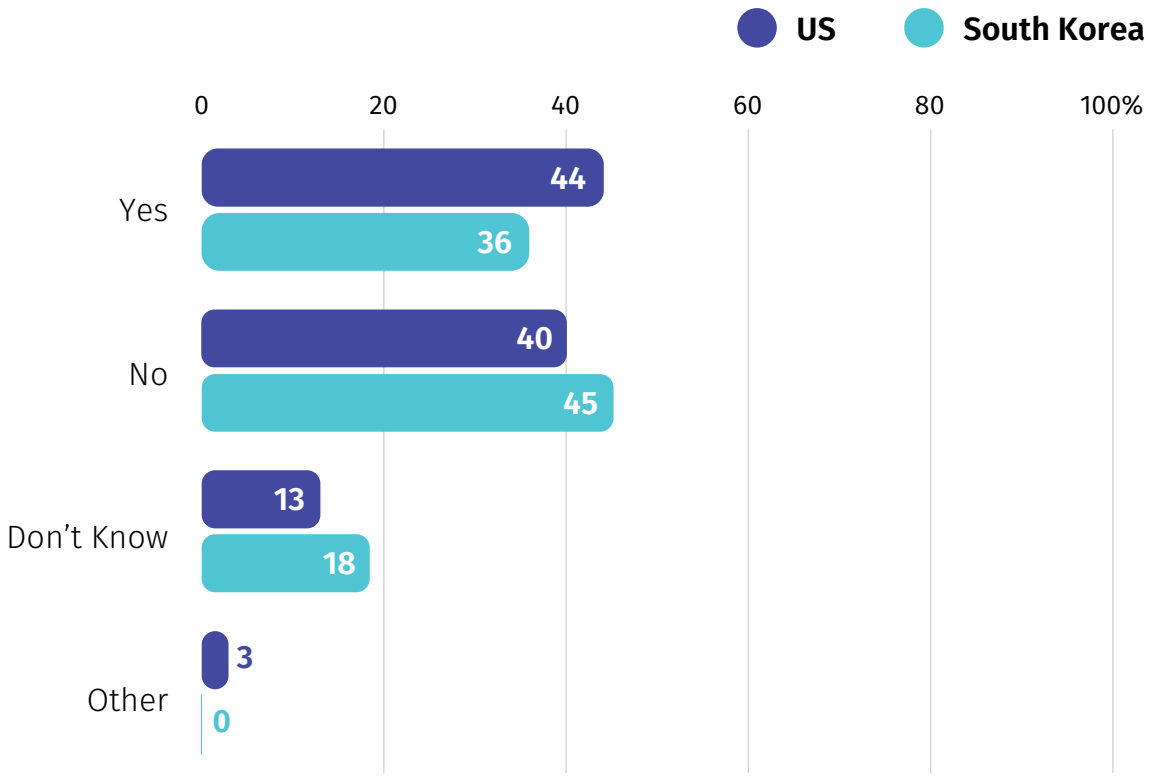


Compared to the American participants, less South Korean participants thought that a human should intervene with the automatic braking system of the car. Interestingly, almost 40% of of the South Korean participants were unsure of their position in this question.

Q2. A car equipped with automatic blind-spot detection can detect when there is an object in the blind-spot of the car and prevents the driver from making unsafe turns.

For example, if a driver tries to make a right turn without noticing a potential collision with a bicycle in the blind-spot, the car will automatically steer back to go straight to avoid a collision with the cyclist.

Should a driver be able to override this automation feature (e.g. press on the brake), even if it means there will be a higher risk of collision?

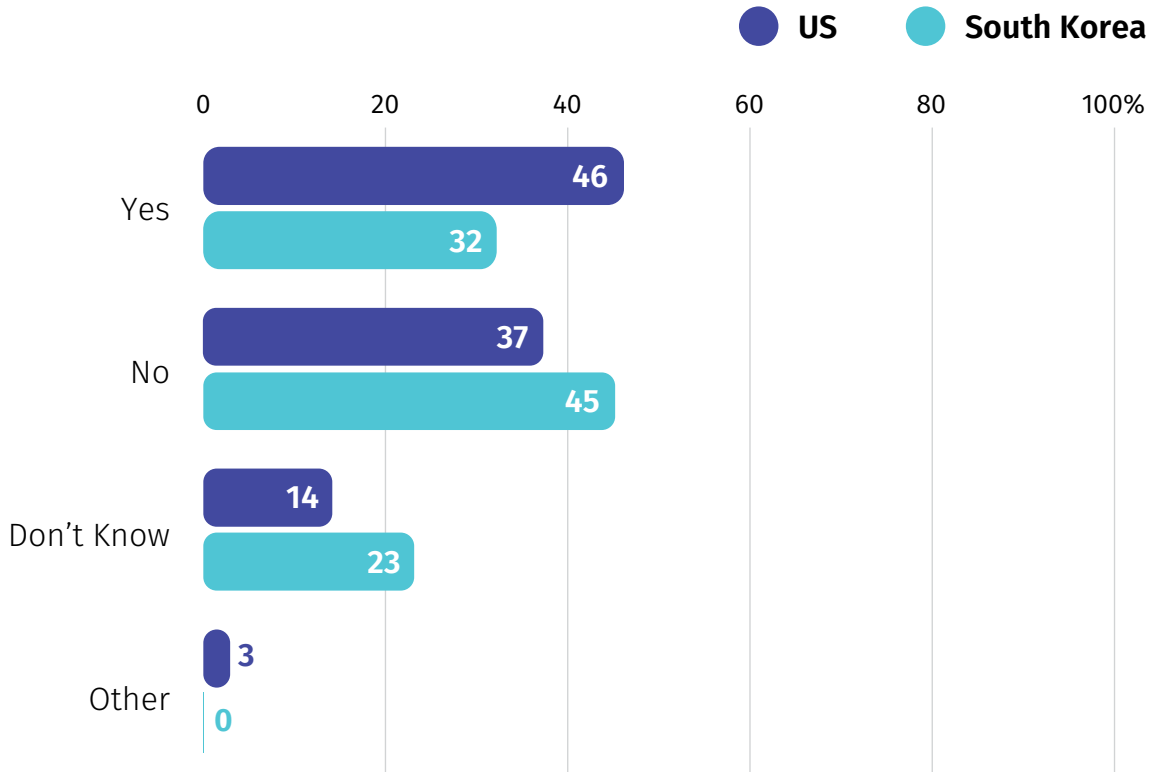


Similar to question 1, a lower number of South Korean participants wanted a human driver to intervene with the automatic blind spot detection system of the vehicle.

Q3. A car equipped with automated emergency braking is able to detect situations where hard braking is required to avoid colliding with an oncoming object in front of the vehicle. For example, if a driver initiates a left turn at an intersection, but the car detects oncoming traffic that it deems to be too risky, then the car will apply emergency braking to prevent the left turn.

Imagine a situation where the car detects an oncoming car that it deems to be too close for a safe left turn. The car engages the emergency braking.

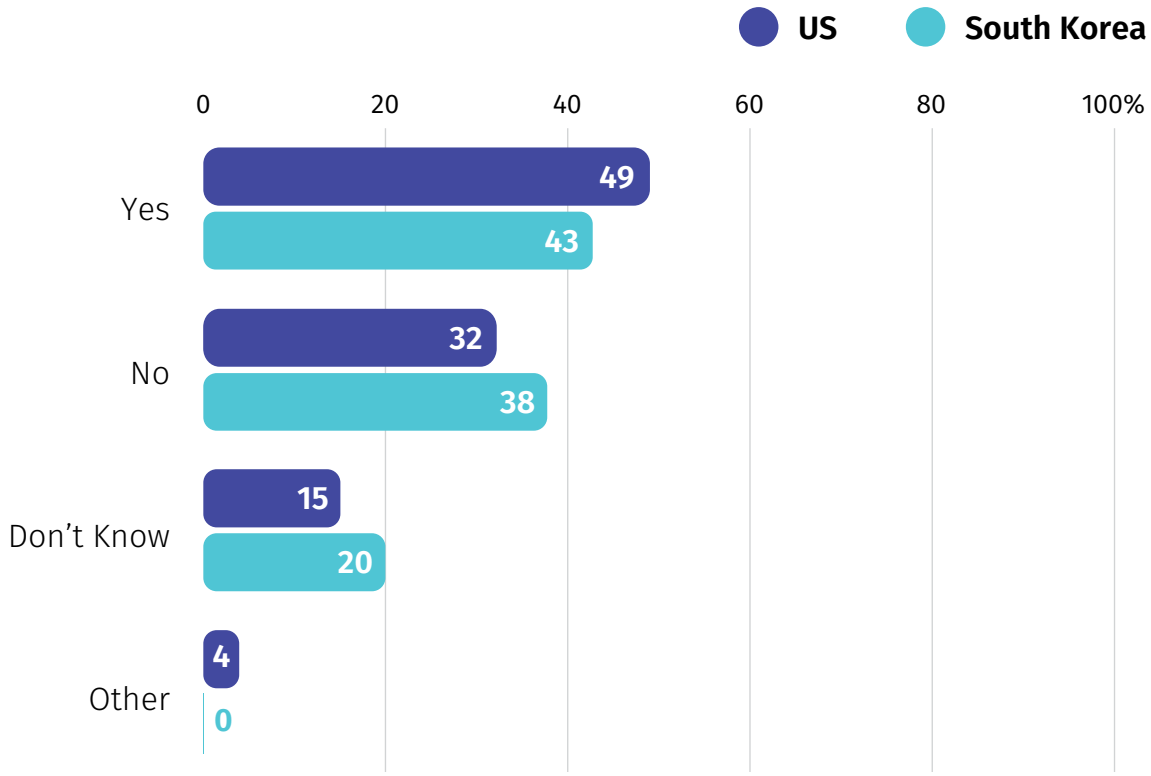
Should the car allow the driver to override this automation feature (e.g., still move the car to the left), even if it means there will be a higher risk of collision?



Q4. A car equipped with a rear-end collision prevention is able to detect situations where the car needs to move away from a location to avoid being hit by an object approaching from behind the car. It will start moving at the last possible moment but with enough speed to avoid a collision with even a fast approaching car from behind.

Imagine a case where the car engages the automated rear-end collision prevention feature to avoid being hit from the back.

Should a driver be able to override this automation feature (e.g., stop the car after it has started moving), even if it means there will be a higher risk of collision?



The trend in questions 3 and 4 mimics those in questions 1 and 2. The South Korean participants are more reluctant to have a human driver intervene with the tasks of the automated system regardless of whether the car needs to come to a stop, make a left turn or avoid a rear-ended collision. On the other hand, the majority of the US participants prefer to have the driver take over control in cases of potential accidents.

HANDLING SOFTWARE UPDATES

The second set of four questions (Q5-Q8) raises issues that deal with the manner in which software updates to a car is distributed.

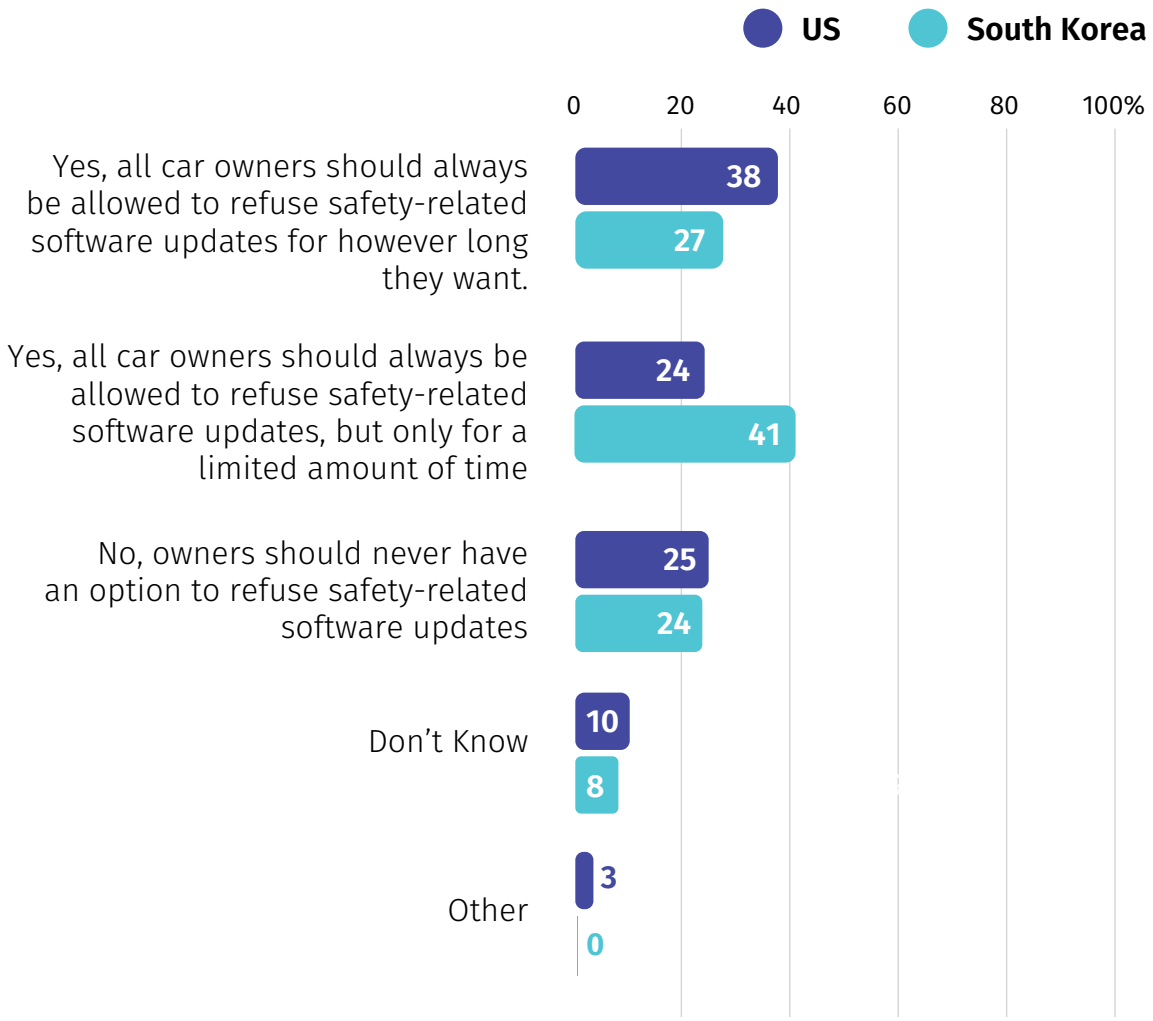
Unlike manually driven cars, distribution of software in level 3 automated cars are necessary. However, it can also disturb the balance between individual autonomy and safety of the public. Automated vehicles are expected to undergo software updates that can be distributed and installed onto the cars without the need for the car owners to enter professional maintenance facilities for servicing.

The public is already familiar with the notion of software updates from their interaction with personal computers and smartphones. However, frequent and unsupervised software updates for heavy machinery that actively manipulates our physical world — including having the capacity to cause physical harm to the driver, passengers, and pedestrians — is a new phenomenon.

Q5. Last month, Joe purchased a car with the latest automation features. Joe realized that he doesn't like some of the frequent software updates he was getting from the manufacturer. He is aware that some of the updates include new safety features, such as newer ways for the car to detect potential collisions, which claim to improve the overall safety profile of the car.

However, Joe would rather wait for a while to see whether the updates actually make the cars of the same model safer or not, before deciding to update the software.

Should Joe be allowed to refuse safety-related software updates to his car?

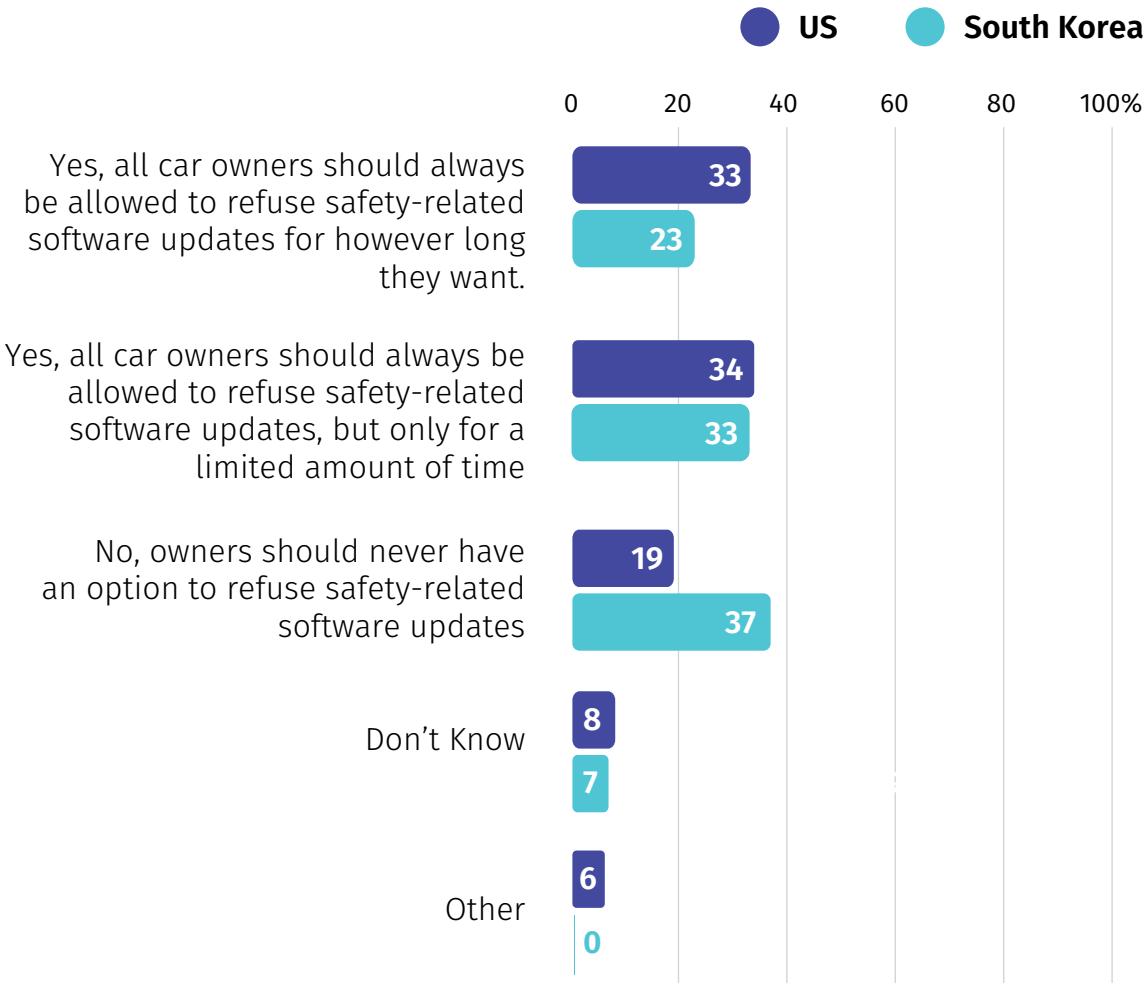


Interestingly, the majority of the US and the South Korean participants thought that the car owner should be able to refuse the safety-related software update. However, the Korean participants thought that the car owner should be able to reject the update only for a limited amount of time; whereas, more of the US participants

Q6. Last month, Tom purchased a car with the latest automation features. Tom realized that the car was receiving frequent software updates from the manufacturer to be installed in the mornings, typically when he is on his way to work. Tom is aware that some of the updates include new safety features, such as newer ways for the car to detect potential collisions, which claim to improve the overall safety profile of the car.

However, Tom often refuses the updates because he is in a rush to get to work.

Should Tom be allowed to refuse safety-related software updates to his car?

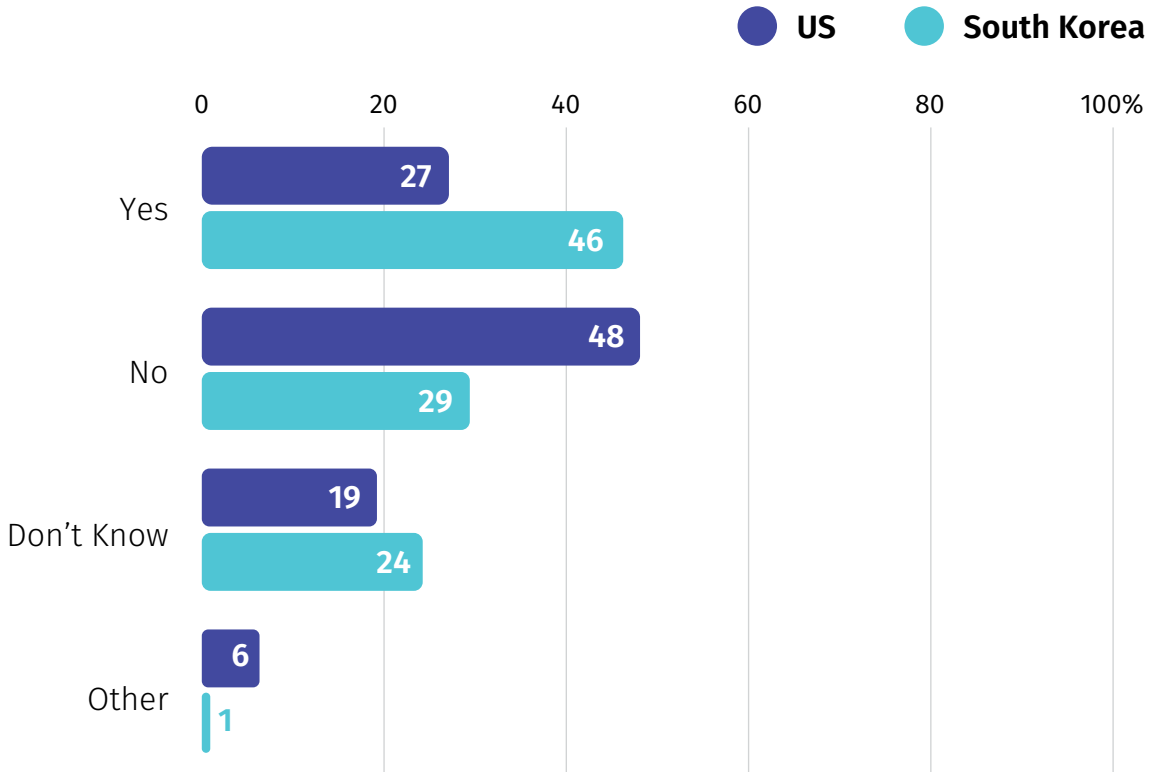


The results shift slightly when the car owner decides to ignore the updates because of their own convenience as opposed to seeing whether it actually makes the vehicle safer. Compared to the US participants, less South Korean participants would accept that a car owner can ignore the updates for a long time. In this situation, significantly more Korean participants think that the car owner should be allowed to ignore the update.

Q7. Pat is an avid programmer with over ten years of experience in the robotics industry. One day, Pat finds out that there is a minor security issue (e.g., potential hacking of the car's microphone) with his semi-autonomous vehicle. He develops a small piece of software (a software patch) that he believes fixes the issue. The manufacturer of the car has yet to release a software update themselves to address the security issue, and Pat does not work for the manufacturer.

Pat puts the new piece of software online so that anyone with an internet connection can download it and fix the same security issue in their cars for free.

Should individuals like Pat be allowed to distribute software modifications for semi-autonomous cars?

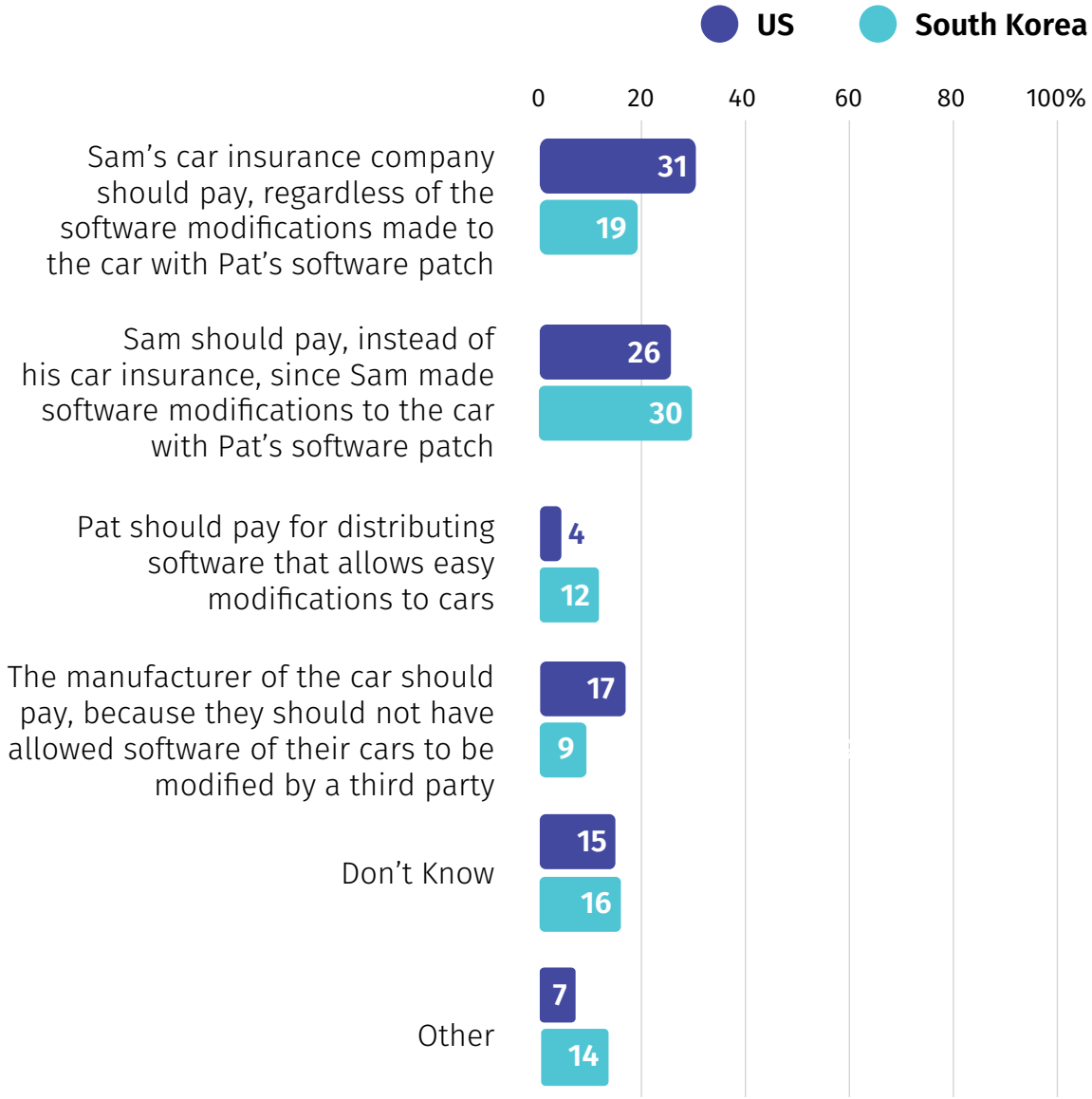


There is quite a large difference across two US and South Korean participants for this question. Majority of the Korean participants that third party developers should be able to distribute software modifications. Whereas the majority of the American participants take a different position. Majority of US participants prefer that third party programmers are not be allowed to distribute updates.

Q8. Sam is an owner of the same model of car as Pat's, described in the last question (Q.6). Sam found out about the same minor security issue with his semi-autonomous vehicle. Upon searching online, he downloaded the small piece of software (the software patch) that Pat developed and distributed for free to address this issue. The manufacturer of the car has yet to release a software update themselves to address the security issue. The next day, Sam gets into an accident where the car's automated emergency braking failed to stop early enough to prevent rear-ending a truck in front of him.

The accident did not involve any security issues, and only minor damages were done to the truck.

Who should pay for the damages from the accident?



The opinions of the US and South Korean participants are spread across all of the options. There is not a clear depiction of who should be accountable for software updates. Both of the participant pools put more of the burden on the insurance company and Sam himself.

Who made this project possible

This project was a collaborative effort between the Open Roboethics Institute (ORI) and the Korea Transport Institute (KOTI).

ORI researchers led the survey design and also launched and analyzed the survey for the US participants. The KOTI researchers translated the survey to Korean and conducted the survey for the South Korean participants.

Contact

Website: www.openroboethics.org **Information:** info@openroboethics.org

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