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# Localization vs. Internationalization: Research and Practice on Autonomous Vehicles across Different Cultures

**Seul Chan Lee**

Virginia Tech  
Blacksburg, VA 24061, USA  
seulchan0926@gmail.com

**Kristina Stojmenova**

University of Ljubljana  
1000 Ljubljana, Slovenia  
kristina.stojmenova@fe.uni-lj.si

**Jaka Sodnik**

University of Ljubljana  
1000 Ljubljana, Slovenia  
jaka.sodnik@fe.uni-lj.si

**Ronald Schroeter**

Queensland University of Technology  
Brisbane City QLD 4000, Australia  
author5@yetanotherco.ca

**JaeKon Shin**

Korea Automotive Testing & Research  
Institute (KATRI), Seoul, Korea  
katriemc@kotsa.or.kr

**Myounghoon Jeon**

Virginia Tech  
Blacksburg, VA 24061, USA  
myounghoonjeon@vt.edu

**Abstract**

AutoUI conference is the premier forum for user interface research in the automotive domain, annually bringing together over 200 researchers and practitioners interested in both the technical and the human aspects of in-vehicle user interfaces and applications. However, over 80% of its published papers come from only five countries from western Europe and North America. Considering the importance and valuable impact this conference has on the research and development of HMI (Human-Machine Interface) and automated systems in recent years, it raises the need for greater diversity and inclusion of researchers and practitioners from other continents. The goal of this workshop is to bring together researchers, practitioners, experts, and students from different research background, influenced by or influencing the automotive domain, and discuss the cross-cultural differences in driving behaviors and infrastructure, which is an essential prerequisite for future vehicle systems and driving safety.

**Author Keywords**

Diversity; Autonomous Driving; Automotive Systems

**CCS Concepts**

•Social and professional topics → User characteristics:  
Cultural characteristics, Geographic characteristics

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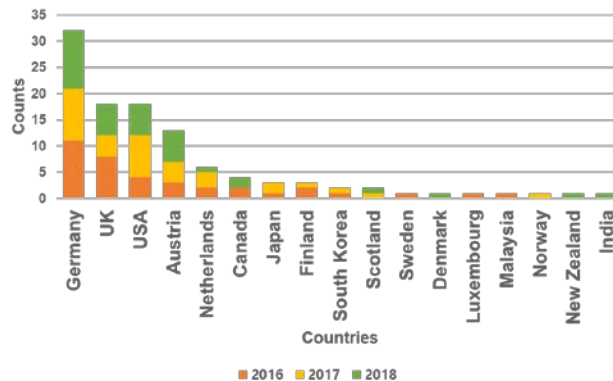
AutomotiveUI '19 Adjunct, September 21–25, 2019, Utrecht, Netherlands  
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ACM ISBN 978-1-4503-6920-6/19/09.  
<https://doi.org/10.1145/3349263.3350760>

**Table 1:** Driving grammar / common behaviors in different countries

Country	Driving grammar / Common law
China	1) Mixed traffic with unexpected pedestrians and motorbikes from different directions 2) Not all drivers wear seatbelts (even required to do so), most passengers not wearing seatbelts
Korea	1) Turning on emergency light after changing the lane – meaning “thank you” or “sorry” 2) Blinking light after curved expressway – saying “be careful. Traffic enforcement is on the way” to cars in the opposite lane
Slovenia	1) Turning on the left blinker on the highway – meaning “move to the right lane, I want to pass”. 2) Blinking light to the vehicles the opposite lane – informing the drivers “there is a speed radar, slowdown”
Australia	1) Blinking light to the vehicles in the opposite lane – informing “there is a speed radar, lowdown” 2) Car drivers can overtake cyclists and then turn in front of them, essentially cutting them off. The cyclist needs to give way to an indicating car and is not allowed to overtake it
USA	1) Blinking light to the vehicle in the intersection – meaning “after you” 2) At a four-way stop if two vehicles reach the intersection simultaneously, the vehicle on the left must yield the right-of-way to the vehicle on the right.

## Introduction

Diversity encompasses variety in many ways. It emphasizes individual uniqueness and recognizes differences between individuals or individual groups. As in any other communities composed of representatives from all around the world, within the AutoUI community we need to consider representation from different countries, as well as gender and ethnic diversity. This growing need among researchers and practitioners in the AutoUI community is underscored by the rapid changes in car technologies and the rapid movement of goods across the world. Figure 1 shows that in the past three years, the AutoUI conference has been well represented by researchers from Germany and the US, but not from other continents (e.g., Asia, Australia, and Africa). In fact, the top five countries represent over eighty percent of attendees. This biased trend makes it a challenge to generalize findings and conclusions for automotive design, user interfaces, and road user behavior to all nations and cultures.



**Figure 1:** The nationality distribution of the first authors' institutions over the last three years (including only the main proceedings of the Automotive UI' 16-18).

Previous studies have shown cross-cultural differences between drivers, including perceptual or motor driving skills [5], driving behaviors [15], safety perception [8,9,11], and attitudes toward the technology [7,10]. For example, Jeon et al. [7] compared the differences among Austrian, American, and Korean drivers in the use of in-vehicle technologies, showing that American and Korean drivers were more progressive to the use of in-vehicle technologies compared to Austrian drivers. Nordfjærn et al. [9] reported drivers from Norway, Russia, India, Ghana, Tanzania, and Uganda showed differences in risk perceptions and attitudes toward traffic safety. Özkan et al. [11] also revealed differences in a driving behavior across the six countries (Finland, the UK, Greece, Iran, The Netherlands, and Turkey). In fact, there are unique and distinctive interactions among drivers in different countries, showing that the same gesture could be differently interpreted in different cultures (Table 1).

In the context of autonomous driving, diversity is becoming more important as drivers need to operate within their own environment as well as cooperate with the entire automated driving infrastructure. Therefore, it is impossible to consider a single automated driving system on a global scale without considering the local environment (e.g., roads, traffic lights, pedestrians, and other environmental elements). That is why many car manufactures first send out a fleet of drivers who simply engage in local traffic and record their behavior with cameras and sensors. This data set is then processed and fed into machine learning algorithms to adopt these localized specialties.

There have been reports that acceptance or attitudes toward an autonomous vehicle are different among people who have different backgrounds. For example, Hergeth et al. [6] showed that Chinese drivers reported higher mistrust than German drivers after performing a take-over task when

the automated system failed to control the situations. Chien et al. [2] investigated the effects of culture on trusting automation with American, Taiwanese, and Turkish participants, which showed that Turkish participants generally exhibited lower trust in an automation system than the American and Taiwanese participants. Schoettle and Sivak reported that Japanese people had more neutral attitudes toward an automated driving system and were less willing to pay for it compared to people in the U.S., the U.K., Australia, and China [14].

Understanding the cultural differences and domestic environments, and how they shape people's attitudes towards new in-vehicle information systems or autonomous vehicles, can be used for localization, which consequently can result in an increase of their acceptance rates. However, these differences first have to be identified, further revealing the need for diversion and inclusion of researchers and representatives of different countries in the AutoUI community. In summary, evidence has shown that there is a necessity to discuss the cross-cultural differences in driving behaviors and safety, which is an essential prerequisite for future vehicle systems and driving safety.

As part of the effort to understand these cultural differences and diversity, we would like to propose a workshop on the title of 'Internationalization vs. Localization: Research and Practice on Autonomous Vehicles across Different Cultures'. Internationalization refers to "the process of isolating the culturally specific elements from a product" [13]. This issue has been important because a product or service is consumed by people in the world. For example, Apple and Google provide UI guidelines for iOS and Android developers [1,4]. On the other hand, localization means "the process of adapting a product or service to a particular language, culture, and desired local 'look-and-feel'" [3]. The

localization allows local people to use an internationalized product or service regardless of technological, linguistical, and cultural differences, and even includes local contents or functions [12,13]. We will invite international researchers and practitioners with different cultural backgrounds to the workshop. Experts from other domains related to or affected by the automotive community and the changes autonomous vehicles will bring, such as legislative decision making, law enforcement, and road infrastructure building and management will also be invited. We will discuss issues on internationalization, localization, and diversity.

### **Objectives & Topics of Interests**

**Objective** The primary objectives of the workshop are as follows:

- 1) To invite international researchers and practitioners who previously have not or very few times attended or submitted their work to AutoUI conferences and provide a venue for an open discussion.
- 2) To share research and practices with people who have diverse cultural and geographical backgrounds.
- 3) To explore diversity issues for the future vehicle systems including the autonomous vehicle.

**Topics of Interests** Potential topics at the workshop will include, but not limited to:

- In both Manual driving and Autonomous driving
  - ✓ Standardization – International, National, Regional standard
  - ✓ Localization
  - ✓ Legal / Legislation issues

**Table 2:** Tentative schedule of the workshop

<b>Tentative Schedule</b>	
<b>Introduction (09:00 – 09:15)</b>	Opening and Introduction (organizers and topics) (15 min.)
<b>Session 1 (09:15 – 10:15)</b>	5 – 7 Presentations (tentative numbers) (60 min.)
<b>Coffee break (10:15 – 10: 30)</b>	Coffee break
<b>Session 2 (10:30 – 11:30)</b>	Speed dating (30 min.)
	Brainstorming (30 min.)
<b>Coffee break (11:30 – 11:50)</b>	Coffee break
<b>Session 3 (11:50 – 12:50)</b>	Discussion (40 min.)
	Presentation (20 min.)
<b>Closing (12:55 – 13:00)</b>	Closing

- ✓ Infrastructure – Road, Traffic lights, etc.
- ✓ Social / Cultural issues and differences – Trust, Acceptance, Past experiences, Education, Driving grammar
- ✓ Drivers' behavior & characteristics
- ✓ Traffic objects – Pedestrian, Automobile, Bicycle, etc.
- ✓ Other issues

### **Schedule & Activity**

The tentative schedule of the workshop is in Table 2.

**Introduction (15 min.)** The schedule begins with the introduction of the organizers and topics. Then, we will move onto three sessions.

**Session 1 (60 min.)** We will invite some guest speakers from different cultural backgrounds, including organizers to address the suggested topics of interest. They will present their work in the PechaKucha style (20 slides and 20 seconds presentation for each slide; around 6 minutes). The number of presentations will be decided considering the final workshop schedule.

#### **Coffee break (15 min.)**

**Session 2 (60 min.)** After the coffee break, session 2 will start with a 30 minute speed-dating session for all participants, which allows for quick and effective introductions. After that, a brainstorming session will be conducted to find important issues related to the topics of interest. The organizers will collect Post-it notes on a brainstorming wall and elicit most mentioned topics and keywords for session 3.

#### **Coffee break (20 min.)**

**Session 3 (60 min.)** After the coffee break, participants will be split into 4 or 5 groups (depending on the number of participants) and will be given time for discussion. Each group will discuss the topics from the brainstorming session and try to come up with common terminology for those specific topics that could be used across countries and disciplines (different research background). Forty and twenty minutes will be given to discuss and present, respectively.

**Closing (5 min.)** The schedule will be ended with a short wrap-up discussion on the issues.

### **Expected Outcomes**

The tangible results will be a list of major issues that should be addressed given cross-cultural diversity in a driving context. Additionally, a list of suggested common terminologies on automotive user interfaces to be used and understood across a larger number of countries and disciplines will be created. The organizers of the workshop will prepare a report of the workshop which will include both lists and publish it on the workshop webpage.

Furthermore, we hope that this workshop can help participants understand the diversity issues in terms of localization and internationalization. We also hope that this workshop will be a good starting point for researchers and practitioners of diverse backgrounds to interact with each other and develop collaborative projects.

## Biographies

**Seul Chan Lee** is a postdoctoral associate of Industrial and Systems Engineering at Virginia Tech. His overall research goal is to make systems and devices better based on the understanding of human's behavior. For doing this, he uses many scientific theories and methodologies including human factors and human-computer interaction.

**Kristina Stojmenova** is a Research Associate at University of Ljubljana, Slovenia, Faculty of electrical engineering. Her field of research is human-computer interaction in in-vehicle information systems, focusing on assessment of driver's biometric data and cognitive load.

**Jaka Sodnik** is a Professor at the Faculty of Electrical Engineering, University of Ljubljana. As a member of the ICT department, he is an active researcher and supervisor in the fields of human-machine interaction, web technologies and acoustics. He leads the R&D department of Nervtech d.o.o., a company that develops state-of-the-art motion driving simulators and methods for evaluation of drivers' physiological state and their driving performance.

**Ronald Schroeter** is a Senior Research Scientist at the Centre for Accident Research and Road Safety – Queensland (CARRS-Q), QUT (Brisbane, Australia). His research focus is the design of innovative driving experiences that make transport by car or bike more fun and safe. This work allows him to embrace multidisciplinary research across HCI/HMI, psychology and road safety.

**Jaekon Shin** is a Head of the Automated Vehicle Division at KATRI (Korea Automobile Testing & Research Institute). He is in charge of the R & D projects for automated vehicles in Korea. Previously, he worked for the R & D Center of Hyundai Motor Company as a senior engineer with a focus

on the evaluation of the automotive electronic control system.

**Myounghoon Jeon** is an Associate Professor of the Department of Industrial and Systems Engineering at Virginia Tech. His Mind Music Machine Lab research is focused on auditory displays, affective computing, automotive user interfaces, assistive technologies, and aesthetic computing. His research has been supported by the US DOT, FRA, NSF, NIH, KATRI, and industry partners.

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