To Customize or Not to Customize – Is That the Question?

Conference Paper · September 2021
DOI: 10.1145/3473682.3477435

6 authors, including:

Sidney Scott-Sharoni
Georgia Institute of Technology

Nadia Fereydooni
Georgia Institute of Technology

Myounghoon Jeon
Virginia Polytechnic Institute and State University

Andreas Riener
Technische Hochschule Ingolstadt

To Customize or Not to Customize - Is That the Question?

Sidney Scott-Sharoni*
Nadia Fereydooni*
Bruce N. Walker
sidney.scott.sharoni@gatech.edu
nadia.fereydooni@gatech.edu
bruce.walker@psych.gatech.edu
Georgia Institute of Technology
Atlanta, GA, USA

Myounghoon Jeon
Virginia Tech
Blacksburg, VA, USA
myounghoonjeon@vt.edu

Andreas Riener
Technische Hochschule Ingolstadt
Ingolstadt, Bavaria, Germany
andreas.riener@thi.de

Philipp Wintersberger
Technische Universität Wien
Vienna, Austria
philipp.wintersberger@tuwien.ac.at

ABSTRACT

As automated vehicles become more prevalent, designing interfaces that best fit all users, especially ones in minority populations, is a pressing but difficult goal. System-driven adaptation is a commonly used approach as it is easier and created by experts but, has innate flaws. Customization, on the other hand, allows users to consciously alter the interface to appear and operate in a manner most suited to their needs and wants. However, various components of the interface have different constraints, capabilities, and requirements with the amount of customization appropriate. In this workshop, we will dissect an expansive taxonomy for customization and develop a series of levels in order to get the full benefits from customization, which in turn can help engineers and designers in creating more user-centered systems.

CCS CONCEPTS

• **Human-centered computing → HCI theory, concepts and models**; Visualization design and evaluation methods.

KEYWORDS

customization, user interface, automated vehicles, standardization

ACM Reference Format:

Sidney Scott-Sharoni, Nadia Fereydooni, Bruce N. Walker, Myounghoon Jeon, Andreas Riener, and Philipp Wintersberger. 2021. To Customize or Not to Customize - Is That the Question?. In *13th International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI '21 Adjunct), September 9–14, 2021, Leeds, United Kingdom.* ACM, New York, NY, USA, 4 pages. https://doi.org/10.1145/3473682.3477435

*Both authors contributed equally to this research.

AutomotiveUI '21 Adjunct, September 9–14, 2021, Leeds, United Kingdom

ACM ISBN 978-1-4503-8641-8/21/09.
https://doi.org/10.1145/3473682.3477435

1 INTRODUCTION

With the growing interest in automated driving system features in vehicles, researchers have investigated more actively the dynamic communication and relationship between the user and user interface (UI). Additionally, as technology becomes more ubiquitous, its use extends and has greater capabilities for those of various cultures, ages, and physical and mental limitations. However, in a world of over 7 billion, each with unique backgrounds, needs, and preferences, developing a standardized, 'one-size fits all' UI can be difficult. Standardization, or the generation of universal systems based on the average user, may allow for greater continuity and transfer of technology across groups, but may not optimize use for everyone. The implementation of user-centered design through customization may ensure that special populations interact with a system that best fits their preferences and needs. However, as laymen may not have the same expertise as designers, engineers, and researchers, too much freedom in customization may be confusing or lead to ineffective design. Moreover, different aspects of the UI in automated vehicles (AV) afford different degrees of customization. Defining formal levels and a taxonomy of customization will provide a fruitful method for developing components of a UI to be consistent when necessary, without sacrificing individualistic needs when permitted.

2 BACKGROUND

Universality is a value that HCI seeks to achieve through its design [5], so it can be generalized to all user groups. The generalizability and universality of a technological artifact allows the artifact to transcend the boundaries of the specific context it was generated in [1], increase learnability and familiarity with the product across various contexts, and to be consistent among various users [14]. On the other hand, the universal logic belies the white, male, able-bodied perspective that is too often behind it, forcing itself as the objective truth, and renders all other perspectives as less valid [9]. In other words, given that every design is carrying the positioning of its creators and their assumptions, "universal design" may be usable to some, while a barrier and equipment for suppression for others. There is no doubt that the inclusion of various stakeholders, regardless of their background, status, and technical knowledge, has to start early in product design. However, the design process does not end when the product is sold to the users, and the process may continue as the users adapt it to their daily lives. Hence, allowing the users to tailor the technological artifact to their needs and preferences —to customize it— can ease this process for them.

It is widely known that customization can increase user experience when interacting with an interface by accommodating individual needs, abilities, and preferences [19]. Moreover, it can increase product loyalty and reduce operating costs for businesses [3]. Originally defined as a solitary activity allowing users to express individual preferences [12], customization has become one of the key components of various applications. These applications allow users to customize various aspects of the UI, from the color palette and surface characteristics [8] to the displayed content [17] and the UI functionalities.

System-driven adaptation has been proposed as a solution to the increasing possibilities for customization, such that the system proactively assesses user states, preferences, and needs, and offers personalization options respectively [7, 15, 20, 23]. For example, adaptive automation in automated vehicles surveys the drivers' performance, affect, and physiological responses to tailor the UI's communication mechanisms to the user [4, 6, 16]. However, research into the interaction of customization of UI and automation is wanting. This research gap is surprising as extensive research on UIs and adaptive automation exists; furthermore, automation customization in automated vehicles may exist in the future, as users may control not only the vehicle's internal user interface, but also the level of driving automation.

System-driven adaptation assists the users who may not want to or not know how to customize, by learning from them and adapting itself to the user, instead of the user initiating the customization; however, it suffers from lack of transparency, may prove intrusive, and takes users' agency away [22]. Additionally and more pertinently, the implementation of adaptation can result in unethical outcomes; The process through which data are processed to generate decisions is not neutral [13, 18]. Moreover, the interpretation and evaluation of neutrality is observer-dependent. The outcomes of algorithms may also be discriminatory, even if they were made with conclusive, scrutable, and well-founded evidence. System initiated personalization can also lead to discrimination, by segmenting populations and offering different information and opportunities to them [13].

Adaptive automation and other forms of system-driven adaptation provide clear benefits to users, including taking over routine tasks, calibrating users trust, and ensuring safety [4, 11, 23]. However, the aforementioned reasons engender concerns for relying too heavily on AI-generated decisions, made without the user's awareness or consent. Many of these concerns can be circumvented through user customization. The explicit decision-making transfers the control of potentially biased algorithms back to the operator. The ability to make decisions can allow for populations subverted during design and development to build a system most appropriate for them.

Contrarily, too much customization can have negative effects. In situations where the individual must offer private information to have a more personalized experience, too much customization can lead to negative affect and feelings of intrusiveness [21]. Additionally, individuals may design an interface they erroneously believe to be most effective. One cannot ignore that not all users have the necessary expertise or self-awareness to create an optimal UI [12]. Too much customization without boundaries may lead to negative legal ramifications and system abuse. For example, an individual could customize the interface to remove all warnings, thereby destroying its original intention. It is essential for any customization to not exceed the boundaries of the system.

Evidently, there is reasonable concern with allowing both too much and too little customization. However, not all aspects of a UI are equivalent in the degree of customization that is appropriate. For example, auditory warnings for vehicle system failures may not afford the same individualistic input as personalizing how the AV conveys superfluous or auxiliary information. Furthermore, the level of customization may differ depending not only on the different aspects of the UI, but also on the level of driving automation for the system itself. Warnings in a vehicle with level 2 automated driving features are more pertinent as the driver is expected to remain vigilant, than warnings in a vehicle with level 5 autonomous driving features, in which the user has no need to intervene [10]. Understanding the role of customization in automotive UI's will help enable a smooth and safe transition to AV's. The development of a system of customization levels is a necessary foundation to engendering optimal UI's that best fit and support users of all backgrounds and abilities, and ensure their trust.

3 WORKSHOP GOALS

The overall objective of this workshop is to reconcile research in customization from various fields in order to inspire an interdisciplinary investigation into how personalizing can benefit and limit users on both overt and hidden levels. That is, defining the role of customization in UI, its range, and dissecting its taxonomy to build a more recognizable and comprehensive model for engineers and researchers. Specifically, we aim to discuss what features of automotive UI's can be standardized and what should be customized, and work towards creating a taxonomy. By generating a cohesive understanding of customization in UI, researchers can begin to investigate its effects on other psychological constructs such as trust and acceptance.

4 WORKSHOP OVERVIEW

Learning from previous virtual workshops [2], this workshop will contain 2 60-minute sessions in order for participants to have meaningful discussions and leave with concrete deliverables. During the first day, organizers will briefly go over the concepts of customization, adaptive automation, and standardization to provide participants with necessary background knowledge to understand the importance of and gaps in the research area. Participants then will be divided into multiple breakout groups, and will be given access to their respective Miro page. Groups, with the guide of one organizer, will utilize the Miro page to discuss their choices on the features to standardize in an automated vehicle, the features to allow customization for, and the potential implications of these decisions. At the final portion of the first day, groups will present the results of their discussion, and the day will conclude with discussing the need for various levels of customization.

The second day of the workshop will start with a recap of the first day's results. The participants will then be divided into breakout groups to generate a taxonomy of customization, types of customization, and its limits. The second half of the session will consist of group presentations. Each group will share their customization levels to the larger group; to keep presentations succinct, organizers will provide participants a template to follow. During the presentations, other participants may ask groups questions about their customization levels. Finally, organizers will do a brief wrap-up and discuss next steps for research exploring customization in automated vehicles.

At the end of the workshop, participants will leave with a taxonomy for customization levels and new collaborators. It is expected that there will be follow-on workshops, as well as a publication laying out the taxonomy and discussing the need for more structure around this topic in both research and development efforts. Our anticipation is that collaborative grant proposals will also emerge from the discussions facilitated by this workshop.

5 AUTHOR BIO

Sidney Scott-Sharoni is an Engineering Psychology doctoral student at Georgia Institute of Technology. She completed her BS in Psychology at Old Dominion University, then worked as a research scientist for NADS at The University of Iowa. Her research interests focus on customization of advanced in-vehicle displays, human-automation interaction, and trust in automation within the space of high driving automation.

Nadia Fereydooni is a Human-Centered Computing doctoral student at Georgia Institute of Technology. She earned her Bachelors degree in Computer Engineering from University of New Hampshire. Her research focuses on the integration of VR devices in dynamic real world contexts such as automated vehicles, and investigating the influence of the real and virtual worlds and experiences on each other.

Bruce N. Walker is Professor in the School of Psychology and the School of Interactive Computing at Georgia Tech, and founder of the Sonification Lab. Dr. Walker completed his Ph.D. at Rice University in Human Factors Psychology and Human-Computer Interaction in 2001. He is a Core Faculty member in the GVU Center, a member of the Center for Music Technology (GTCMT) and the Center for Biologically Inspired Design (CBID), and a Project Director in the WirelessRERC. Dr. Walker is a Past-President of the International Community for Auditory Display (ICAD) and served as Program Chair for the AUTO-UI 2018 conference.

Myounghoon Jeon is an Associate Professor of the Department of Industrial and Systems Engineering and the Department of Computer Science at Virginia Tech. His Mind Music Machine Lab tries to integrate different levels of research on human-automation (vehicles, robots, and agents) interaction, including neurological, psychological, and computational approaches. Dr. Jeon will serve as a General Co-chair for Auto-UI 2022.

Andreas Riener is a professor for Human-Machine Interaction and Virtual Reality at Technische Hochschule Ingolstadt (THI) with co-appointment at the CARISSMA research institute of Automated Driving (C-IAD). He is the program manager for User Experience Design and leads the usability research and driving simulator labs. In 2017, he founded the interdisciplinary Human-Computer Interaction Group. His research interests include human-computer interaction in mixed-reality applications, user experience design and usability evaluation, and human-automation cooperation (system transparency, trust calibration, explainable UIs/XAI, responsibility displays). Riener is steering committee co-chair of ACM AutomotiveUI and chair of the ACM SIGCHI German chapter.

Philipp Wintersberger is a researcher at TU Wien (Vienna University of Technology). He obtained his doctorate in Engineering Science from Johannes Kepler University Linz specializing on Human-Machine Cooperation. His publications focus on trust in automation, attentive user interfaces, transparency of driving algorithms, as well as UX and acceptance of automated vehicles and have received several awards in the past years. He has co-organized several workshops at CHI and AutomotiveUI, and currently serves as Technical Program Chair for AutomotiveUI'21.

REFERENCES

[1] Sasha Barab and Kurt Squire. 2004. Design-based research: Putting a stake in the ground. *The journal of the learning sciences* 13, 1 (2004), 1–14.
[2] Zoe M Becerra, Nadia Fereydooni, Andrew L Kun, Angus McKerral, Andreas Riener, Clemens Schartmüller, Bruce N Walker, and Philipp Wintersberger. 2021. Interactive Workshops in a Pandemic: The Real Benefits of Virtual Spaces. *IEEE Pervasive Computing* 20, 1 (2021), 35–39.
[3] Jen Cardello and Jakob Nielsen. [n.d.]. *Customization Features Done Correctly for the Right Reasons 46 Design Guidelines To Improve Web-based Interface and Product Customization HOW TO SHARE.* Technical Report. http://www.nngroup.com/reports/customization
[4] Jenna E Cotter, Andrew Atchley, Barbara C Banz, and Nathan L Tenhundfeld. 2021. Is my User Impaired? Designing Adaptive Automation that Monitors the User's State. (2021).
[5] Paul Dourish and Scott D Mainwaring. 2012. Ubicomp's colonial impulse. In *Proceedings of the 2012 ACM conference on ubiquitous computing*. 133–142.
[6] Frédéric Fonsalas. 2019. Holistic HMI Architecture for Adaptive and Predictive Car Interiors. In *Electronic Components and Systems for Automotive Applications*. Springer, 217–227.
[7] Krzysztof Z Gajos and Krysta Chauncey. 2017. The influence of personality traits and cognitive load on the use of adaptive user interfaces. In *Proceedings of the 22nd International Conference on Intelligent User Interfaces*. 301–306.
[8] Connor C Gramazio, David H Laidlaw, and Karen B Schloss. 2016. Colorgorical: Creating discriminable and preferable color palettes for information visualization. *IEEE transactions on visualization and computer graphics* 23, 1 (2016), 521–530.
[9] Donna Haraway. 1988. Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist studies* 14, 3 (1988), 575–599.
[10] SAE International. 2018. SAE MOBILUS. saemobilus.sae.org/content/J3016{_}201806
[11] Anthony Jameson. 2007. Adaptive interfaces and agents. In *The human-computer interaction handbook*. CRC Press, 459–484.
[12] Wendy E Mackay. 1990. Patterns of sharing customizable software. In *Proceedings of the 1990 ACM conference on Computer-supported cooperative work*. 209–221.
[13] Brent Daniel Mittelstadt, Patrick Allo, Mariarosaria Taddeo, Sandra Wachter, and Luciano Floridi. 2016. The ethics of algorithms: Mapping the debate. *Big Data & Society* 3, 2 (2016), 2053951716679679.
[14] Carson Reynolds. 1999. Generalization in User Interface Design.
[15] Andreas Riener, Myounghoon Jeon, and Ignacio Alvarez (Eds.). 2022. *User Experience Design in the Era of Automated Driving | Andreas Riener | Springer.* Springer. https://www.springer.com/gp/book/9783030777258
[16] SM Sarala, DH Sharath Yadav, and Asadullah Ansari. 2018. Emotionally adaptive driver voice alert system for advanced driver assistance system (adas) applications. In *2018 International Conference on Smart Systems and Inventive Technology (ICSSIT)*. IEEE, 509–512.
[17] Ben Shneiderman. 1994. Dynamic queries for visual information seeking. *IEEE software* 11, 6 (1994), 70–77.
[18] Kate Starbird, Ahmer Arif, and Tom Wilson. 2019. Disinformation as collaborative work: Surfacing the participatory nature of strategic information operations. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (2019), 1–26.

[19] S Shyam Sundar and Sampada S Marathe. 2010. Personalization versus customization: The importance of agency, privacy, and power usage. *Human Communication Research* 36, 3 (2010), 298–322.

[20] Gabriel Urzaiz, Sergio F Ochoa, Jose Bravo, Liming Luke Chen, and Jonice Oliveira. 2013. *Ubiquitous Computing and Ambient Intelligence: Context-awareness and Context-driven Interaction: 7th International Conference, UCAmI 2013, Carrillo, Costa Rica, December 2-6, 2013, Proceedings*. Vol. 8276. Springer.

[21] Jenny Van Doorn and Janny C Hoekstra. 2013. Customization of online advertising: The role of intrusiveness. *Marketing Letters* 24, 4 (2013), 339–351.

[22] Daniel Weld, Corin Anderson, Pedro Domingos, Oren Etzioni, Krzysztof Z Gajos, Tessa Lau, and Steve Wolfman. 2003. Automatically personalizing user interfaces. (2003).

[23] Philipp Wintersberger, Hannah Nicklas, Thomas Martlbauer, Stephan Hammer, and Andreas Riener. 2020. Explainable Automation: Personalized and Adaptive UIs to Foster Trust and Understanding of Driving Automation Systems. In *12th International Conference on Automotive User Interfaces and Interactive Vehicular Applications*. 252–261.