Prospectus

Improving the User Dishwashing Experience Through the Design of a Smart UI
(Technical Topic)

User Configuration and the Biases Embedded in Crash Test Dummies
(STS Topic)

By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Socio-Technical Problem

User experience is the cornerstone for the design and development of any new technology. A meaningful user experience design fulfills user needs and provides a positive experience to any user of the technology (Gangadharan, 2020). While a technology can be groundbreaking in its function, if its intended user can't figure out or have positive experiences using the technology, the user will be left frustrated. Today, the field of user experience has become a focal point for all developers of technologies--provide a good experience for the user, or get left behind.

In accordance with this new rapidly growing wave, the household appliance industry has been quick to adapt. Refrigerators and ovens are adopting new and improved features and interfaces to take advantage of this trend. These innovations mark a large step in the efficiency and usability of these tools that are used daily. Dishwashers however, seem to have been ignored. Contemporary dishwashers today have sleek designs and a focus on their efficacy, but their user experiences are lacking. Users are often left frustrated with the dishwasher process due to a lack of transparency and understanding of technology itself.

To address this problem, my capstone group is doing research in order to develop a user interface (UI) that will improve the dishwashing experience and shed light on the black box that is the dishwasher. Now, in the 21st century, smart and autonomous technologies spurred innovation in the field of user experience. These technologies have been successfully implemented in many different industries, leading to better user interfaces and experiences and giving users a better understanding of their technology. By conducting interviews, surveys, and other research on dishwasher user pain points and by researching how users interact with smart

and autonomous features and their effects, we hope to develop a UI that best improves the dishwashing user experience.

However, to fully understand the problem, it is important to understand the social factor of how biases can be embedded into designs concerning the identity of users causing certain groups to become marginalized even if done unintentionally. In history, crash test dummies have used the medium-sized male body as a norm. While the dummies were meant to provide testing to provide the most possible safety for any person driving a car, people who did not fit the mold of this normal male body were not accounted for. Females, obese people, and the elderly all have body shapes that differ greatly from the male standard. While new designs for crash test dummies have been made to attempt to remedy this issue, pregnant women still remain largely forgotten (Inclusive crash test dummies, n.d.). With seatbelts not fitting pregnant women properly and crashes being a leading cause of fetal death, it is important to understand why the designs of crash test dummies were configured for some users and not others, and how biases embedded into the designs can cause this. I will specifically be looking at this in the case of crash test dummies and the biases embedded in them that marginalize pregnant women.

By addressing both the technical and social problems, it will be possible to provide a better and equal dishwasher user experience for all users, not just one group of people. In order to address the technical problem, my group will perform research to develop a UI that will give the best experience to users. I will also use User Configuration to analyze the how biases embedded in designs of crash test dummies can impact certain demographics in a negative way leading to designs that are not inclusive for all.

Technical Problem

As technology rapidly expands in the 21st century, the societal expectations for the abilities and usability of technology increases. Specifically, smart and automatic household appliances have become extremely popular and more affordable for everyone. People expect their technology to operate at lightning speed without decreasing the capability of the system. The objective of this project is to optimize the user interaction experience through the use of the latest technology with their dishwasher appliance without sacrificing the functionality of the product.

To create the optimal user interface, it is important to consider factors that influence user behavior ranging from the size of the household to typically overlooked personal characteristics like religion (Assadi, 2003, p. 3). A balance between technology and usability of a user interface (UI) is extremely important for a consumer because a UI that is too technologically advanced can become unusable and a UI without limited functionality would result in dissatisfaction from the consumer, an overview of the influence of usability factors is shown below in Figure 1. Figure 2 provides a visualization of the primary components referenced in Figure 1. For example, a study of 200 in-house consumer surveys showed that 20% of dishwasher cycles were not fully loaded

and some households preferred higher cleaning temperatures, so the value of

TABLE 4. Generated Dishwasher's Physical Design Factors and the Degree of Influence

Component of Dishwasher	Physical Design Factor	Degree of Influence (%)
Exterior	Label icon	21.50
	Size	21.64
	Button shape	15.82
	Color	10.44
	Panel size	9.95
	Button color	8.23
Interior	Rack size	41.47
	Bar	32.11
	Strength of bar	17.95
	Distance between racks	8.47
Doorknob	Shape of knob	67.40
	Thickness	32.60
Display	LCD size	26.56
	Display font type	22.16
	Color	20.47
	Control sound	14.91
	LCD font size	9.02

Figure 1: Generated Dishwasher's Physical Design Factors and the Degree of Influence. Results of research by Jin, Ji, Choi, and Cho (2009) in the appearance and technology factors in dishwashers effect on customer preference (p. 191).

energy consumption would be higher than the value listed on the appliance label (Richter, 2011, p. 186). This study shows that most users do not fully comprehend the capabilities and user interface of their dishwashers. Therefore, this project aims to ensure that the user interface is up to date with the latest technology and is intuitive for the consumer while achieving their desired operational capabilities.

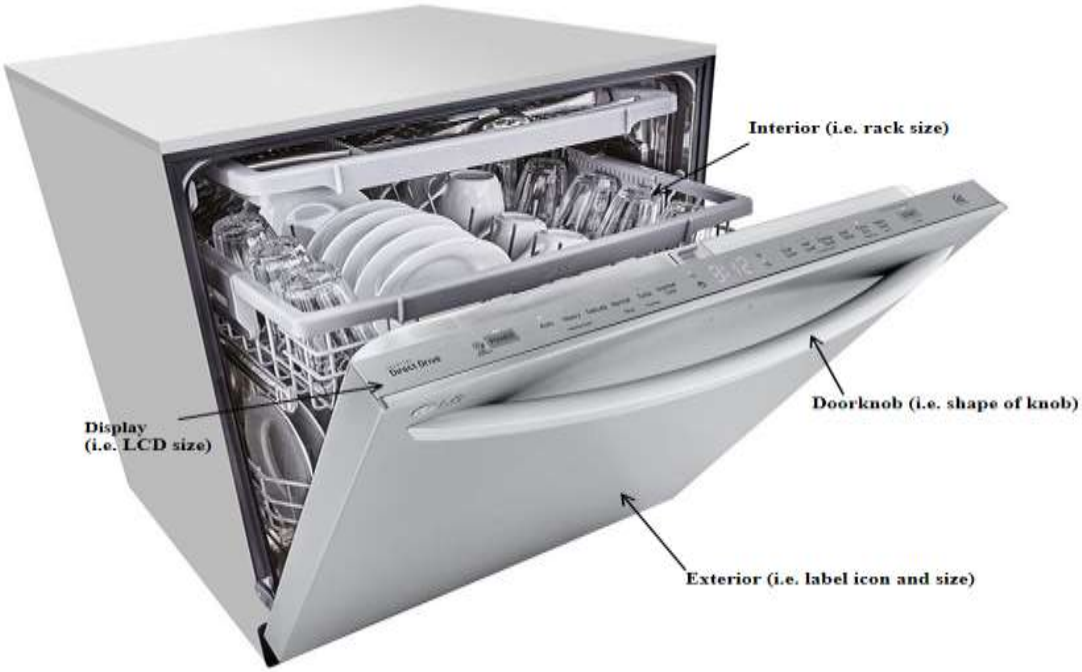

Figure 2: Visualization of Dishwasher Component Terms. The labeled depiction of a dishwasher identifies the physical counterpart to the terms used to describe influencing features (Chappidi, 2020).

A study from the U.S. The Energy Information Administration found that, out of 80 million households with dishwashers, 54% of households utilize it at least once a week (McNary, 2017). Since dishwashers are a technology used daily by a large number of people around the world, having a more streamlined and efficient experience for users would be a great benefit. The next generation of consumers are comfortable with technology and therefore, expect certain features to be present in their devices. This new acceptance of technology and these rapid advancements can create an influx of integration of smart home technology in multiple homes.

Smart technologies have been rapidly emerging and pervading throughout a multitude of industries such as the automotive industry, home connect device industry, and now, even the household appliance industry. The rapidly growing demographic of tech-savvy consumers require a new approach to daily tasks that are often taken for granted. Through our research, we

intend to find what users believe would best improve their dishwashing experience. By first gathering information on user pain points using methods such as interviews and surveys and then by looking into how smart technologies such as sensors, connectivity, and autonomous features change the way users interact with dishwashers, we aspire to develop a UI that would provide the features and experience that address current pain points, improve usability, and provide transparency in the dishwashing process.

STS Problem

Crash dummies are used often in the development of car designs and car safety regulations. These dummies are meant to help understand and measure the movement of a human body during a crash. In development of safety features such as seatbelts, these dummies are pivotal in understanding how to best keep drivers safe. Based on the purpose of the crash test dummy, it looks like it has been designed for most people to use. By using crash test dummies, there seems to be safety devices and regulations that were able to be created that keep all people who use a car safe. However, the artifact's design features indicate certain biases concerning the user's identity have been embedded in the product.

Injury rates in car crashes are significantly higher for people who don't fit the standard male norm. For example, seatbelts are a lot less safe for women. After a car crash, female drivers were 47% more likely to be seriously injured. This discrepancy can easily be explained by the design of the seatbelt. In the past, when safety regulations were imposed on automakers, regulators wanted there to be the use of two test dummies. One would represent a 95th percentile male and the other, a 5th percentile woman. This would allow seat belt designs to accommodate for anyone within the size of these two dummies, providing an equal safety net for both genders. These regulations were disregarded by designers however, and eventually, the testing settled to

using just one test dummy that represented the 50th percentile male. Women, who are on average smaller than their male counterparts, were disproportionately untested for in the design of seat belts, leading to regulations that were much more unsafe for women than men (Criado-Perez, 2019).

While, now, a female crash dummy has been created and is tested upon more regularly, this same problem that women faced are now faced by pregnant women. Advances in the diversity of the use of different crash test dummies systematically exclude pregnant bodies. Testing even with crash test dummies modeling women do not currently take pregnancy into account. Currently, most seatbelts do not fit pregnant women properly. Additionally, motor vehicle crashes are the leading cause of fetal death relating to maternal trauma with even crashes at 35 mph causing harm. Pregnant women account of 13 million people across the United States and the European Union, and ignoring this large demographic of people can lead to unnecessary injury and death. By exploring the designers' ideas about who the drivers of cars are and who to design safety standards for were embedded into the artifact, we'll gain a better understanding of the way implicit bias can affect product design (Inclusive crash test dummies, n.d.). Drawing upon the framework of User Configuration, I argue that the designers embedded biases about the users' demographic into the technology's design.

User Configuration is a science, technology, and society (STS) framework where engineers and designers configure user identity and practice by encoding and embodying certain ideas that they have about users into the technologies they design, whether consciously or unconsciously (Grint & Woolgar, 2013). Here, the designers are the engineers in charge of the design of crash test dummies, the technology is the crash test dummies, and the users are people that drive cars that have safety devices and regulations from the testing on the crash test

dummies. I will use User Configuration to analyze the biases designers had about the users that were embedded in crash test dummies leading to the marginalization of pregnant women in regards to crash test dummy testing. To support my argument, I will analyze evidence from a Gendered Innovations case study on inclusive crash test dummies as well as a study that looked at automobile crash simulations with the first pregnant crash test dummy.

Conclusion

In this paper, the technical and social problems illustrate a need for better designs of technology in order to help solve problems in the inequality between among different demographic groups. Through my capstone group's research in how users interact with and feel about smart and autonomous user interfaces with regard to dishwashers, we hope to create a design that will be intuitive and easy to use by improving the usability and user experience of dishwashers. The STS research paper will seek to illuminate how the biases of designers embedded in their designs on the intended user can marginalize and harm certain types of people by using User Configuration to analyze the biases present in crash test dummies that systematically excluded pregnant bodies. This will shed some light on how it is possible to reduce the bias in technologies allowing for a better user experience for all people.

The results of these findings will shed light on how to resolve the broad socio-technical problem of a better dishwasher design. The findings of the technical paper will show how the use of smart and autonomous technologies in user interfaces help increase the usability and intuitiveness of an appliance, while the results of the STS paper aim to understand how biases in the designs of technologies can exclude and marginalize certain people leading to designs that are not inclusive for all people.

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