Prospectus

Improving Pedestrian and Bicycle Safety and Comfort Along Water St. Corridor
(Technical Topic)

How Have Particular Transportation Infrastructure Designs Discriminated Against Low-Income and Diverse Communities in the United States?
(STS Topic)

By

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October 30, 2019

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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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I. Introduction

Pedestrians and bicyclists are put at risk every day due to insufficient transportation infrastructure. In 2017 alone, a total of 6,760 pedestrians and bicyclists were killed in the United States by motor vehicles (Pedestrian and Bicycle Information Center, 2019). The U.S. Department of Transportation describes a livable community as one where all forms of transportation in that community are safe and easy to use for all residents (Federal Highway Administration, 2018). However, according to the Department of Transportation, the number of pedestrian and bicyclist deaths and injuries are increasing annually. In order to provide livable communities for all, the condition of pedestrian and bicycle infrastructure in the United States needs to be addressed. Unfortunately, for transportation infrastructure in general, some communities are at a greater disadvantage than others.

Across the United States, infrastructure serves as a constant barrier to residents attempting to travel from one location to another (Schindler, 2015). More specifically, transportation infrastructure has been designed to exclude minorities by increasing their difficulty and length of travel to particular destinations. Premeditated at times, and unintentional at others, engineers and designers have created infrastructure over the years that discriminates by race and socio-economic status. For example, in many low-income and diverse communities, sidewalks and bike paths are almost nonexistent. Therefore, this restricts the connectivity between neighborhoods and forces residents to walk on or along the shoulder of high-volume roads (Schindler, 2015).

My STS research paper will address this issue on how particular transportation infrastructure designs have discriminated against low-income and diverse communities in the United States. On the other hand, my Capstone project will aim to improve the safety of pedestrians and bicyclists along the Water Street corridor, more specifically between 2nd Street SW and 4th Street SE. Water Street has been identified by the Virginia Department of Transportation (VDOT) as an area of focus due to a high rate of pedestrian crashes between 2012 and 2016 (Virginia Department of Transportation, 2018). During this time frame, ten pedestrian crashes have occurred in this area, including one incident where the pedestrian was severely injured (Virginia Department of Transportation, 2018). Additionally, Water Street tends to have a high amount of bicycle traffic. Therefore, the objective of this Capstone project is to redesign this corridor to incorporate a variety of safety features for pedestrians and bicyclists.

II. Technical Topic

The current conditions of Water Street are not ideal for pedestrian and bicycle traffic. The corridor involves two-lanes of undivided traffic with a mix of signalized and unsignalized intersections. Only two of the five intersections have pedestrian signals and the walkway striping at all of the intersections is becoming faded. Both travel lanes are shared roadways, meaning they are travel lanes that utilize both bicycles and vehicles. Shared roadways can be both uncomfortable and unsafe for bicyclists. Figure 1 highlights the marking indicating that this corridor is a shared roadway. Also, note in Figure 1 the absence of any form of stop sign or signalization, thus allowing vehicles to continuously move through the intersection without needing to give much attention to pedestrians.

Figure 1. The intersection of Water Street and 4th Street SE. Note: The bicycle marking outlined in red indicates a shared roadway. (Image Source: Dobson, 2019)

Ideally, Water Street would be able to accommodate vehicles, pedestrians, and bicyclists in a safe and efficient manner. Through design and evaluation of alternative transportation infrastructure, the Capstone team will develop a new corridor that will bolster pedestrian visibility and provide facilities that improve safety, comfort, and connectivity for bicyclists. In achieving this goal, the team will analyze best practices from other bike- and pedestrian-friendly cities to inspire design ideas. The Capstone team is responsible for creating preliminary design alternatives in AutoCAD Civil 3D, evaluating each of the alternatives in virtual reality through user testing, and determining the preferred alternative through feedback from users. AutoCAD Civil 3D is a civil engineering software that allows for the user to design and manipulate a variety of features including roadways, bike lanes, and sidewalks. The project scope will not include the actual installation of the alternatives, detailed design documents for construction, detailed cost breakdowns, removal of buildings, signal timing changes, or changes that require additional right-of-way. Additionally, it will be important to keep in mind the effect of our design on vehicles traveling down Water Street, but the team will not be analyzing the direct impact of our design on traffic patterns.

Planning level design documents are to be created in AutoCAD Civil 3D in order to communicate the team's design solution alternatives. Once the planning level design documents are produced, the alternative designs will be implemented in Unity. Unity is a software that allows for the development of a virtual reality (VR) environment. The Capstone team will have access to the bicycle and pedestrian VR simulators in the Omni-Reality and Cognition Lab (ORCL) in order to conduct user testing of the proposed alternatives. Current ORCL researchers have already developed a VR environment that replicates the Water St. corridor. Therefore, the team will be able to easily alter this base environment to include the design alternatives.

The VR experimental studies will be used to evaluate how the different alternative designs impact pedestrian and bicyclist behavior, perception of safety, and comfort. The user testing involves collecting the participants' preferential and behavioral information through questionnaires and physiological indicators such as heart-rate, body temperature, and physical movements.

The final design report for this Capstone project will include the selection of a preferred design alternative using multiple criteria for justification. These criteria will include design standards, estimated cost, overall safety, constructability, aesthetics, environmental impacts, equity, and the results from the user testing in the VR environment.

III. Transportation Infrastructure as a Physical Barrier

Transportation infrastructure shapes our world, affecting the way people get to and from different locations. It directly authorizes or inhibits individuals from being able to access particular locations. This has allowed transportation infrastructure to serve as "physical barriers [that] divide urban space in ways that reinforce or exacerbate segregation" (Roberto, 2016, p.1). At first glance, transportation systems may not appear to discriminate against low-income and diverse communities. However, after careful analysis, it becomes apparent that transportation infrastructure can discriminate. For example, Robert Bullard (2003) describes a case where a seventeen-year-old, African-American girl named Cynthia Wiggins was killed by a dump truck while crossing a seven-lane highway in order to get to the nearest bus stop. Cynthia was working at the Walden Galleria Mall, where the mall's owners refused to have a bus stop on its property (Schindler, 2015). Therefore, she was forced to jaywalk across a seven-lane highway to reach the nearest bus stop. During the court trial of her death, it was "revealed that this transit-siting decision was motivated at least in part by race or class bias" and that the mall's owners wanted to discourage people who rely on public transportation from accessing the mall (Schindler, 2015, p. 1964). While this example illustrates an outcome of intentional discrimination, there are a great number of cases where the discriminatory infrastructure was unintentional. The theories of *technological politics, actor network*, and *discriminatory technologie*s can be useful to reveal those forms of discrimination.

In 1980, Langdon Winner introduced the theory of technological politics in his publication *Do Artifacts Have Politics?*. This theory attempts to explain how technological devices are embedded with political properties. Winner identifies two instances where this takes place and provides case studies to back his theory. The first instance occurs when technologies are utilized as a form of order in communities. Winner provides an example where Robert Moses purposefully designed overpasses in Long Island, New York to discriminate against minorities and the lower class. Moses had designed a vertical clearance of nine feet for these overpasses to prevent buses, and those who rely on this form of public transportation, from traveling on the parkways underneath. Winner (1980) argues "how technologies can be used in ways that enhance the power, authority, and privilege of some over other". He also mentions how technologies are able to unintentionally have political consequences. Winner (1980) states "consciously or not, deliberately or inadvertently, societies choose structures for technologies that influence how people are going to work, communicate, travel, consume, and so forth". The second instance where the theory of technological politics applies deals with inherently political technologies. This is "the belief that some technologies are by their very nature political in a specific way [and that] … the adoption of a given technical system unavoidably brings with it human relationships" (Winner, 1980, p.128). This differs from the first instance in that there is no flexibility in whether the technology will have political properties if adopted. Winner provides two different cases for inherently political technologies. In the first, the technology requires the adaptation of certain social conditions while in the second, the technology is strongly compatible with a set of particular social conditions. Along with the theory of technological politics, actor network theory will also be utilized to examine transportation infrastructure.

Actor network theory was developed by Bruno Latour in 1992 in his article *''Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts''*. This theory attempts to explain how human and nonhuman actors have an equal part in developing how society is today. Latour (1992) notes how "we have been able to delegate to nonhumans not only force as we have known it for centuries but also values, duties, and ethics". The primary example discussed throughout the article deals with the human and nonhuman aspects of a door. As new technologies were developed for the door, human actions adapted consequentially. In order to understand how a new technology affects human actions, Latour (1992) suggests to "simply imagine what other humans or other nonhumans would have to do were this character not present". To disregard the impacts of technology on society, as most sociologists do, would be the same as looking at only half the picture. Latour describes technologies as being anthropomorphic. Anthropomorphism is the projection "of a human behavior onto a nonhuman" (Latour, 1992, p.160). Therefore, he is perpetuating that technologies reflect human thoughts and values. Thus, technological artifacts can be created to "replace human action and constrain and shape the actions of other humans" based upon the values of the creator (Latour, 1992, p. 151). It is important to consider both the human and nonhuman actors when analyzing the discriminatory factors of transportation systems.

The theory of technological politics will be utilized in conjunction with the actor network theory in my STS research paper. Winner's theory is applicable to discriminatory transportation infrastructure as its design has political consequences for sections of the community. Latour's theory is applicable to discriminatory transportation infrastructure as it is a nonhuman actor reflecting the human values of its designer. This STS paper is of particular concern because of the limited amount of research completed involving the impact of infrastructure design on communities (Coutard, 2007). Furthermore, it is important to identify and acknowledge transportation systems that are discriminatory in order to progress society in regards to race and socio-economic status.

Dylan Wittkower provides an evaluative framework for analyzing discriminatory technologies in his article *Technology and Discrimination*. In this article, Wittkower (2018) argues "how technologies embody, transmit, and produce ontologies of normativity which result in privilege and discrimination". He presents three separate theoretical structures that are utilized in his theory of discriminatory technologies, which are the theoretical structures of Heidegger, Latour, and Ihde. Heidegger contributes the idea of the "One" to Wittkower's theory. The One is defined as the perfect image of normativity and averageness. Wittkower emphasizes how the One directly excludes anyone who does not fall into its image. Privilege is defined as "the invisibility of our attributes caused by their fallenness into the One" (Wittkower, 2018, p.6). Latour's work contributes to Wittkower's theory by what Wittkower refers to as a Latourian delegation, a Latourian delegation being "social values [that] are enforced through material implication, surviving through replication of design long after their designers unthinkingly built their discriminatory values" (Wittkower, 2018, p. 7). The theoretical structure of Ihde contributes to Wittkower's theory by providing four different categories of human technics: embodiment technics, hermeneutic technics, alterity relations, and background relations. Each of these categories describes a different way of how technology interacts with users and/or the world that produces a discriminatory outcome. This theory of discriminatory technologies will be utilized in the following section as a method of evaluating different transportation infrastructure systems.

IV. Research Question and Methods

My research question is: How have particular transportation infrastructure designs discriminated against low-income and diverse communities in the United States? The importance of this question deals with the equality of all people, independent of race and socio-economic status. It evaluates transportation systems in respect to having equal opportunities for all and the effect of this technology when it does not meet these standards. This research question will examine transportation systems in the United States in order to narrow down the subject area, and case studies will serve to constrain the focus even further. The methods that will be utilized to analyze this research question include case comparisons and Wittkower's framework.

Three case studies will be collected and analyzed for this research question in order to do a case comparison. The first case involves two communities in Baltimore that are separated by Greenmount Avenue (Greenspan, 2012). These communities are clearly divided by economic class and race, which is a result of historic legislation and current infrastructure. The second case involves the overpasses designed by Robert Moses that were previously mentioned as an example in Langdon Winner's article. Moses purposefully designed these overpasses to discriminate against those who rely on buses as a form of public transportation. Information on both these case studies will be found through current literature. As for the third case, I will attempt to examine the Water Street corridor from my Capstone project for discriminatory properties. This will be completed by conducting a personal investigation of the transportation infrastructure on the corridor and determining its social impacts. This analysis will then be compared to the two other case studies in order to come to a conclusion of the overall effects of transportation infrastructure on low-income and diverse communities. Wittkower's theory of discriminatory technologies will be utilized to evaluate these three transportation systems to determine who is seen as the "One", what social values are being imposed by each design, and what category of human technics each design falls into.

V. Timeline and Expected Outcomes

The technical deliverable for my Capstone project includes planning level design documents for the Water Street corridor in AutoCAD Civil 3D. This deliverable will be summarized in a final design report, where justifications will be provided for the design based on a variety of criteria. The objective of this design is to improve the safety of pedestrians and bicyclist along the corridor. It is my hope that the city of Charlottesville will take our design into consideration and improve the safety along Water Street.

The STS Research Paper will be completed by May 1st, 2020 (See Table 1). The objective of this research paper is to bring awareness to the discriminatory effects of current transportation infrastructure and hope that future measures are taken by city planners, designers, and engineers to reduce discriminatory designs.

Expected Completion Date	Activity
09/22/2019	Statement of Topics
10/18/2019	Annotated Bibliography
10/30/2019	Prospectus
12/10/2019	Signed Prospectus
01/01/2020	Complete Research
01/19/2020	Complete Investigation of Water Street Corridor
02/02/2020	Annotations of All Research
03/01/2020	Develop Comprehensive Outline for STS Research Paper
04/05/2020	Rough Draft of STS Research Paper
05/01/2020	Finalized Research Paper

Table 1. Timetable to complete STS research paper.

VI. References

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