

Contested Spaces, Shared Concerns: Road Interactions from the Perspective of Three User Groups

*Sarah Stutts, Kenneth Saintonge, Nicholas Jordan,
and Christina Wasson*

Abstract

Roadways are sociocultural spaces constructed for human travel which embody intersections of technology, transportation, and culture. In order to navigate these spaces successfully, autonomous vehicles must be able to respond to the needs and practices of those who use the road. We conducted research on how cyclists, solid waste truck drivers, and crossing guards experience the driving behaviors of other road users, to inform the development of autonomous vehicles. We found that the roadways were contested spaces, with each road user group enacting their own social constructions of the road. Furthermore, the three groups we worked with all felt marginalized by comparison with car drivers, who were ideologically and often physically dominant on the road. This article is based on research for the Nissan Research Center - Silicon Valley, which took place as part of a Design Anthropology course at the University of North Texas.

Page 1 of 37

JBA 9(2): 155-191
Fall 2020

© The Author(s) 2020
ISSN 2245-4217

DOI:
10.22439/jba.v9i2.6118

Key words

Autonomous Vehicles, Road Use, Design Anthropology, Space and Place, Contested Space

Introduction

This research was conducted as a class project for Nissan Research Center – Silicon Valley. The class was Design Anthropology, taught by Christina Wasson at the University of North Texas. Our project started with the goal of investigating how three types of road users experienced the road behaviors of others. But as we embarked on our investigation, it became clear that we were learning how each user group interacted with the roadway in a more holistic sense: how their contrasting uses of space generated a different social construction of the road for each group.

The three road user groups we worked with were bicyclists, crossing guards, and solid waste truck drivers. Each of these groups contrasted markedly in their relationship with the road and their interactions with other road users. Their understandings of the road were shaped by their embodied experience of traveling in particular ways. They used the road for different purposes; spent different amounts of time on it; used different forms of locomotion; moved at different speeds; experienced different levels of physical vulnerability; and varied in how much room for improvisation their activities permitted.

Given these dramatic differences, it is not surprising that we initially focused our analysis on the ways in which each user group was unique. To some extent this was also the result of our client's request for a separate report on each group. However, as we continued to analyze our data in collaborative brainstorming sessions, we were increasingly struck by unexpected yet profound similarities across groups. In this article, we examine three shared themes that appeared across all three groups:

- Theme 1. Each group had a sense that their group was not understood by other road users, that their specific needs and navigational constraints were often not known and that many road users did not respect their group
- Theme 2. Each group had a sense that some road users engaged in selfish or aggressive driving behaviors that caused inconvenience and danger to other road users
- Theme 3. Building on the two prior themes, each group was concerned about unpredictable behaviors from other road users that produced anxiety and a need for constant alertness

These three themes were all connected to a fourth theme, namely the prevalence of a “car culture” that privileged car drivers over other

types of road users (Lutz and Fernandez 2010). Each of the three road user groups we worked with regarded car drivers as occupying a physically and ideologically dominant position on the roads. Most of their contestations of space were with car drivers, although conflicts with other road user groups could arise as well. It was the ideological dominance of cars on the road that led to incidents such as this one, narrated by a cyclist we interviewed: the cyclist, Tim, was riding to work one day and a car came up next to him at a stoplight and started yelling at him to get out of the road. *"So I turn around and go 'excuse me?' and he goes 'Get the fuck out of the road!' I go 'I belong here!' So we started yelling at each other."* In this dialogue, the car driver's attitude of "owning" the road was stated as baldly as it could be, and the cyclist's contestation was explicit as well.

Historical Context: How the Dominance of Cars Emerged

To understand the cultural logic of the roads that produced these articulations of car driver entitlement, it is useful to review the historical development of roads (Crute et al. 2018; Kunstler 1993; Oatman-Stanford 2014). While the early United States was characterized by an ideology that all road user groups had equal rights to the road, there is now a widespread assumption that car drivers are the most legitimate users of the road. How did this shift happen?

In the early years of the United States, urban roads were a cacophony of activity. While most were mud and dirt, with minimal sidewalks, it was common for people to traverse and mingle there. Draft animals carried wares from one place to another, carriages transported mail and passengers, and children played in the street (Oatman-Stanford 2014). This highly heterogeneous use of roads by diverse types of users was not regarded as a problem. "Roads were seen as a public space, which all citizens had an equal right to, even children at play... Common law tended to pin responsibility on the person operating the heavier or more dangerous vehicle... so there was a bias in favor of the pedestrian" (Oatman-Stanford 2014, 3).

The first major shift in conceptions and practices of road use came with the invention of the bicycle, which started as a quirky novelty of the Victorian age. After several iterations, the "safety bicycle" facilitated affordable travel and independence for those that did not have access to animal or carriage transportation, especially benefiting women and lower classes (Friedel 2007). The popularity of the bicycle encouraged cities to make streets more bike-friendly by paving them or reducing ruts and mud in other ways.

The next shift was initiated by the development of the automobile in the early 1900s. Automobile acceptance was not instantaneous. At first cars were seen as a scourge on society: these infernal machines were horseless, propelled themselves, and tore around the countryside at a

hellish speed of 25 mph. Eventually, auto companies and related interest groups engaged in a successful public relations campaign that shifted blame for accidents from the car to individual bad drivers and the irresponsible public that did not use the roads with caution and respect for the car (Oatman-Stanford 2014). The car industry also bought out many public transportation systems, especially street cars, and eliminated them (Kunstler 1993).

After World War II, suburbs developed rapidly, further encouraging reliance on cars. The U.S. government poured money into transportation infrastructure, particularly through the Federal Aid Highway Act of 1956, an overhaul and expansion of the U.S. highway system (Friedel 2007). This made it easier for people to buy homes that were further from their place of work. The middle class was expanding, and suburbia embodied the American dream of individualized success. The cyclical development of suburban sprawl and transportation infrastructure was born (Putnam 2000).

As a result of these shifts, cars enjoy ideological dominance on the road in much of the United States today (Lutz and Fernandez 2010). At the same time, we may be seeing the beginnings of a shift away from car culture. The New Urbanism movement has encouraged people to live in downtown areas, drawing on design innovations like mixed-use zoning (Putnam 2000; Kunstler 1993). Similarly, the Complete Streets movement requires streets to enable safe, convenient and comfortable travel and access for users of all ages and abilities, regardless of their mode of transportation (Smart Growth America 2019). People of all age groups, especially teenagers, are showing less interest attaining drivers' licenses (Sivak and Schoettle 2014). Bicyclists have founded social movements to promote their rights on the road (Udvarhelyi 2009; Vivanco 2013; Wray 2008). We return to questions about how the future may evolve in our conclusions.

Roadways as Socially Constructed Spaces

The interpretation of our research findings draws on the anthropology of space and place, in particular writings that focus on embodied spaces and contested spaces. A focus on embodiment allows us to trace the ways in which people's movements through space – their bodily practices of navigation – shape their lived experience and social construction of the road (Bourdieu 1977; De Certeau 1984; Ingold 2000; Low 2009). In this regard, a vehicle may be considered an extension of the body. Each of the road user groups we worked with had their own set of embodied practices for navigating the roadways. For example, cyclists would move closer to the side of the road when they heard a car approaching from behind. Such habits were ingrained over time, becoming part of the road users' habitus. Furthermore, these navigational practices socially

constructed the meanings of the roads. For instance, for a crossing guard, a school zone intersection might embody the experience of helping every child cross that street safely for the last twenty years, making this space rich with meaning and history for them.

A focus on contested spaces allows us to examine the ways in which roads are a zone of contestation among groups, as each group has assigned different uses and meanings to the same pieces of territory (Kuper 2003; Low 2000; Low and Lawrence-Zuniga 2003; Moore 1998). Contested spaces exist at the intersection of conflicting interests from different social actors. For instance, cyclist Tim stated, *"The roads are public space, they're for everybody. But we have this culture of 'it's for cars'."* Likewise, school crossing zones could become a space of opposition when motorists challenged the authority of the crossing guard by disobeying commands.

For our interpretation of video recorded observations of road encounters, we draw on Conversation Analysis (CA) as it has been adapted in anthropological studies of technology use, and vehicle use in particular (Haddington and Rauniomaa 2014; McIlvenny et al. 2014; Wasson 2000). Specifically, an approach termed "interactional mobility studies" brings attention to "the ways in which embodied actors or participants orient to each other and organize their actions" with respect to each other as they move through space (McIlvenny et al. 2014, 104). For example, Haddington and Rauniomaa examined the moment-by-moment processes through which drivers offer space to other drivers. "They may communicate this by positioning themselves in space in different ways or by drawing on mutual gaze, gestures, the car's technology, or other multimodal resources" (2014, 176).

The Project

Research Question

Our client for this class project, the Nissan Research Center – Silicon Valley, focuses on the development of autonomous vehicles (AV). Our key contacts and collaborators at the Center were Melissa Cefkin, Manager of the User Experience Team, and Laura Cesafsky, a researcher on that team. Cefkin and Cesafsky are deeply interested in the problem of car dominance introduced above. They advocate for making AVs better "road citizens" by reproducing in AVs some of the best qualities of human drivers, while leaving out some of the worst.

For Cefkin and Cesafsky, the class project was an opportunity to learn more about the experiences of comparatively marginalized road user groups. Ethnographic research with several road user groups that each had different social constructions of the road, and different ways of navigating, could produce insights about how to design interactions

between AVs and members of these road user groups. Through discussions with Wasson prior to the class, they selected three road user groups to focus on: bicyclists, crossing guards, and solid waste truck drivers. The research question posed by Cefkin and Cesafsky was: How do these three types of road users experience the driving behaviors of others? And, what are the implications for autonomous vehicles?

Each of these three groups had a unique set of experiences that came with the ways in which its members inhabited road spaces and interacted with other road users. Another, fourth group studied in the class project was interactants with an autonomous shuttle that operated in a business park in a Dallas suburb, offering free rides to employees of businesses. An analysis of this group will appear in a separate publication. We discovered practices of road use to be powerful tools in the construction of space and sociocultural identity for each road user group.

The class took place in fall 2018. It included graduate and undergraduate students, from both anthropology and design backgrounds. The variety of perspectives, backgrounds, and experience levels contributed to the richness of collaboration among students.

This was the second time Wasson had partnered with Nissan Research Center - Silicon Valley to conduct a class research project. Cefkin led the collaboration efforts from Nissan, and Cesafsky worked closely with student researchers. Cesafsky initially met with students via videoconference, and subsequently visited us in Texas twice during the project. When Cesafsky discovered the quality and quantity of video data being collected by students on her first in-person visit, she requested that the final deliverables for Nissan take the form of videos, one for each road user group studied.

Road User Groups and Fieldwork Methods

Each of the road user groups – bicyclists, crossing guards, and solid waste truck drivers – were examined by their own research team of 2-3 students. Participants were recruited in North Texas. They were compensated for their participation (save for the solid waste truck drivers and some crossing guards, who could not accept compensation due to city policy) and given pseudonyms to protect their confidentiality. We had four to eight participants per user group, ranging in age, gender, ethnicity, and skill or experience level. It is important to note that the experience of study participants was shaped by the North Texas context, including infrastructure, culturally shaped driving practices and attitudes, and climate factors.

Our main research methods were interviewing study participants and observing them as they used the roadways. These general methods were adapted and customized to the particularities of each group. All

fieldwork was video recorded and transcribed. Figure 1 shows how many hours of video data we collected for each user group, and how many pages of field notes were produced. The field notes included interview transcripts, descriptions of observations, and researcher reflections on the fieldwork. Figure 1 demonstrates the intensive field engagement exhibited by the class in the short space of a semester.

Road User Type <input type="checkbox"/>	Hours of Video Data	Pages of Field Notes (Transcripts)
Bicyclists	7 hours 2 minutes	114
Solid Waste Workers	6 hours 35 minutes	83
Crossing Guards	2 hours 28 minutes	53
Interactants with Self-Driving Shuttle	3 hours 13 minutes	83
TOTALS	20 hours	333

Figure 1. Fieldwork Data by Road User Group

Cyclists

The first road user group examined was commuter cyclists, who were also a particularly vulnerable road population with very little protection between their own bodies and numerous tons of metal as they maneuvered the roads. Cyclists were recruited from across the North Texas area, ranging from Denton and Flower Mound to Fort Worth. While we specifically recruited cyclists who commuted to work or school, their motivations for cycling ranged from political/environmental, to simply enjoying the physical exercise. We found that they used the road differently depending on their past experience, riding style, and confidence of road use. For example, some of the more novice cyclists only traveled short trips and would avoid high volume intersections and traffic at all costs. Other more advanced cyclists rode special fixed gear racing bikes, were engaged in the local cyclist community, and had less fear of cars, sometimes even hitching a ride on one. We found most cyclists to be very passionate about their form of transportation, often having an emotional connection to it and feeling a sense of pride in their identity as a cyclist and a sense of social investment in the road spaces. A common thread among all cyclists was feeling generally unwelcomed by motorists on road spaces, and at times unsafe.

Researchers did “ride-alongs” with the cyclists by riding behind them on their own bicycle, with an action camera attached to their head or bicycle. Figure 2 shows one of our study participants as they were followed by a researcher. In one case, we gave the cyclist an action camera that they attached between their own handlebars. Through these techniques, we obtained footage that documented both the behavior of

cyclists and showed how other road users interacted with them. Cyclists were also interviewed both prior to and after their commute. The initial interviews were shorter, just to assess cyclist experience level, attitudes, and general information about their commute. The post-ride interviews were longer and explored in depth specific interactions with road spaces and users that had been observed during the commute.



Figure 2. *Cyclist on Her Commute*

Solid Waste Truck Drivers

The second of the three road user groups were solid waste truck drivers who worked for the city of Denton. In our interviews, we found that while they played a significant and vital role in the North Texas community, they felt largely unnoticed by most residents. Solid waste truck drivers displayed a distinctive outlook because they drove large machinery that could pose dangers to other road users, and often had to engage in emergency driving maneuvers to protect other road users from the consequences of their own erratic behaviors. In Denton, the solid waste department was characterized by long service among employees; our eight interviewees had work experience ranging from a couple of months to over twenty years of service. The department was characterized by a culture of care (Stayton and Cefkin 2018, 335). For instance, we shadowed a truck driver in a residential area who kept track of all the elderly residents, helping them manage their garbage needs even beyond what they asked for or what was required of his occupation. Figure 3 shows this driver at work. A truck driver whom we shadowed in industrial areas described the need to remain calm and not react when other drivers engaged in verbal abuse and provocative driving behaviors.

Researchers joined solid waste truck drivers for portions of shifts in their trucks, to observe their routes and see firsthand how other road users and members of the community interacted with them. Interviews were conducted inside the truck during the drive, providing an

opportunity for simultaneous interviews and observations. In addition, researchers conducted a focus group with four supervisors and managers and two newer driver hires in the solid waste department, to follow up on the observations and gain additional insights and stories from members of this road user group who had a long history of service and a managerial perspective.



Figure 3. Solid Waste Truck Driver in Residential Area

Crossing Guards

The third group were crossing guards, who played an important role at the intersection (quite literally) of traffic, pedestrians, and community. Crossing guards were recruited from Denton and Coppell independent school districts. These crossing guards, by contrast to solid waste truck drivers, had no machinery or protection between themselves and the road spaces. This was a population of people who were often perceived as a nuisance by motorists and other road users; however, they were physically putting their own bodies on the line to protect the children of the community on a daily basis. We also discovered crossing guards to have been important community members, similar to solid waste workers; they developed close relationships with those in the neighborhoods in which they worked, implementing and upholding a distinct culture of care (Stayton and Cefkin 2018, 335). However, often motorists would not treat them as an authority figure on the road, ignoring their signaling or trying to “sneak” around them, despite the authority that crossing guards possess, both legally and by building relationships with community members.

Crossing guards were joined on the roads by researchers during their before-school and after-school shifts, to see them in action and witness their routines. Figure 4 shows one of our study participants at work. Researchers conducted interviews and participant observations simultaneously both to see the crossing guards in action, and due to the brief nature of crossing guard shifts (only an hour or so at a time). As such, answers regarding how crossing guards interacted with motorists,

pedestrians, and other road users were simultaneously answered verbally as well as physically demonstrated as they carried out their jobs.



Figure 4. Crossing Guard at Work

Analysis and Preparation of Deliverables

The analysis process consisted of five major steps, visually represented in Figure 5. The analysis of fieldwork began with many weeks of class discussions. Each research team reported on the results of their fieldwork, and students brainstormed possible interpretations and insights about patterns. All ideas were noted in a Google Document that was organized into columns for instances, patterns, and recommendations. Some insights were organized by user group, and some cut across user groups. Over time, a set of consistent patterns emerged from this brainstorming process.



Figure 5. Steps in Analysis and Preparation of Deliverables

Students then developed codes for these patterns, and systematically coded their field notes/transcripts in Dedoose, in order to ensure rigorous and thorough analysis of the data. Dedoose is a cloud-based qualitative analysis application. In total, students created 86 codes, and applied those codes 1,986 times to 1,104 excerpts. Figure 6 shows a word cloud of the codes. Code names usually started with an abbreviation for the relevant road user group (such as XGRD for crossing guards), or ALL if they applied to all user groups. The most used codes were “Culture of Care” with 83 uses, “Selfish and Aggressive Driving” with 80 uses, and “Bad Behaviors” with 72 uses. These codes highlight a fascinating juxtaposition between the concern for others shown by some people in some contexts, and the apparent lack of concern exhibited by some people in other contexts.

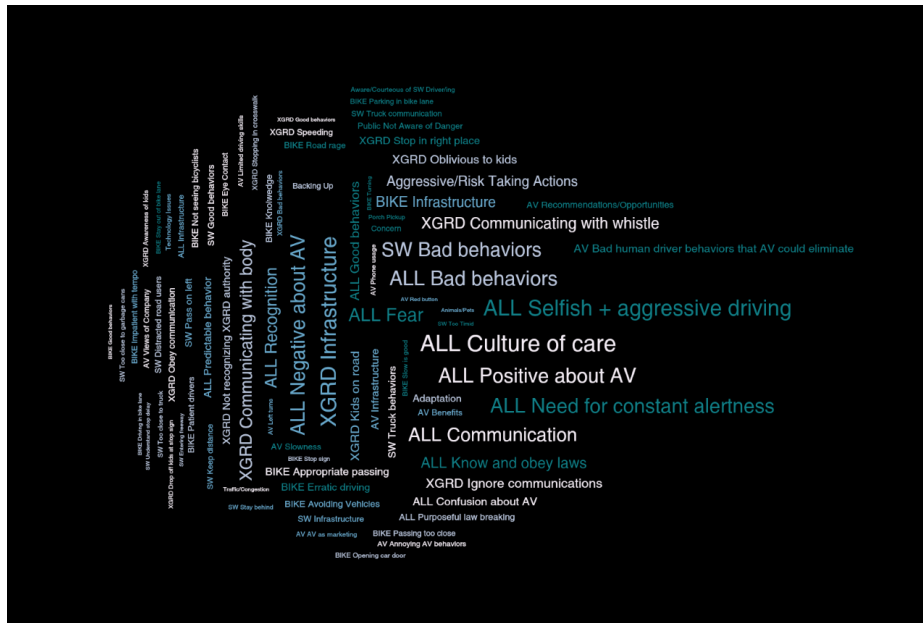


Figure 6. Word Cloud of Codes Used in Analysis

Students then used code reports generated by Dedoose to gain more nuanced insights into each pattern in the data. Through this process, each of the four research teams produced an analysis document that described insights and recommendations for their road user group. Next, since the client had requested deliverables in the form of videos, each research team translated their analysis document into a storyboard for a video. Finally, they created a video based on the storyboard. Each video used observations and interview excerpts to illustrate insights that had significant implications for autonomous vehicles' ability to interact successfully with the relevant road user group. The videos are publicly available on a Vimeo channel, <https://vimeo.com/channels/roadux>.

Further Analysis

Further analysis was performed after the course was finished. The authors of this paper continued to engage in analysis well into 2019, focusing on patterns shared across road user groups. We also conducted a further literature review. While the readings from the class provided a foundational knowledge of design anthropology and the ethnography of cars, our additional literature review provided a more nuanced theoretical lens through which to analyze findings.

Theme 1: Wish for Recognition and Understanding from Other Road Users

The most pervasive theme shared among all three road user groups was

their strong sense of not being understood by many of the other people they shared the road with. Each group identified navigational constraints particular to that group's uses of the roadway and forms of locomotion. These constraints had implications for how members of that group needed to be treated by other road users. Yet our interviewees had a sense that those constraints and their implications were often not recognized by their fellow travelers. This kind of invisibility produced dangerous situations. The roadway was therefore a contested space where a variety of user groups placed widely varying social constructions on a common physical infrastructure (Low 2000; Moore 1998).

Cyclists

When cyclists described their embodied experience of the roadways, they often contrasted themselves with car drivers. Cyclists navigated the roads in quite different ways from car drivers, due to the contrasting affordances and constraints of their vehicles. They moved much more slowly than cars. Bikes and their users also occupied much less space than cars and their drivers. It was harder for other road users to see bikes, due to their smaller size. In terms of their movement patterns, cyclists had much more difficulty accelerating from a stop to full speed than cars. Because of this, cyclists tended to avoid stopping whenever possible, often running stop signs. Cyclists could also use space more flexibly than car drivers - they could easily weave back and forth among the street, the sidewalk, parking lots, and so forth.

Cyclists displayed a strong sense of not being understood by other road users, and they linked this to fears for their safety. For instance, they wished that others would understand and accept their slower pace. They wanted to be recognized as road users whose presence on the road was equally as legitimate as car drivers. And they wanted others to understand their physical vulnerability and take care to prevent accidents. One issue often raised by interviewees was their tendency not to stop at stop signs. Susan explained this practice by saying *"I may not come to a full stop, because the amount of time I need to get started again may be super inconvenient to other people trying to use a four-way stop."* She wanted motorists to understand how difficult it is for everyone at the intersection to wait for a cyclist to stop and start again, especially considering the bike's top speed.

Probably the most basic concern expressed by cyclists was that other road users were often not aware of cyclists being present - cyclists were harder to see than cars, and many drivers were not trained to look for them. Whether drivers were approaching an intersection, changing lanes, or opening a car door while parked on the street, they might not see the cyclist until it was too late. But also, those road users might not have internalized a practice of checking their surroundings for cyclists.

All of the cyclists we interviewed expressed concerns about the attitude of some car drivers toward cyclists. Some of our participants described motorists who were bullying, aggressive, and downright hostile towards cyclists. They had encountered motorists who expressed the view that bikes do not belong on the road, when bikes negatively affected their speed and ability to maneuver. All of our interviewees brought up the dominance of the car in Texas culture (Lutz and Fernandez 2010).

One of the assumptions that seemed to be part of the local car culture was that bicycles were seen as vehicles for leisure activity, while motor vehicles were seen as utilitarian. A couple of participants noted they were treated differently depending on what they were wearing while riding. For instance, Susan said:

"But wearing clothes where I look like a commuter, I feel like cars are almost less aggressive than what I've noticed when I'm all spandexed up and have my kit on. I feel like for some reason cars can understand why I'm using my bike from point A to point B, but when I'm on the road because I want to be they're like 'What are you doing? Why are you here?'"

Our interviewees felt that car drivers sometimes had the perception that the road was primarily for cars and for non-leisure activities. Tommy also mentioned a bias triggered by how he looked:

"When you're carrying a bag, they just assume that you are going somewhere important, whether that's school, work. You're not out having fun for no reason, being in their way. You are on track to a destination. Whereas, I think when you are just in your cycling gear, and you look like you're not doing anything but riding a bike, they are a little bit more open to being rude or being assertive with their personality or their thought process at that time."

Study participants compared the car culture they experienced locally with other places they had visited. Those who came from or spent some time in bike friendly communities noted very different interactions with other road users. Susan said, *"I went to Colorado last year and the drivers were so nice... they were considerate, they would wait at a stop sign first because they knew it would take me more time to stop... The bike lanes were 4 to 5 bikes wide; it was amazing."* This quote highlights the greater knowledge and awareness that drivers in Colorado displayed regarding the particular navigational constraints of cyclists. At the other extreme, Denton-based Tommy described a nearby town as having an even stronger dominance of cars than Denton: *"It is even worse there, it's way worse to ride your bike. There is no bike infrastructure, cars are really rude, there's a lot of really angry drivers."*

Interviewees described Denton as being a town in flux with regard to residents' awareness of cycling. On the one hand, the city government had initiated quite a few bike-friendly initiatives in recent

years, such as bike lanes, bike racks, and bike sharing. Also, Denton was a university town and politically progressive. On the other hand, most longtime Texas residents were still not familiar with the needs of cyclists.

Furthermore, as the Dallas-Fort Worth metroplex continued to expand, Denton had gone from being a free-standing town to becoming one more piece of a large suburban area. This meant that Denton was experiencing an influx of people from other parts of the Dallas-Fort Worth area. Some of these people came from suburbs that had a stronger car culture than Denton. Susan said about people from the town mentioned above, with the angry drivers: *"So those people come here and they're not used to many cyclists nearby, so that sucks."*

All of our interviewees reflected on the bike lanes that the municipal Denton government had created in recent years. In theory, bike lanes would be a way to resolve the contradictions between car drivers and cyclists in their social constructions and uses of the road, by creating separate spaces for each group to navigate. In Denton, bike lanes were indicated with painted lines on the road; there were no physical barriers between car lanes and bike lanes. Bike lanes were only found on certain streets. Creating this cyclist-specific zone in the road could play an integral role in establishing the legitimacy of cyclists' use and presence on the road (Lefebvre 1991). The bike lane helped motorists understand that the road space was shared with cyclists, by visually and symbolically inscribing their presence on the road space.

Our interviewees described both positive and negative experiences with Denton's bike lanes. On the positive side, Tommy explained: *"I am not 100% for bike lanes, but I do feel like it will get more people out and about on their bikes if they do feel safer. Especially if here (gestures) we had a bike lane, I'm sure it would attract more people to use it."* Nathan noted that some cyclists felt more confident when using bike lanes: *"Yeah I feel a lot safer in them. Because, when I am in a bike lane, if anything happens to me, it's their fault, not mine. That's my mindset, at least and usually, there's like one or two other bikers in the lane too, so it's like strength in numbers. I feel a lot safer with other people."*

On the negative side, interviewees said that some bike lanes could be more of a danger than a blessing when designed incorrectly or misused by other road users. Participants mentioned instances where a bike lane forced cyclists to switch lanes across traffic. They also described bike lanes that stopped abruptly, jettisoning cyclists into heavy traffic without warning. Another major issue was that other road users often encroached on bike lanes. Participants noted that the lanes could become very dangerous when motorists parked in them, construction blocked them, or pedestrians or skateboarders misused or crossed them. In Video Example 1, Susan described these issues. Here is the text of what Susan said in the video:

"We have great bike lanes on campus going down Hickory. The issue is that there's no one stopping them (cars) from parking in the freaking bike lane so I've literally had to insert myself into traffic anyways, I've almost been 'doored' by people parking just outside of the bike lane then opening the door into the bike lane. Which if you've never seen a video of someone being 'doored', it's brutal. They'll hit the door and fly over it, land on their backs or on their heads."



Note: This and other embedded videos in this article will play on Adobe Acrobat Reader DC, but may not play on other PDF readers.

Video 1. Misuse of Bike Lane

Cyclists noted that a sure way to protect bike lanes would be the addition of a physical barrier separating bike lanes from car lanes. This type of infrastructure was often mentioned by interviewees when they described cities that were more bike friendly. While painted lines were a valuable symbolic statement, they did not provide the protection for cyclists that barriers would. For this reason, barriers would generate a very different embodied experience for cyclists, with a great reduction in anxiety. At the same time, they would remove much of the contestation for space that currently existed between car drivers and cyclists.

Solid Waste Truck Drivers

Solid waste truck drivers had very different navigational constraints from cyclists. They were perched in mechanical behemoths that weighed up to 6,500 lbs. when full, slogging through their daily routes. One of our participants, solid waste manager Bobby, stated, *"Garbage trucks have one speed: SLOW."* The trucks needed a lot of room to maneuver and could not change their speed quickly. Drivers displayed a high level of skill in how they manipulated their trucks, both in terms of driving the vehicle, and in terms of moving the mechanical arm to pick up trash cans and empty them over their truck's holding bin. They had internalized an intuitive

sense of the increasing weight of their trucks over the course of a run, and how that affected the truck's maneuverability.

Given the large size and weight of their vehicles, solid waste truck drivers did not have the physical vulnerability on the road that cyclists had. On the contrary, their immediate concern in case of an accident was focused on the vulnerability of other, less protected road users, understanding the harm such unforgiving weight and machinery could cause.

At the same time, solid waste employees did also encounter physical risks on the job. They might get run over by a motorist while collecting a can, picking up fallen trash or performing maintenance on a truck. They were *"quite likely to get beamed on the head, punched in the gut, or scored on the legs with a random assortment of blunt or sharp or jagged objects. Various toxic substances inside trash"* could "cripple or even kill" them (Nagle 2011, 26). The Federal Bureau of Labor Statistics noted that this line of work was one of the most dangerous jobs in the nation (Nagle 2011, 26). In Video Example 2, solid waste manager Jack explained some of the challenges of working around car drivers who "fly on by" without regard for the needs of the solid waste trucks. Here is the text of what Jack said in the video:

"A lot of times the bad thing is the customer will not even slow down or look, they'll just fly on by, speeding past these guys working. And then when throwing something in the back, something could bounce out or the guy could lose balance and step into traffic on accident. With these people flying by, there is a high possibility of someone getting hit or the car is going to get hit by an object bouncing out of the truck."



Note: This and other embedded videos in this article will play on Adobe Acrobat Reader DC, but may not play on other PDF readers.

Video 2. Drivers Who Fly on By

In our fieldwork, truck drivers' fears for themselves with regard to accidents were primarily focused on the danger of losing their job. Joe, a veteran solid waste worker, mentioned that unlike car drivers, solid waste truck drivers hold a CDL license. Any incidents that occur go against their certification; without the license they would be without a job. Our study participants valued their jobs and seemed to identify closely with the work. Employees in the Denton Solid Waste Department typically worked there for many years.

We observed and heard about many encounters between solid waste truck drivers and other road users that revealed clashes in how each group had socially constructed the space of the road. Car drivers and motorcyclists seemed to be imposing the norms of *their* navigational practices onto the truck drivers. When the trucks failed to follow these norms, other drivers became frustrated. For instance, motorists who found themselves behind a truck making frequent stops or driving slowly might resort to aggressive driving behaviors, such as passing too close or tailgating.

The solid waste truck drivers we worked with expressed a wish for other road users to understand the difficulty and logistics that went into operating such complex and dangerous vehicles, and to keep this in mind when interacting with them. Bobby expanded on the public's misjudgment of a truck's maneuverability: *"We have those vehicles that, they'll pass us and they will get right in front of us, and at that point when there is a sudden stop (shakes head), even with the brakes slammed, you know, the air break, we can't- it's almost like a train. We can't ever stop that whole load."* He also explained the truck driver's limited visibility: *"If you can see the driver in their mirror, they can see you. If you can't see that driver, he can't see you. So, you're hidden back there. And that's the number one thing that needs to change, is that they need to realize that they need to make contact with the driver. If you can't see him, they can't see you."*

Our study participants said that they wished for interactions on the road where the people they encountered displayed an understanding of the navigational constraints involved in driving a solid waste truck. John explained:

"Every now and then people do understand that you're out there, we got cans on the street, so, we have to stop and get the can right there, you're in their way. There are people that are nice about it. You know, right after you get done, you're on your way, they wave. It's nice to know that there are people out there that kinda understand what you're out there doing, you know. they're patient. People need to be more patient."

The road users that *"kinda understand what you're out there doing"* are those who don't impose their own navigational logic onto solid waste trucks. They understand that truck drivers experience the road in a

different way from car drivers, motorcyclists, or pedestrians.

Crossing Guards

While cyclists and solid waste truck drivers traveled along the paths of the roads, crossing guards traveled *across* the roads, at right angles to most road users. This immediately produced significant differences in their lived experience of the roads. Furthermore, they were on foot, while the other user groups we worked with traveled using a vehicle.

Crossing guards identified their mission as protecting children from cars when the children crossed the street to get to school, or head home from school. Crossing guards literally placed their bodies between the cars and the children in order to keep the kids safe. They communicated with approaching cars using gestures and hand-held stop signs; in theory, at least, their directions were supposed to be followed unquestioningly by car drivers, and even take precedence over posted road signs.

In the Video Example 3, Steve described the work practices of crossing guards. He noted their commitment: *"We're gonna get run over before they are."* Then, a car started to make a right turn while another crossing guard was attempting to cross children. The crossing guard put her sign up and placed her body between the car and the crosswalk, making the car stop halfway into the intersection. The children finished crossing the road before the crossing guard moved from her position and lowered her sign, signaling to the car that it could resume driving. Steve met the children to walk them across the following crosswalk.



Note: This and other embedded videos in this article will play on Adobe Acrobat Reader DC, but may not play on other PDF readers.

Video 3. *The Work of Crossing Guards*

The nature of the work crossing guards did made it likely that there would be clashes between their social construction of the road, and the

perceptions of car drivers. After all, their job was to stop cars to permit pedestrian cross-traffic, while many drivers implicitly seemed to regard the road as a venue that should privilege their own movement along the “grain” of the road. At the same time, crossing guards were in a highly vulnerable position, as they shared the road with vehicles weighing thousands of pounds.

While quite a few drivers ignored the directions of crossing guards, it seemed like their motivation might be more about prioritizing their own needs, rather than a failure to *understand* the crossing guards’ directions. Our interviewees felt car drivers often did not respect the authority and work crossing guards did. Problematic behaviors of car drivers included rolling through stop signs, taking illegal right on red turns, and aggressive or combative reactions to crossing guards and their instructions. Martha said: *“They stop while I have my sign in hand and I am pointing at them and the minute I turn... I turn my back they take off.”* Jordan gives us another example:

“But even though the stop sign [school bus retractable stop sign] is out. You can’t pass it and I have seen cars pass it and just go on in. So, you know I blow my whistle at them and I say, ‘Hey look at the bus.’ So, I stand out there so the cars can’t go across at all and some of them just wanna turn in here and them don’t wanna stop, you see it all the time I mean people come on.”

One of the challenges facing crossing guards was that they could not give traffic citations; they could only take license plate numbers and pass them on to law enforcement. They could also request the presence of police officers in a location with recurring incidents. Study participants told us that directions from the police were indeed accorded more respect than directions from crossing guards. Steve stated: *“We had a police officer and he was doing her (the crossing guard’s) job. There was nobody turning on red and nobody pulling out in the intersection.”*

Theme 2: Seemingly Selfish or Aggressive Driving

A second theme shared across all three road user groups was the perception that many car drivers engaged in selfish and aggressive behaviors. Of course, our study participants could not know what was actually going on in the minds of other drivers that caused them to engage in particular behaviors. We researchers also do not wish to make any claims about the motivations of drivers. However, what the study participants and the research team could do was observe how certain kinds of driving behaviors impacted other road users. The kinds of driving behaviors considered in this section are those that conveyed a sense to others on the road that the driver was putting their own needs above other road users.

While this theme came up in conversations with members of all three road user groups we worked with, we had particularly thoughtful conversations with crossing guards on this topic. They offered three kinds of explanations. First, drivers might be in a hurry. Second, drivers might be distracted by cell phone use. Third, drivers might be distracted by their own thoughts as they tried to manage the many pressures of their life. Martha was especially insightful in articulating this last phenomenon:

"Our world is very busy, and as I said we got the kids in the car, and we are just thinking about an hour, 5 hours, 2 days, a week away, of what we have to do and what we are behind on. We aren't thinking about that little girl walking there, or the kid on the bicycle. You know, they just aren't paying attention, their minds are someplace else."

For much of this quote, Martha's first-person pronoun use revealed that she was putting herself in the position of the distracted driver. Her switch to third person in the final sentence lets us know that she was stepping back and offering a concluding reflection about this pattern of car driver behavior.

The theme of perceived selfish or aggressive driving offers a lens onto the contestation of space among different road user groups (Low 2000; Moore 1998). Most often, the road users being categorized as selfish or aggressive were car drivers. The theme thus reveals how other road user groups, such as crossing guards, cyclists, and solid waste truck drivers, feel marginalized by car drivers, and treated by them as being less entitled to occupy the road. This in turn points to the dominance of car culture in the United States.

Cyclists

All of our cyclist participants described frightening experiences with aggressive car drivers on the road. Cyclists expressed that they did their best to stay out of the way of drivers to not cause conflict, but sometimes it was unavoidable. Car drivers would yell at cyclists, cut them off, and honk at them to get out of the way. Cyclists perceived that aggressive driving might be caused by impatience due to the cyclist's slower speed, or, as described in theme one, a broader lack of recognition of cyclists as valid users of the roadways.

Participants felt that their slower speed accounted for a lot of the angry motorists around them. Many car drivers seemed to be in a hurry. Sharing the road meant that motorists were constantly attempting to pass or get around cyclists. Cyclists felt like they were a burden to motorists because of this, but also felt that motorists could be a bit more patient with them. For one thing, cyclists couldn't always safely occupy the side of the road or bike lane. As previously mentioned, the bike lane was often

obstructed by parked cars, trash, and construction. Likewise, cyclists navigating narrow streets with parked cars tended to drive in the middle of the lane for fear of getting hit by parked vehicles suddenly opening their car doors. They typically preferred to be separated from traffic in bike lanes to avoid impatient drivers honking at them to move out of the way, but the current infrastructure made it difficult to always occupy the bike lane safely.

Cyclists regularly experienced situations where they were driven off the road or yelled at just for being there. One cyclist recounted a situation where he *“was riding home the other day, and the guy driving the opposite direction was mad at me for riding on the road. He like, threw his hands up and flipped me off. [laughs] For just being on the road, it was crazy!”* Encounters like these were common for cyclists and had the ability to escalate to a collision or violence.

Because cyclists were much more vulnerable to injury than car drivers in the case of a crash, they perceived aggressive drivers as dangerous and frightening. To protect their safety, most of them tried to keep a distance from car drivers when possible. Nathan, who was a beginner cyclist, said, *“I’ll always let all the cars go before I do, so I’ll sit at a stoplight and let all the other cars go before I go. Because I am afraid that someone will go, and they’ll just run through and kill me!”* Beyond the risk of physical injury, cyclists also encountered what might be termed emotional violence or trauma, when car drivers honked at them or subjected them to verbal abuse.

Solid Waste Truck Drivers

Encounters with seemingly aggressive and selfish drivers were among the most dangerous situations that solid waste truck drivers faced in their daily work. Drivers proactively planned their daily routes to avoid situations that might foster this type of negative driving behavior, such as rush hour, construction, and morning delivery congestion. Still, they, like other road users, could not fully avoid interactions with such drivers.

One group of driving behaviors that presented a threat to solid waste workers were actions that ignored the needs and constraints of solid waste truck drivers. They included blocking trash/recycling cans by parking in front of them or by parking too close, not letting solid waste trucks merge into traffic, or abruptly stopping in front of a truck. A good example to illustrate this came up during a group interview with veteran solid waste managers. In Video Example 4, Jack tells this story of the days when he was driving a tractor trailer, but it also applies to solid waste trucks’ handling. Here is the text of what Jack said in the video:

“A citizen missed their exit. So, they stopped, to a complete stop in the lane and turned their blinker on. And they were just a little bit

past the exit, so I'm in this, I'm in a tractor trailer at that point, I'm 80,000 pounds, and I almost hit him, and I was lucky to stop and my load didn't collapse on me... I guess they're just waiting for me to go around them. Well it's a two-lane highway and cars are doing 70 miles an hour past me."



Note: This and other embedded videos in this article will play on Adobe Acrobat Reader DC, but may not play on other PDF readers.

Video 4. *Danger from Car Abruptly Stopping in Front of Truck*

The embodied experience of this former truck driver was grounded in his awareness that a large truck cannot stop suddenly. There are physical constraints on its stopping distance. For experienced truck drivers, their trucks almost seem to become an extension of themselves when they are on the road - they instantly react to emergencies like this without needing any time to plan their actions. Their arms and legs engage appropriately with the complex controls of the truck, and their awareness shifts into crisis mode. As Jack told this story, we could see him vividly relive his great fear of not being able to stop in time.

Another group of driving behaviors that presented a threat to solid waste workers were risk-taking actions. These included tailgating, cutting off a truck on the inside of a right-hand turn, passing in unsafe areas, and confrontational interactions or road rage directed at solid waste truck drivers. For instance, solid waste manager Joe gave this example:

"He was coming past me, doing 80 mph, there was a car coming. I really thought that him and that car were going to collide, going to hit head on. Of course, I would have been in it too because there is no place to go, it's evasive driving. We try to go the speed limit, apparently there is no speed limit for a lot of people these days."

An additional example of aggressive driving behavior was captured while doing observations in the field. Video Example 5 shows a motorcyclist

passing the solid waste truck impatiently in a congested residential area. It also includes some comments from the truck driver, John, afterwards, about the wisdom of giving aggressive drivers like that space: “Just let ‘em go through and stay away from that situation.” Motorcyclists were mentioned by multiple participants as disproportionately engaging in risky driving behaviors around solid waste trucks compared to other drivers.



Note: This and other embedded videos in this article will play on Adobe Acrobat Reader DC, but may not play on other PDF readers.

Video 5. *Motorcycle Aggressively Passing*

As this video shows, risk-taking behaviors were particularly dangerous in that they put not only the drivers in danger but also others around them. As mentioned in the previous theme, solid waste drivers were fully aware of the potential dangers the truck could cause to the public around them. This perspective was developed through rigorous training, the industry's collective memory, and personal experience (Nagle 2013, 136).

Crossing Guards

Although the crossing guards made thoughtful observations about the possible causes for seemingly selfish and aggressive behaviors of car drivers, as described at the start of this section, they nonetheless experienced a great deal of frustration from such behaviors. Common actions of car drivers included inching forward into an intersection despite the crossing guard either standing in the way or clearly signaling for the driver to stop. More extreme instances included motorists simply running through lights or making turns contrary to the crossing guards' signals.

These behaviors endangered the safety of the crossing guards and the children they were overseeing. Crossing guards, as authority figures, possessed varying levels of social influence and local authority. As such, crossing guards had to assess each situation and learn to calculate several

steps ahead, thinking about how to best position themselves to keep traffic flowing and keep the children safe even if cars did not heed their warnings.

When asked what she thought about her duties as a crossing guard, Jordan said,

"I had my stop sign up and he didn't stop and I had to push my kids out of the way. I had my stop sign up and they were coming and I seen she wasn't going to stop so I had to I push my kids out of the way. And a parent was there too and she saw it. It's kind of dangerous because traffic doesn't want to slow down you know even when you are in a school zone. They still don't go the 20 [miles per hour speed limit]. So you really got to watch your traffic and knowing if they are going to stop or not even when you are out there. It's really dangerous that they don't stop. If that was there kid, they wouldn't want that. It's my duty and my responsibility to keep my kids safe. I treat them just like I would treat my own. I don't wanna do them harm."

This is an illustration of the general disregard for authority and communication from crossing guards. Sometimes this disregard manifests as speeding in a reduced speed limit school zone and sometimes it is inching into an intersection against the signage of the crossing guard. All five of the crossing guards we interviewed identified this type of experience as a regular concern.

Theme 3: Unpredictable Behavior

The final theme shared among all three of the road user groups we worked with was that many study participants expressed a wish for more predictable behavior from those they shared the road with. They described this wish in interviews, and during our observations, we regularly saw study participants being surprised by the actions of other road users. This theme builds on the two previous themes. There were several reasons why behaviors of other road users might appear unpredictable and unexpected to our study participants:

- Building on theme 1, sometimes an action was surprising because the study participant was not familiar with the cultural logic of the road user group that the other road user belonged to, or vice versa
- Building on theme 2, sometimes an action was surprising because the other road user did not follow laws or signage
- Similarly, there could be cases where the other road user wasn't fully paying attention to the road around them
- The restricted communication affordances of vehicles often made it hard for a driver to clearly communicate her intentions to others on the road

Because of the unpredictability of other road users, the embodied experience of navigating roadways was often described by study participants in all three groups as one of constant monitoring, anxiety, and fear. Interviewees felt that they needed to be in a constant state of alertness. While each road user group we worked with had different reasons for feeling endangered, that feeling was shared across all three groups. The embodied experience of crossing guards and cyclists on the road was one of great physical vulnerability to motor vehicles. Solid waste truck drivers, maneuvering their giant vehicles like prosthetic extensions of themselves, were deeply afraid of injuring people in cars, cyclists, or pedestrians. Their fear was due both to concern for others and to the danger that they could lose their job if they were guilty of hitting someone.

Road users' wish for predictability cross-cut their wish for courteous behavior in interesting ways. There were contexts in which seemingly selfish or aggressive driving by other road users was experienced as the norm. In those contexts, unexpectedly polite behavior might actually cause confusion and anxiety due to the need to quickly recalibrate one's own behavior in response. Thus, even aggressive driving might have advantages when it was predictable, and polite driving might be problematic when it was unexpected.

Cyclists

For cyclists, there were two significant reasons why unpredictable behavior from motorists occurred. First, depending on the city's bicycle infrastructure and culture, the lack of knowledge of bicycle behaviors caused cars to behave unpredictably. Second, cyclists and motorists didn't have solid strategies of communication, making for complicated situations like cars passing cyclists too closely.

As a side note, cyclists' flexibility on the road and the shifts between acting more like a pedestrian and more like a motorist made for a set of unpredictable behaviors on their end as well. Cyclists often cut through parking lots or onto the sidewalk, rolled through stop signs, and disobeyed signage and markings on the road. Tommy admitted, *"Cyclists don't always follow all the traffic laws, myself included. On my commute, there are stop signs I won't stop for, especially at four-ways."* From a motorist's perspective, these unpredictable behaviors from cyclists could cause uncertainty.

The unpredictability in the world of cyclists was highly dependent on infrastructure and place. The behaviors and experiences cyclists had on the road were contingent on the role that the road gave them. One of our participants, Susan, reflected on the ways that city infrastructure could drastically change the experience of cycling. Here she talked about her visit to Colorado.

"It was so awesome, that was in Colorado Springs. I was blown away because the week before I was on a group ride [in Texas] when we were on a narrow road and a truck tried to drive five people off the road and successfully knocked a person down and then stormed off and almost hit someone. And so it was such a stark contrast. I think that Texas just isn't there yet."

Variations in bicycle infrastructure informed drivers' perceptions and knowledge of cyclists' behavior on the road. Urban centers with prominent bike infrastructure, such as bike lanes protected by a barrier, separated cyclists from cars, leading to less interaction and conflict. In areas without extensive bike infrastructure, cyclists were expected to share the road with cars, and/or stay to the right side of the road unless crossing intersections. These variations in infrastructure shaped the level of unpredictability that cyclists faced. Areas in which cyclists were required to share the road with cars could cause problematic behaviors in which cars were unsure how to navigate around cyclists, leading towards ambiguity and confusing behaviors.

Cars passing too closely was an issue that most of our participants mentioned. It was difficult for cyclists to know how close a motorist was going to pass them. Our participants said that ideally, there should be a distance of at least six feet between the vehicle and the bicycle when passing. Our participants also noted that motorists who might not have experience being passed by cars at fast speeds did not consider that passing closely startled the cyclist, and that, as Susan said, *"A lot of cars don't understand how much wind there is [as] a result of them passing even within three feet of you."*

The concern of passing distance stemmed from a lack of explicit communication between cyclists and motorists. Especially since cyclists had their backs turned to cars coming up behind them, communication was made through subtle movements on the road. In Video Example 6, Tommy was riding on the shoulder of a two-way street with a camera mounted to his handlebars. The clip shows three different cars passing at varying speeds and distances. In order to pass at a safe distance, the first car entered the opposite lane. When the second car was about to pass, two cars approached from the opposite direction. The car closely passed the cyclist anyway, trying to give space while staying in the lane. A third car passed in a similar fashion to the first. We can draw on conversation analysis studies of how road users offer space to each other through movement and gestures to understand the behaviors in these videos (Haddington and Rauniomaa 2014). In the position the cyclist was in, communication was made by moving closer to the side of the road and slowing down a bit, while the three motorists tried to keep their distance when passing. In this instance, even though the two parties were unable to make eye contact to more directly communicate, they offered each other space where they could.

While it can be difficult to predict how close a car might pass, the cyclist utilized embodied habits (hearing cars approach from behind) and quick space offerings to prevent conflict. This is how predictability was partially mediated between motorists and cyclists. Cyclists would still prefer to know that a car would not pass them too close.



Note: This and other embedded videos in this article will play on Adobe Acrobat Reader DC, but may not play on other PDF readers.

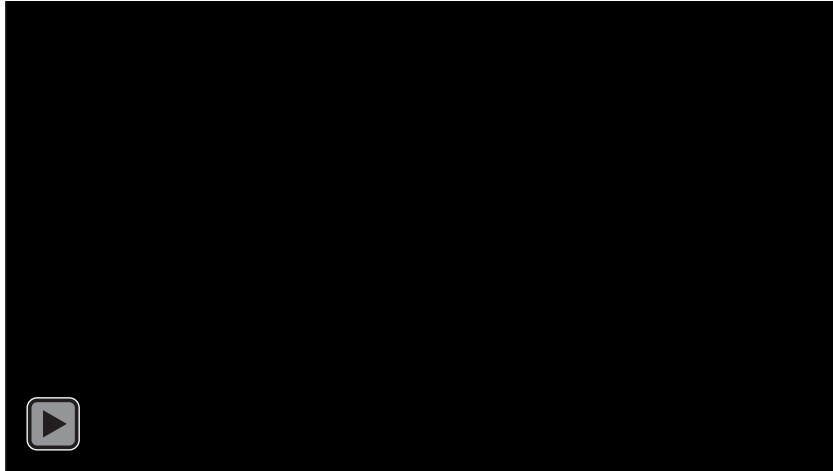
Video 6. Cars Passing a Cyclist

Solid Waste Truck Drivers

Solid waste employees wished for other road users' predictable behavior to keep themselves and the community safe from their trucks. Unpredictable behavior from other road users could easily lead to accidents. They were particularly concerned about drivers who seemed distracted or reckless. One positive attribute that the trucks were afforded was their height. Solid waste workers were able to see more of the roadway than other cars, allowing them to survey the road and detect drivers who were on their phones or otherwise prone to unpredictable behavior.

Video Example 7 illustrates the issue of unpredictable driving through a series of clips from various participant interviews. The first clip features Jerry talking about how he often is navigating around drivers who are "*distracted driving, texting over here, trying to apply makeup here, trying to eat over here, so you really gotta watch out for everybody.*" In the second of the recorded clips, Reid recounted a situation where a distracted driver was on their phone and crashed into the back of their garbage truck. In the last two clips, two participants both bring up the issue of cars texting and driving, especially at stop lights. It is crucial for active communication between solid waste drivers and cyclists to avoid ambiguous situations. When drivers are on their phone, they are unable to take part in space-offering negotiations with solid waste drivers and

are otherwise prone to close calls and accidents. Navigating around distracted drivers was a shared concern among our solid waste worker participants, as their livelihood and the safety of their community are on the line.



Note: This and other embedded videos in this article will play on Adobe Acrobat Reader DC, but may not play on other PDF readers.

Video 7. *Examples of Distracted Driving Encountered by Solid Waste Truck Drivers*

Despite the diversity of practices that existed among road users and solid waste employees, each driver was aware of the intricacies of their routes and knew what to expect from road users in those areas. Navigating the same route each week afforded a comfort with the road itself, in which the driver could focus on paying attention to road users rather than navigating an unknown route. Being aware of the behavioral norms within a certain area or road type was also important. Motorists' behaviors were often informed by variations in road infrastructure, geography, and related factors. Solid waste workers adapted to their surroundings by mapping out their route and noticing patterns in the behavior of the residents in the neighborhood and surrounding areas. In this way, solid waste workers produced a social space wherein they could predict certain patterns and behaviors for more foreseeable driving conditions.

Crossing Guards

Crossing guards were on constant alert for unpredictable behavior from both motorists and children. When cars were in a rush or not paying attention to signage and speed limit signs, crossing guards had a hard time predicting their actions. Crossing guards were also cognizant of the unpredictable behavior of children who would run out into the street.

When cars didn't follow general road rules and crossing guard's orders, their behavior became unpredictable and potentially dangerous. Crossing guards recounted instances of motorists making right turns at stop lights while children were crossing, disobeying school zone speed limits, and ignoring the crossing guard's directions. One of our participants recounted a situation where a car ignored her stop sign and sped past her, so she had to push the children out of the way. Crossing guards didn't always know if a car was going to stop or not, even when they held their stop sign up. Motorists also often disobeyed school zone speed limits, presumably in a rush to work or due to other distractions. This unpredictability caused crossing guards to be on constant alert, and could cause safety threats to the crossing guard, the children, and even other motorists at the intersection.

In Video Example 8, Martha talks about unpredictable behavior coming from parents dropping their kids off at school. She says that sometimes parents will suddenly let their kids exit the vehicle at a crosswalk intersection, rather than drive to the designated drop off zone at the school. Martha fears that motorists may not see a small child in the middle of the street, especially when they expect the car to turn.



Note: This and other embedded videos in this article will play on Adobe Acrobat Reader DC, but may not play on other PDF readers.

Video 8. Cars Letting Out Children

Our participants believed that many motorists don't consider the unpredictability of children. The crossing guards told us that children would sometimes run out into the street if they saw a crossing guard or try to cross the street themselves if the crossing guard was not present. A motorist at an intersection might not notice a small child running into the street, especially if the crossing guard was not actively guiding children across the crosswalk. Martha explained that *"if they see me in the street, they keep running,"* referring to children who run from the sidewalk into

the road. If a car driver was not paying attention, they could pull out and accidentally hit the child. The unpredictability of both children and motorists in these intersections made it difficult for crossing guards to do their jobs.

Design Implications for Autonomous Vehicles

The design implications of our research emerged gradually over the course of the semester, through weekly class discussions. Our understandings were shaped by fieldwork, analysis, interactions with Cesafsky and Cefkin, and readings about AV. Ideas that emerged during class discussion were captured in the Google Document that we maintained for that purpose. This document was organized into three columns: Instances, Patterns, and Recommendations. The structure helped students conceptually link ethnographic examples to patterns across examples, and patterns to design implications. Every week we would add to the document and modify previously noted ideas, as our insights developed further.

Design implications for each individual road user group were provided in the videos that constituted the class's client deliverables (available at <https://vimeo.com/channels/roadux>). In this section, we focus on design implications that cut across road user groups. The findings described in this article led to four kinds of design implications for the development of autonomous vehicles.

The Advantages of Programmed Behavior

Some of the problematic road user behaviors identified in our study will be eliminated through the fundamental logic and characteristics of autonomous vehicles. For instance, the problems of selfish and aggressive driving described under theme 2 will be addressed by AVs being programmed to follow road laws and signage. An important advantage of AVs is precisely that the whole issue of emotions interfering with driving skills will go away. Presumably AVs will *not* be prepared to help passengers who are running late by engaging in risky driving behaviors.

AVs will also address the concerns around unpredictable behaviors described under theme 3 by being much more predictable road users than humans are, due to their law-abidingness. When asked about their thoughts on autonomous vehicles on the road, Don said, "*If I was in a garbage truck and I had nothing but automated cars moving around me, it would be awesome. Because I wouldn't have to worry about 'Oh I'm gonna back up and hit this person' or send some signals to somebody that 'Hey you passed me when you shouldn't have'...*" Autonomous vehicles could alleviate the stress of not knowing how a car might behave. The solid waste worker would have confidence that if they are backing up, an

automated car behind them will recognize the behavior and act predictably.

Of course, we expect that AVs might be programmed to deviate slightly from laws, for instance one could imagine enabling them to drive a few miles faster than the posted speed limit. The specifics go beyond our own expertise. But we expect that AVs will not deviate greatly from the law.

Provide AV with Detailed Knowledge of Road User Groups

Other problematic road user behaviors identified in our study will only be mitigated by AVs if they are intentionally and strategically programmed into the AVs. Each road user group have their own set of realities within their constructed spaces, which are often met with contested perceptions of those spaces. Misunderstandings of how road user groups interpret each other's assumed spaces leads to dysfunction and confusion. Autonomous vehicles must be aware of these realities to avoid conflict.

In particular, we recommend that AVs be programmed with detailed knowledge of our three road user groups, to address their need to be understood as described in theme 1. As a start, it would be good if AVs could recognize a particular road user as a member of the solid waste, crossing guard, or cyclist category. Then they could access knowledge of that group's particular characteristics and needs. Some of this knowledge could be input when an AV is made road-ready; knowledge particular to a geographic region or town might be added later.

For instance, for solid waste trucks, the AV should know to:

- Keep a safe distance
- Allow turning room
- Not block the path to trash containers

For crossing guards, the AV should know to:

- Follow the directions of the crossing guard
- Understand that those directions take priority over posted signs
- Be on the lookout for kids

For cyclists, the AV should know to:

- Give them room for passing
- Yield to cyclists at intersections when safe to do so
- Treat them with special care in light of their greater physical vulnerability than cars

A more expansive list of ways that AVs should be able to interact with cyclists is provided in the "Bicyclists' Manifesto for an Autonomous Vehicle Future" (Riggs and Boswell 2016).

AVs Must Be Prepared for Unpredictable Behavior

As described in theme 3, the unpredictable behaviors of other road users were a significant concern for all of our study participants. The potential for such behaviors required them to maintain a state of constant alertness. At the same time, study participants had learned to identify patterns in the unpredictability that road users exhibited. For instance, a crossing guard could not know whether a particular car would attempt to slide through a crosswalk without permission, but the crossing guard did know that this was a recurrent behavioral pattern, and they had developed ways to deal with it. In the same way, AVs should be provided with knowledge of common patterns of unpredictable behavior, to assist them in evading potential dangers. It might make sense to specify the unpredictable behaviors by user group and by road context (e.g. a behavior seen mainly in the context of an intersection).

Have an AV Communicate at Moments of Ambiguity and Potential Danger

Finally, our study participants' wish for predictability in road users also has implications for communication. Even though AVs are expected to adhere more or less to road laws, there will still sometimes be ambiguity about an AV's planned actions. It would be highly reassuring to all three of the road user groups if AVs could communicate their plans at moments of potential danger to those groups.

We will not attempt to make specific recommendations about the design of such communications. There are obviously many options, both visual and auditory. We do want to remind designers that for cyclists, visual communications are only useful when the AV is in front of them; they cannot see behind them when they ride.

Conclusions

In terms of the impact our project may have on our clients, Cesafsky wrote "I would say that the research renewed and strengthened our conviction that we need to really understand the experience of a diverse road users in an ethnographic way in order to be able to create future AVs that can truly do better by those users." Cefkin added, "You stated it perfectly. I know I indeed continue to draw on the work generally as a way of reminding of commitments to diverse road users." While it is rarely possible to document the precise impact of ethnographic research at the "fuzzy front end" of the design process (Wasson and Squires 2012), it is encouraging that the User Experience Team at the Nissan Research Center – Silicon Valley is keeping our research findings in mind in their ongoing collaborations with designers of autonomous vehicles.

At a conceptual level, many of the challenges crossing guards,

solid waste truck drivers, and cyclists encounter on the road can be understood as contestations of space between the ideologically dominant road user group, car drivers, and other groups that are comparatively marginalized. As described in the first section of the article, the dominance of car drivers emerged over the last century through a series of technological inventions, corporate public relations efforts, and government policies.

In recent years, however, we may be seeing a shift away from the dominance of cars, as evidenced by movements such as the New Urbanism, Complete Streets, and Critical Mass (a cycling movement) (Udvarhelyi 2009; Wray 2008). As AVs start to populate the roads, how will they affect the politics among road user groups? We envision at least three possible trajectories, each of which has different implications for how AVs will interact with other road users:

- Cars with human drivers will remain dominant on the road
- AVs will become dominant on the road
- AVs will stimulate urban planning efforts that encourage more egalitarian uses of the road

A recent report by the American Planning Association titled *Planning for Autonomous Mobility* described the potential for this third possibility: “While the private automobile yielded a 20th century dominated by suburban expansion, this report makes the case that AV technology has the potential to support and promote urban (re-)development for the next century” (Crute et al. 2018, 5). The recommendations included:

Planners must rethink the right-of-way for alternative modes, recognizing that AVs offer an opportunity to “right-size” roads at the human scale. Building upon the complete street’s movement, in the longer run AVs offer the potential for aggressive road diets that reallocate space previously used for automobiles back to human-powered and active travel modes. Communities should prioritize these modes in their comprehensive and general plans and begin to experiment with new roadway typologies that provide accommodation to these modes. Right-of-way reallocation also holds the potential to provide new space for green infrastructure, public gathering places, and other features that can help achieve various community goals (Crute et al. 2018, 4).

In other words, the American Planning Association promotes a vision for the future in which the road will return to its earlier state as being a space that multiple road user groups, including pedestrians and cyclists, have an equal right to use. We encourage corporations developing AVs to support this vision.

Roads have been contested spaces since their inception: they have been argued over and shared by conflicting groups since before automobiles even existed. At every turn in history, roads have been shaped by human action, and will continue to be. The imminent

relationship between human motorists and autonomous vehicles could bring new and profound conflict. But perhaps, if AVs are designed with human interactants in mind, contestation can shift to understanding and collaboration.

References

- Bourdieu, Pierre, trans. Richard Nice. 1977. *Outline of a theory of practice*. Cambridge: Cambridge University Press.
<https://doi.org/10.1017/CBO9780511812507>
- Crute, Jeremy, William Riggs, Timothy S. Chapin, and Lindsay Stevens. 2019. *Planning for autonomous mobility: PAS Report 592*. Chicago: American Planning Association.
- De Certeau, Michel, trans. Steven Rendall. 1984. *The practices of everyday life*. Berkeley: University of California Press.
- Friedel, Robert. 2007. *A culture of improvement: Technology and the western millennium*. Cambridge: MIT Press.
- Haddington, Pentti and Mirka Rauniomaa. 2014. "Interaction between road users: Offering space in traffic." *Space and Culture* 17(2):176-190.
<https://doi.org/10.1177/1206331213508498>
- Hitchcock, Louise A. 2008. "Henri Lefebvre." In *Theory for classics: A student's guide*, 180-184. London: Routledge. <https://doi.org/10.4324/9780203932919>
- Ingold, Tim. 2000. "Chapter 13: To journey along a way of life: Maps, wayfinding and navigation." In *The perception of the environment: Essays on livelihood, dwelling and skill*, 219-242. London: Routledge.
- Kunstler, James Howard. 1993. *The geography of nowhere: The rise and decline of America's man-made landscape*. New York: Simon & Schuster.
- Kuper, Hilda. 1972. "The language of sites in the politics of space." *American Anthropologist* 74 (3): 411-25.
<https://doi.org/10.1525/aa.1972.74.3.02a00130>
- Lefebvre, Henri, trans. Donald Nicholson-Smith. 1991. *The production of space*. Oxford: Blackwell.
- Low, Setha M. 2000. *On the plaza: The politics of public space and culture*. Austin: University of Texas Press.
- Low, Setha M. 2009. "Towards an anthropological theory of space and place." *Semiotica* 175 (1/4):21-37.
<https://doi.org/10.1515/semi.2009.041>
- Low, Setha M., and Denise Lawrence-Zúñiga. 2003. *The anthropology of*

- space and place: Locating culture*. Malden, MA: Blackwell Publishing.
- Lutz, Catherine, and Anne Lutz Fernandez. 2010. *Carjacked: The culture of the automobile and its effect on our lives*. New York: Palgrave Macmillan.
- McIlvenny, Paul, Mathias Broth, and Pentti Haddington. 2014 "Moving together: Mobile formations in interaction." *Space and Culture* 17(2):104-106. <https://doi.org/10.1177/1206331213508679>
- Moore, Donald S. 1998. "Subaltern struggles and the politics of place: Remapping resistance in Zimbabwe's eastern highlands." *Cultural Anthropology* 13 (3): 344-81. <https://doi.org/10.1525/can.1998.13.3.344>
- Nagle, Robin. 2013. *Picking up: On the streets and behind the trucks with the sanitation workers of New York City*. New York: Farrar, Straus and Giroux.
- Oatman-Stanford, Hunter. 2014. "Murder machines: Why cars will kill 30,000 Americans this year." Blog post in *Collectors Weekly*. Available at <https://www.collectorsweekly.com/articles/murder-machines/>.
- Putnam, Robert D. 2000. *Bowling alone: The collapse and revival of American community*. New York: Simon & Schuster. <https://doi.org/10.1145/358916.361990>
- Riggs, William, and Michael R. Boswell. 2016. "The Bicyclists' manifesto for an autonomous vehicle future." *Planetizen*, September 23. Available at <https://www.planetizen.com/node/88564/bicyclists-manifesto-autonomous-vehicle-future>.
- Sivak, Michael, and Brandon Schoettle. 2014. "Recent decreases in the proportion of persons with a driver's license across all age groups." *Traffic Injury Prevention* 15: 6-9. <https://doi.org/10.1080/15389588.2013.839993>
- Smart Growth America 2019. "Complete Street policies nationwide." Accessed September 29, 2019. <https://smartgrowthamerica.org/program/national-complete-streets-coalition/publications/policy-development/policy-atlas/>
- Stayton, Erik, and Melissa Cefkin. 2018. "Designed for care: Systems of care and accountability in the work of mobility." *2018 Ethnographic Praxis in Industry Conference Proceedings*:1-16. <https://doi.org/10.1111/1559-8918.2018.01211>
- Udvarhelyi, Éva Tessza. 2009. "Reclaiming the streets — Redefining democracy: The politics of the Critical Mass bicycle movement in Budapest." *Hungarian Studies* (23): 121-145. <https://doi.org/10.1556/HStud.23.2009.1.9>
- Vivanco, Luis. 2013. *Reconsidering the bicycle: An anthropological perspective on a new (old) thing*. New York: Routledge. <https://doi.org/10.4324/9780203584538>

Wasson, Christina. 2000. "Ethnography in the field of design." *Human Organization* 59(4):377-388.

<https://doi.org/10.17730/humo.59.4.h13326628n127516>

Wasson, Christina, and Susan Squires. 2012. "Localizing the global in technology design." In *Applying anthropology in the global village*, edited by Christina Wasson, Mary Odell Butler and Jacqueline Copeland-Carson, 251-284. Walnut Creek: Left Coast Press.

Wray, J. Harry. 2015. *Pedal Power: The quiet rise of the bicycle in American public life*. London: Routledge. <https://doi.org/10.4324/9781315632896>

Sarah Stutts is a Master's Candidate in Applied Anthropology at the University of North Texas. She has interests in design anthropology, user-centered research, and consumer insights with experience in qualitative market research. She is endlessly fascinated by roads as cultural spaces and has completed a number of research projects concerning road use, ranging from projects for UNT's department of transportation, to research for the city planner of Denton, Texas. For more information, see <https://sarahstutts.wixsite.com/website>.

Kenneth Saintonge is a Master's Candidate in Applied Anthropology at the University of North Texas. He is interested in the intersections of design, digital and material culture, and identity. He received a Bachelor's in Visual Arts from Eastern Connecticut State University, with concentrations in Studio Sculpture and Art History. He has been involved with community and public outreach through various organizations that promote local artistic and cultural development. Presently volunteering with the Texas Parks and Wildlife Department as an AmeriCorps VISTA, he is focused on community resource development, outreach, and visitor experience.

Nicholas Jordan earned his Bachelor's in Anthropology at the University of North Texas in the fall of 2018 and will be returning in the fall of 2019 to continue with a Master's in Applied Anthropology. He is interested in the anthropology of design and technology and hopes to conduct applied research relating to human-centered design. Nicholas currently works as an intern for Cultural Awareness International, which facilitates intercultural trainings and relocation services for organizations.

Christina Wasson is Professor of Anthropology at the University of North Texas. She was trained as a linguistic anthropologist. After finishing her Ph.D., she worked for E-Lab, a design firm that used anthropological research to develop new product ideas. Here she developed an interest in the emergent field of design anthropology. Christina was a founding member of the Ethnographic Praxis in Industry Conference (EPIC) Steering Committee. At UNT, Christina teaches a course in design anthropology that prepares students for careers in this field. Clients for class projects have included the Nissan Research Center – Silicon Valley, Motorola, Microsoft, and the Dallas/Fort Worth International Airport. For more information, see <https://www.christinawasson.com>.

Acknowledgements

We are deeply grateful to all of our study participants for generously sharing their time and their thoughtful reflections and insights. We also wish to express our appreciation to the City of Denton for enabling our interactions with their solid waste workers and crossing guards, and to the Coppel Independent School District for enabling our interactions with their crossing guards. Finally, we wish to thank Melissa Cefkin and Laura Cesafsky from the Nissan Research Center – Silicon Valley for giving us such a wonderful learning opportunity.