



Transportation Institute

North Carolina Agricultural and Technical State University

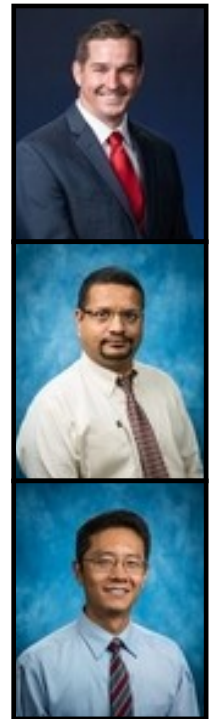
New CATM-Sponsored Research Projects

Modeling Future Outbreaks of COVID-19 Using Traffic as a Leading Indicator

The movement of people is inherently connected to the spread of viral diseases. Infected individuals expose others as they travel between home, work, school, shopping, recreation and other daily necessary destinations. Understanding the relationship between social and economic activity and the spread of COVID-19 could prove valuable in reopening and helping prevent spread in the future.

Unfortunately, some states that were the first to reopen experienced spikes in COVID-19 cases. For example, Florida, which entered phase one of the reopening process on May 18, 2020, recorded significant increases in the daily number of COVID-19 cases approximately two weeks later. By June 9, the state was experiencing the highest single daily increases in positive cases since the start of the pandemic.

Prior research has shown that drastic changes in human behavior can be measured using highway volume data as a representation of personal activity. It would appear that increases in highway traffic might be a leading indicator of where and when outbreaks of COVID-19 are likely to occur. A team at Embry-Riddle Aeronautical University (ERAU), Daytona Beach, Florida, consisting of Scott Parr, Ph.D. (lead), assistant professor in the College of Engineering; Sirish Namilae, Ph.D., associate professor of aerospace engineering; and Dahai Liu, Ph.D., professor in the College of Aviation, started researching and tracking this information in November of 2020. *right from top: Scott Parr, Sirish Namilae, Dahai Liu (continued on page four)*



Mask-Wearing Behaviors in Air Travel During the Coronavirus Pandemic – An Extended Theory of Planned Behavior Model

Fall 2021 Issue

New CATM Research Projects

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Virtual Summer Transportation Institute 2021

While air travel is fast, efficient and vital to both the public and business sectors globally, it also carries some risks. Exposure to disease is one of the biggest. Research shows that air transportation can be a vehicle for the rapid spread of infectious diseases. Some prior studies identified effective steps to help prevent disease transmission in air travel, such as isolation, personal hygiene and public education. Other measures, specifically mask-wearing, have not been thoroughly examined yet.

The purpose of this study, conducted by Jing Yu Pan, Ph.D. (lead), and Dahai Liu, Ph.D., is to examine air travelers' mask-wearing intentions on an airplane. Pan is an assistant professor and Liu is a professor both in the School of Graduate Studies in the College of Aviation at ERAU. A self-administered survey was conducted to collect empirical data from airline passengers in the U.S. who traveled during the COVID-19 pandemic. The researchers will utilize the theory of planned behavior to examine the relationship between potentially relevant factors, such as attitude, social norms, *(continued on page four)*

New CATM Research *continued*

Equitable Dynamic Pricing for Express Lanes



Congestion pricing implementations, such as express lanes and tolls, ease traffic congestion by internalizing travelers' external traffic costs while generating much-needed revenue for infrastructure projects. Express lanes provide reliable travel time in exchange for a toll that changes dynamically with time of day. However, these lanes do raise equity concerns because the dynamic tolls may put a hardship on the economically disadvantaged traveler.

Real-world case studies show that express lane use is impacted by various factors, such as travelers' residential location and urgency of travel purpose, more than income. However, the choice of dynamic tolls can significantly skew the distribution of benefits towards travelers who are already financially well off. For example, tolls as high as \$47 observed on express lanes in Virginia might be too expensive for some travelers. Similarly, revenue-maximizing tolls employing a "jam-and-harvest" (JAH) strategy, where regular lanes are intentionally jammed in earlier time periods to harvest more revenue later, can produce inequitable outcomes.

In this project, Venktesh Pandey, Ph.D., assistant professor of civil, architectural and environmental engineering at N.C. A&T, aided by a graduate student and two undergraduate students, is investigating the equity issues of express lanes' dynamic pricing by building on data from his prior research on Loop One express lanes in Austin, Texas, and analyzing other express lane networks. He aims to contribute to the state-of-the-art equity considerations for express lanes by:

1. *Quantifying factors that contribute to JAH as an unintended consequence of tolling and*
2. *Identifying variables for a system-level measurement of equity and creating component lane choice and traffic flow models to measure those variables in the modeling framework.*



So far in the project, researchers have developed and are continuing to work on traffic simulation models to conduct sensitivity analysis considering the impact of various factors, like departure time, schedule delays and toll design. Initial results show that if the capacity of the express lane is fully utilized, the delay differentials across travel groups are lower. However, the generated revenue may be significantly below the maximum possible, which may not be economically efficient for the operation of express lanes. Also, current findings indicate that JAH is highly sensitive to travel demand, availability of alternate routes, pricing objective and lane choice models. Researchers have observed that travelers with the lower value of time suffer the most burden with JAH. *above right: Dr. Pandey*

Hopefully, the study results will show how pricing implementation methods can be utilized to minimize any equity gap discovered in express lane pricing.

CATM Transportation Research *continued*

Connected Electric Vehicles: Vehicle-Pedestrian Communications to Enhance Vision Impaired Pedestrian Safety



The steady increase of electric vehicles (EVs) on roadways causes safety concerns for vulnerable populations. The electric motor utilized in EVs produces considerably less noise when compared to the internal combustion engines present in gasoline-powered vehicles. This is especially true when EVs are traveling at slow speeds.

Although all pedestrians are at risk, visually impaired pedestrians are at a significantly greater safety disadvantage in environments where ambient noise levels are high in relation to the noise coming from an EV. The primary reason for this is because they rely on auditory cues to gauge traffic flow in order to make life-preserving decisions, such as crossing busy intersections and navigating city streets. This project will analyze vehicle requirement data provided by the National Highway Traffic Safety Administration and verify user needs information through a focus

group. The end goal of the research is to improve the lives of vulnerable pedestrians by determining the effects of different vehicle-to-pedestrian (V2P) alert systems on signal-response times. Specifically, the project seeks to:

1. engage in a focus group discussions with vulnerable road users to establish contextually informed user requirements;
2. identify and evaluate sensory input modalities as viable tools for V2P systems to determine their efficacy concerning safe pedestrian actions (i.e., signal detection, decision making, and reaction time, etc.); and
3. use a virtual environment to explore the application of V2P devices in a realistic spatial audio space and simulate traffic crossing situations.

The project is headed by Rafael Patrick, Ph.D., who is an assistant professor at Virginia Tech's Grado Department of Industrial and Systems Engineering. He is assisted by graduate student, Sadie Cooke, studying in the same department. The project, which is scheduled for completion in April 2022, will consist of three phases and is in the final stage of the experiment design development. Much of the initial research has been in the form of literature review. The researchers have found the topic to be fairly underrepresented. Patrick said:

"Some past studies encompass portions of our project's interests but do not entirely align or factor them together, especially considering our purpose of designing specifically for visually impaired road users and bringing them into the development process from the beginning. This was surprising to our team and has challenged us to design this study from a novel perspective with ample possibility for scientific creative freedom."

Overall, this project is important to improving pedestrian safety but will also provide a crucial component of user-centric design evaluation. As the team works in conjunction with the visually impaired community, it will ensure that the needs and desires of end-users are met and that a sense of respect for diversity and accessibility is fostered between the researchers and public.



top: Rafael Patrick
bottom: Sadie Cooke

CATM Transportation Research *continued*

Modeling Outbreaks of COVID Using Traffic as an Indicator *continued from page one*

In the project so far, the researchers have collected traffic and COVID-19 case data from ten states, all of Sweden, and two Provinces in China, Hubei (capital city Wuhan) and Zhejiang. Specifically, they looked at data on the same day one year apart and calculated the percentage change. For example, they compared traffic data from the first Monday in February in 2019 and the first Monday in February in 2020. Then, they noted the percentage change in cases in the same locale days later.



During the initial onset of the pandemic, the team found there was a strong correlation between traffic changes and COVID-19. For example: “reductions in traffic + time = less COVID-19 cases.” The time component was found to be around five to six days in the US and Sweden. The course of COVID-19 was not significantly different in Sweden and the US. China, however, was different in many ways.

China implemented a near complete lockdown. Traffic volumes in the provinces studied effectively dropped to zero for weeks. That wasn’t seen anywhere in the US or Sweden. The provinces reported zero COVID-19 cases for much of this period. In fact, China was the only location to report zero COVID-19 cases during the study period.

In the next project phase, the researchers will see if the SIR (an acronym for susceptible, infected, and recovered people) model developed will result in a better prediction formula than the simple correlation analyses used in the past. A SIR model is an epidemiological model that computes the theoretical number of people infected with a contagious illness in a closed population over time.

The goal of the research is to model the relationship between roadway traffic and viral outbreaks to formulate a SIR model that will be useful in predicting viral spread. The traffic informed SIR model could help identify where and when second wave outbreaks are likely to occur and assist in the planning of recovery efforts.

Mask-Wearing Behaviors in Air Travel During the Pandemic *continued from page one*

control-related factors and the intention to wear masks in an airplane cabin. A structural equation modeling approach is being used to quantitatively analyze the data. The project began in January 2021 and will conclude in May 2022. The data collection phase of the project is complete and analysis thus far shows that certain factors, such as attitude, risk avoidance, descriptive norms and information seeking significantly influence a person’s intention to wear a mask.

The initial data also revealed that the significant factors have different levels of effect on the mask-wearing intention of different age groups. For example, younger travelers’ intentions to wear masks during flight were most strongly affected by their attitude toward masks, and older travelers were mostly driven by wanting to avoid the risks of COVID-19. Interestingly, the data found that travelers were more willing to pay to switch from a non-mask mandate to a mask mandate flight than the opposite scenario.

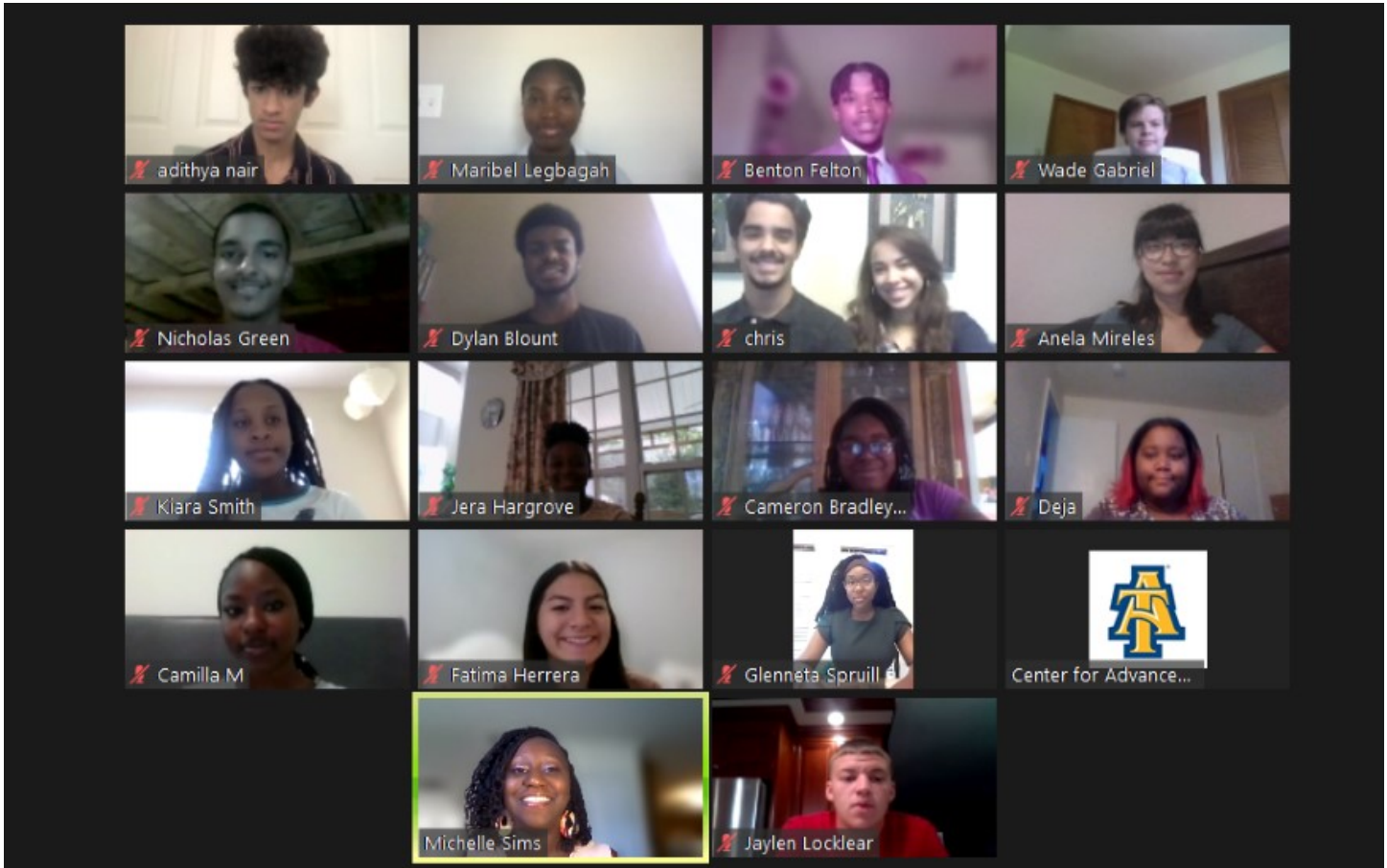
The study data was collected via Amazon Mechanical Turk in May. Many participants sent personal messages telling Pan how important they thought the study was. Pan said, “It’s interesting how this topic touches everyone.” The findings from the study fill in important gaps in the existing research about mask use during a global pandemic.

Study results can be used to inform airlines and air transport policy makers to help them understand airline passengers’ motivations and formulate proper measures to ensure inflight safety as the industry recovers from the pandemic. *right: Dr. Pan*



Virtual Summer Transportation Institute 2021

Due to the COVID-19 pandemic, the 2021 N.C. A&T Summer High School Transportation Institute (STI) was held online this year as a completely virtual event. From Monday, July 12 through Friday, July 23, the Virtual STI program consisted of two weeks of educational, interactive and engaging activities ranging from individual guest presenters and speaker panels to virtual tours and group projects.



Robert Hampshire, Ph.D., deputy assistant secretary for research and technology at the US Department of Transportation

Sixteen high school juniors and seniors completed the program and attended weekdays from 9 a.m. to 2 p.m. with an hour break for lunch. Because it was virtual, the program could expand its geographical reach outside the local area. The students came from across the state of North Carolina with one logging in from the Chicago, Illinois, area.

The keynote speaker at the opening ceremony was Robert Hampshire, Ph.D., deputy assistant secretary for research and technology at the US Department of Transportation. Hampshire shared the education and varied career path he took and emphasized the vital role transportation plays as part of the infrastructure of society. He also answered questions and interacted with the students and guests after his talk.

Virtual STI 2021 continued

Some of this year's program activities included:

- Virtual talent show
- “Shark Tank” team company idea competition (view winning video [here](#))
- Virtual tour of The Turner-Fairbanks Research Center in McLean, Virginia
- SAT math and English preparation and practice
- Bridge building kit assembly and video competition
- Public speaking coaching by Toastmasters
- Introduction to supply chain and engineering education paths by various industry professionals and college educators



Wes Kumfer, Ph.D., from the UNC-CH Highway Safety Research Center, conducted an exercise with the students to place signs and other transportation tools so that pedestrians could navigate safely.



Marabel Lagbagah displays an arch bridge she constructed in her project video.



Myounghoon Jeon, Ph.D., from Virginia Tech Transportation Institute, told students about the research project “Acoustic Situation Awareness and Its Effects on Pedestrian Safety within a Virtual Environment.”



Mubbashar Khan, Ph.D., from the NC Transportation Center of Excellence on Connected and Autonomous Vehicle Technology and the N.C. A&T Electrical and Computer Engineering Department gave an overview of the research in his department.



Camille Mumburi displays the finished product of her bridge building efforts in a video presentation.



Carol Abel Lewis, Ph.D., professor of transportation studies and emerita director of the Center for Transportation Training and Research at Texas Southern University, was the closing ceremony's keynote speaker.

Virtual STI 2021 Outstanding Students

Two STI students received awards at the closing ceremony for their exemplary participation, conduct, and mastery of the information presented during the program.



Anela Mireles

17 years old

Chicago Bulls College Prep

Oak Lawn, Illinois

Anela Mireles, a high school senior, received the director’s award by demonstrating mastery of the subject matter presented over the course of the two weeks of the program. She earned the highest score on a comprehensive test taken on the last day of STI.

Having a long-standing interest in engineering, Anela heard about the STI program from her school and wanted to participate. Her favorite part of the two weeks was learning about all the various ways in which transportation engineering is relevant to our everyday lives — even though it may not be obvious, at first. About her experience, she said:

“I liked that, even though we weren’t able to meet in-person, we got the opportunity to do projects independently, like making the bridges, and compete in group projects, like the Shark Tank competition.”

After high school, Anela plans to attend college and study teaching and computer engineering. She feels the STI program gave her a broader and more realistic view of career possibilities.



Benton Felton

17 years old

James B. Dudley High School

Greensboro, North Carolina

Benton received the outstanding participation award for his high level of engagement and positive attitude consistently in all program activities. He also put forth an exemplary genuine effort and demonstrated thorough planning and execution in all of his independent assignments throughout the duration of the program.

Benton thought participating in STI was a “blast.” He expressed that he was surprised to discover how broad the transportation field is — encompassing almost every industry. At the opening ceremony, Dr. Hampshire, deputy assistant secretary for research and technology at the US Department of Transportation, really made an impression on Benton when Hampshire shared that he had a computer science degree. In his career, Hampshire applied his knowledge of networks and communication systems to the transportation industry.

Besides feeling like he benefitted greatly from the SAT preparation classes, Benton enjoyed the group “Shark Tank” project the most. His group proposed a solution to address the homeless population’s need for transportation. Their project came in second place. You can view the group video [here](#). Benton said:

“Even if you’re not thinking of pursuing transportation as a career, I highly recommend this program. I learned so much about the transportation industry and supply chain management that will be useful in my future.”



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