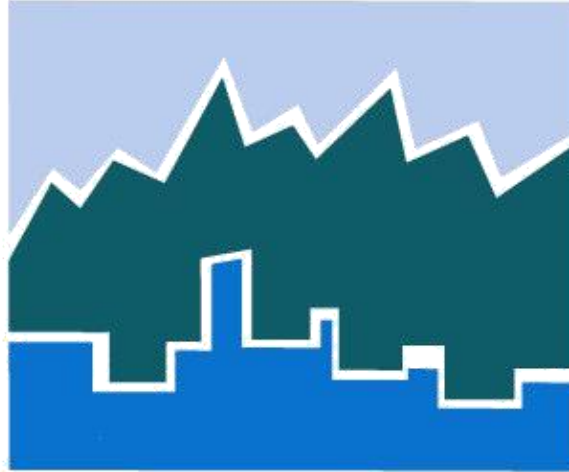


NHTS



National Household Travel Survey

Compendium of Uses

January 2020–December 2020

Foreword

This compendium contains various uses and applications of the National Household Travel Survey (NHTS) data referenced in transportation planning and research from January 2020 through December 2020. The articles and reports in this compendium cover a diverse range of topics in the areas of transportation, health, safety, environment, and engineering and were published in various journals including, but not limited to, the *Transportation Research Record*, the *Journal of Transport Geography*, and the *Journal of Transport & Health*. Several papers were also submitted by researchers and graduate students for presentation and publication to the Transportation Research Board's (TRB's) 99th Annual Meeting and can be found in the [2020 TRB Annual Meeting Compendium of Papers](#). Source material was also identified through [Google Scholar™](#) and [Google Alerts™](#) using “National Household Travel Survey” and “NHTS” keyword and search engine terms.

These selected articles and reports were grouped into 11 categories using the subject areas and index terms identified in each abstract as well as category titles used in previous NHTS compendium databases. The following categories, broken out by report chapter, were used in this version of the compendium:

1. Bicycle and pedestrian studies.
2. Energy consumption.
3. Environment.
4. Health.
5. Policy and mobility.
6. Special population groups.
7. Survey, data synthesis, and other applications.
8. Traffic safety.
9. Transit planning.
10. Travel behavior.
11. Trend analysis and market segmentation.

This compendium includes a short description of each article and report along with the title, author(s), abstract, subject areas, and availability.

Please note that the 2020 compendium consists of 412 research articles and reports. It is updated on an ongoing basis, with newly published papers that cite NHTS data. For information about adding a research paper to the NHTS compendium, please contact Daniel Jenkins at Daniel.Jenkins@dot.gov.

Search and documentation support was provided by Layla Sun (MacroSys), who also categorized the paper abstracts.

Table of Contents

Chapter 1. Bicycle and Pedestrian Studies.....	1
1.1. Title: Barriers to Cycling, Barriers to Health: An Equity Analysis Using 2017 NHTS Data	1
1.2. Title: Perceived Barriers to Commuter and Exercise Bicycling in U.S. Adults: The 2017 National Household Travel Survey.....	2
1.3. Title: Statewide Analysis of Individuals’ Exposure to Business Establishments and Active Travel Behavior.....	3
1.4. Title: The Geographic Disparities in Transportation-Related Physical Activity in the United States: An Analysis of the 2017 NHTS Data.....	4
1.5. Title: Little Change Seen in Walking and Cycling in the U.S. Since 2000	5
1.6. Title: 2018 Benchmarking Report on Bicycling and Walking.....	6
1.7. Title: Electric Bicycle Mode Substitution for Driving, Public Transit, Conventional Cycling, and Walking.....	7
1.8. Title: User Preferences for Bicycle Infrastructure and the Impact of Infrastructure on Bicycle Trips	8
1.9. Title: Distracted by “Distracted Pedestrians”?.....	9
1.10. Title: Chapel Hill-Carrboro Freight Train Trail Feasibility Study.....	10
1.11. Title: The Power of Reforming Streets to Boost Access for Human-Scaled Vehicles	11
1.12. Title: Pedestrian Transportation Research: Past and Future	12
1.13. Title: The Effects of a Citywide Bike Share System on Active Transportation Among College Students: A Randomized Controlled Pilot Study	13
1.14. Title: Development of Systemwide Pedestrian Safety Performance Function Using Stratified Random Sampling and a Proxy Measure of Pedestrian Exposure	14
1.15. Title: Spatiotemporal Analysis of Traffic Crashes Involving Pedestrians and Cyclists in Jefferson County, Kentucky.....	15
1.16. Title: Strava Metro Data for Bicycle Monitoring: A Literature Review	16
1.17. Title: Increasing E-Bike Adoption Just 15 Percent Could Cut Emissions 12 Percent	17
1.18. Title: Exercise Study Pinpoints the Easiest Way to Stay Fit, Even if You WFH	18
1.19. Title: Surveying Silicon Valley on Cycling, Travel Behavior, and Travel Attitudes.....	19
1.20. Title: Psychological Measures to Support a Shift from Individual Car Use to More Sustainable Transport Modes: The Case of Walking	20
1.21. Title: Simulation-Based Evaluation of a New Integrated Intersection Control Scheme for Connected Automated Vehicles and Pedestrians	21
1.22. Title: Can an E-Bike Share System Increase Awareness and Consideration of E-Bikes as a Commute Mode? Results From a Natural Experiment.....	22
1.23. Title: 95 Cycling Statistics Every Biking Buff Needs to Know	23
Chapter 2. Energy Consumption	24
2.1. Title: Cost of Plug-in Electric Vehicle Ownership: Understanding Vehicle Choice and Cost of Ownership Using Behavioral Data.....	24
2.2. Title: Impact of Spatial-Temporal Driver’s Behaviours on PEV Charging Demand.....	25

2.3.	Title: Lifetime Driving Schedules of Fuel-Efficient Vehicles.....	26
2.4.	Title: Comprehensive Impact Analysis of Electric Vehicle Charging Scheduling on Load-Duration Curve.....	27
2.5.	Title: Optimal Design of Grid Connected PV Battery System for Probabilistic EVCS Load.....	28
2.6.	Title: Optimal Driving Range for Battery Electric Vehicles Based on Modeling Users' Driving and Charging Behavior.....	29
2.7.	Title: Effects of Heterogeneity, Technological Progress and Interaction on Carbon Mitigation Costs.....	30
2.8.	Title: Advanced Control and Energy Management Schemes for Power Grids with High Proliferation of Renewables and Electric Vehicles.....	32
2.9.	Title: Plug-in Electric Vehicle Behavior Modeling in Energy Market: A Novel Deep Learning-Based Approach with Clustering Technique?.....	34
2.10.	Title: A Decentralized, Non-iterative Smart Protocol for Workplace Charging of Battery Electric Vehicles.....	35
2.11.	Title: A Comprehensive Study of the Parameters Impacting the Fuel Economy of Plug-in Hybrid Electric Vehicles.....	36
2.12.	Title: A Fuzzy Random Scheduling Model of Islanded Microgrid Considering Dual Uncertainty of EV.....	37
2.13.	Title: EV Charging Load Simulation and Forecasting Considering Traffic Jam and Weather to Support the Integration of Renewables and EVs.....	38
2.14.	Title: Quantifying the Benefits of Electric Vehicles on the Future Electricity Grid in the Midwestern United States.....	39
2.15.	Title: Estimation of Distribution System Capability for Accommodating Electric Vehicles.....	40
2.16.	Title: Joint Planning of EV Fast Charging Stations and Power Distribution Systems with Balanced Traffic Flow Assignment.....	41
2.17.	Title: CyDER: A Cyber Physical Co-simulation Platform for Distributed Energy Resources in Smartgrids.....	42
2.18.	Title: A Data Decomposition Approach to Design a Dynamic Pricing Mechanism for Residence-Based Plug-in Electric Vehicles in Wind Energy- Rich Grids.....	44
2.19.	Title: On-Demand Automotive Fleet Electrification Can Catalyze Global Transportation Decarbonization and Smart Urban Mobility.....	45
2.20.	Title: Charge Scheduling of Electric Vehicles in Smart Parking-Lot Under Future Demands Uncertainty.....	46
2.21.	Title: Impact of EV on the Icelandic Power System: A General Analysis and Cost Estimate.....	47
2.22.	Title: Levelized Cost of Charging Electric Vehicles in the United States.....	48
2.23.	Title: An Investigation on the Feasibility of Near-Zero and Positive Energy Communities in the Greek Context.....	49
2.24.	Title: Reliability Improvement of Distribution System Considering EV Parking Lots.....	50
2.25.	Title: Encouraging Electrification through Energy Service Subscriptions.....	51
2.26.	Title: Optimal Coordination of Electric Vehicles for Virtual Power Plants with Dynamic Communication Spectrum Allocation.....	52
2.27.	Title: Optimal Public Parking Lot Allocation and Management for Efficient PEV Accommodation in Distribution Systems.....	53
2.28.	Title: A Probabilistic Evaluation Method of Household EVs Dispatching Potential Considering Users Multiple Travel Needs.....	54

2.29.	Title: Coordinating EV Charging via Blockchain.....	55
2.30.	Title: Charging Strategy Unifying Spatial-Temporal Coordination of Electric Vehicles	56
2.31.	Title: Two Trillion Gallons: Fuel Savings From Fuel Economy Improvements to US Light-Duty Vehicles, 1975–2018	57
2.32.	Title: Electric Factor—A Comparison of Car Usage Profiles of Electric and Conventional Vehicles by a Probabilistic Approach	58
2.33.	Title: Power Optimized Battery Swap and Recharge Strategies for Electric Aircraft Operations	59
2.34.	Title: Why Do Some Consumers Not Charge Their Plug-in Hybrid Vehicles? Evidence From Californian Plug-in Hybrid Owners	60
2.35.	Title: Vehicle Air Conditioner Temperature Regulation-based Orderly Charging Strategy for Electric Vehicles	61
2.36.	Title: Algorithmic and Simulated Based Transmission Ratio Optimization of A Two-Speed Electric Vehicle For Car-sharing	62
2.37.	Title: A Holistic Analysis of Passenger Travel Energy and Greenhouse Gas Intensities.....	63
2.38.	Title: A Multi-Objective Coordinated Charging and Discharging Strategy for Electric Vehicles Based on Stackelberg Game	64
2.39.	Title: Mitigating Transformer Loss of Life and Reducing the Hazard of Failure by the Smart EV Charging.....	65
2.40.	Title: A Packetized Energy Management Macromodel With Quality of Service Guarantees for Demand-side Resources	66
2.41.	Title: Energy and Information Management of Electric Vehicular Network: A Survey	67
2.42.	Title: Electric Vehicles in Ridehailing Applications: Insights From a Fall 2019 Survey of Lyft and Uber Drivers in Los Angeles	68
2.43.	Title: Optimization of Pricing Policy of Electric Vehicle Charging Station Based on Big Data	70
2.44.	Title: An Analysis of California’s Intercity Travel Demand at Highway Rest Areas	71
2.45.	Title: Sustainability Prospects for Autonomous Vehicles: Environmental, Social, and Urban.....	72
2.46.	Title: How Do US Passenger Vehicle Fuel Economy Standards Affect New Vehicle Purchases?	73
2.47.	Title: A Framework for the Impact of Highly Automated Vehicles with Limited Operational Design Domains	74
2.48.	Title: A Review of the Population-based and Individual-based Approaches for Electric Vehicles in Network Energy Studies	75
2.49.	Title: A Review on Charging Behavior of Electric Vehicles: Data, Model, and Control	76
2.50.	Title: Active Distribution Network Expansion Planning Considering the Uncertainty of Electric Vehicles’ Load	77
2.51.	Title: Are Travel Surveys a Good Basis for EV Models? Validation of Simulated Charging Profiles Against Empirical Data	78
2.52.	Title: Assessment of Light-Duty Plug-in Electric Vehicles in the United States, 2010–2019.....	79
2.53.	Title: Automatic Charging Control for Electric Vehicle to Grid Operations.....	80
2.54.	Title: Can Electricity Pricing Leverage Electric Vehicles and Battery Storage to Integrate High Shares of Solar Photovoltaics?	81

2.55.	Title: Dynamic Real-Time Pricing Structure for Electric Vehicle Charging Considering Stochastic Microgrids Energy Management System.....	82
2.56.	Title: Fleet Re-Balancing with In-Route Charging for Multi-Class Autonomous Electric MoD Systems.....	83
2.57.	Title: Machine Learning Model to Project the Impact of COVID-19 on US Motor Gasoline Demand.....	84
2.58.	Title: Optimizing Workplace Charging Facility Deployment and Smart Charging Strategies.....	85
2.59.	Title: Probabilistic Assessment of Voltage Quality on Solar-Powered Electric Vehicle Charging Station.....	86
2.60.	Title: Spatial Load Forecasting of Distribution Network Based on Artificial Intelligent Algorithm	87
2.61.	Title: Sustainable Energy System Analysis Modeling Environment: Analyzing Life Cycle Emissions of the Energy Transition	88
2.62.	Title: Building the Computing System for Autonomous Micromobility Vehicles: Design Constraints and Architectural Optimizations	89
2.63.	Title: Self-Healing Enhancement Through Co-Deployment of Automatic Switches and Electric Vehicle Parking Lots in Electricity Distribution Network	90
2.64.	Title: Optimization of Vehicle to Grid System in a Power System with Unit Commitment	91
2.65.	Title: Phase Unbalance and Par Constrained Optimal Active and Reactive Power Scheduling of Virtual Power Plants (VPPs)	92
2.66.	Title: Co-Optimization of Energy Losses and Transformer Operating Costs Based on Smart Charging Algorithm for Plug-in Electric Vehicle Parking Lots	93
2.67.	Title: Shared Autonomous Vehicle Fleet Performance: Impacts of Trip Densities and Parking Limitations	94
2.68.	Title: Decarbonizing US Passenger Vehicle Transport Under Electrification and Automation Uncertainty Has a Travel Budget.....	95
2.69.	Title: A New Spatial Load Forecasting Method Considering Photovoltaic Output and Electric Vehicle Access	96
2.70.	Title: Modeling the External Effects of Air Taxis in Reducing the Energy Consumption of Road Traffic	97
2.71.	Title: Comprehensive Pricing Scheme of the EV Charging Station considering Consumer Differences Based on Integrated AHP/DEA Methodology.....	98
2.72.	Title: Estimate the Rebound Effect for Household Vehicle Usage Choice by Regression Models.....	99
2.73.	Title: Demand-side Price Responsive EV Charging Strategy based on Stochastic Model.....	100
2.74.	Title: Techno-Economic Design of EV Powertrain Based on Customer Perspective	101
2.75.	Title: Risk Assessment of Flexible Distribution District Considering Large-scale Fast Charging Load.....	102
2.76.	Title: Demand Contracting Strategy for Charging Stations Based on Load Forecasting.....	103
2.77.	Title: Optimal Fuel Taxation with Suboptimal Health Choices	104
2.78.	Title: Carbon Neutrality Study 1: Driving California’s Transportation Emissions to Zero	105

2.79.	Title: Second-order Cone Programming Based Methods for Two Variants of Optimal Power Flow	106
2.80.	Title: Modelling of Workplace Electric Vehicle Charging Profiles based on Trip Chain Generation	107
2.81.	Title: Assessing the Efficiency Implications of Renewable Fuel Policy Design in the United States.....	108
2.82.	Title: Optimal Demand Control of Electric Water Heaters to Accommodate the Integration of Plug-in Electric Vehicles in Residential Distribution Networks.....	109
2.83.	Title: Two-Stage Stochastic Programming Model to Locate Capacitated EV-Charging Stations in Urban Areas Under Demand Uncertainty	110
2.84.	Title: A Review of Electric Vehicle Load Open Data and Models.....	111
2.85.	Title: A Data-Driven Mobility–Energy Typology Framework for New York State	112
2.86.	Title: Impact of COVID-19 on Mobility and Electric Vehicle Charging Load.....	113
2.87.	Title: Assessing the Impact of Urban Form on the Greenhouse Gas Emissions from Household Vehicles: A Review	114
2.88.	Title: An Overview on Costs of Shifting to Sustainable Road Transport: A Challenge for Cities Worldwide	115
2.89.	Title: Daily Electric Vehicle Charging Load Profiles Considering Demographics of Vehicle Users	116
2.90.	Title: A Methodology to Model Daily Charging Load in the EV Charging Stations Based on Monte Carlo Simulation	117
2.91.	Title: Effects of Electric Vehicle Adoption for State-Wide Intercity Trips on the Emission Saving and Energy Consumption.....	118
2.92.	Title: Energy and Environmental Impact of the Abidjanese Way of Life (Côte D’Ivoire): A Case Study of Energy Efficiency of Transport Modes	119
2.93.	Title: Multi-Objective Framework for Optimal Scheduling of Electric Vehicles	120
2.94.	Title: Minimizing the Cost of Charging Plug-In Vehicles through Smart Charging.....	121
2.95.	Title: Urban Impacts of Mobile Fuel Delivery Service	122
2.96.	Title: V2G Scheduling for an EV Aggregator with Rooftop Solar Charging Park.....	123
2.97.	Title: Plug-in Hybrid Electric Vehicle Observed Utility Factor: Why the Observed Electrification Performance Differ from Expectations.....	124
2.98.	Title: Impact Analysis of EV Preconditioning on the Residential Distribution Network	125
2.99.	Title: Revenue Maximizing Scheduling for a Fast Electric Vehicle Charging Station with Solar PV and ESS.....	126
2.100.	Title: Affordability of Household Transportation Fuel Costs by Region and Socioeconomic Factors	127
2.101.	Title: Evaluation of a Stochastic Vehicle Travel Pattern Generation Model with Real-World Travel Data.....	128
Chapter 3. Environment		129
3.1.	Title: Best Long-Term Environmental Benefit Of COVID-19: Telecommuting?	129
3.2.	Title: Virus Brings Blue Skies to Big Cities. Will That Last?	130

3.3.	Title: How Neighborhood Effect Averaging Might Affect Assessment of Individual Exposures to Air Pollution: A Study of Ozone Exposures in Los Angeles	131
3.4.	Title: Environmental Impacts of Extreme Fast Charging	132
3.5.	Title: E-commerce and the Potential Effect of Changing Transport Activity on CO ₂ Emissions	133
3.6.	Title: A Systematic Review of the Energy and Climate Impacts of Teleworking	134
3.7.	Title: Commuters are Adapting to the Virus. What it Means for CO ₂	135
3.8.	Title: Study Shows How e-Bikes Can Dramatically Reduce CO ₂ Emissions From Transportation	136
3.9.	Title: Comparing the Impacts of Local Land Use and Urban Spatial Structure on Household VMT and GHG Emissions	137
3.10.	Title: CHI 2020: Right Here, Right Now?: A Bottom-up Approach to Estimating the Carbon Emissions From More Than Twenty Years of CHI Conference Travel.....	138
3.11.	Title: Towards a Methodology to Estimate Carbon Emissions Savings From Local Mode Shift Initiatives: A Review of Challenges and Emerging Technologies.....	139
3.12.	Title: The Climate Change Mitigation Effects of Active Travel	140
3.13.	Title: Save the Planet: Stop Riding Transit.....	141
3.14.	Title: Distributed Effects of Climate Policy: A Machine Learning Approach	142
3.15.	Title: The Affluence-Technology Connection: Metrics, Analysis, and Implications for Sustainable Technology	143
3.16.	Title: Ex-post Empirical Assessments of Environmental Policies: A Literature Review	144
3.17.	Title: No Place like Home: Fighting Climate Change (and Saving Money) By Electrifying America’s Households	145
Chapter 4. Health		146
4.1.	Title: What Does ‘Discretionary Travel’ Mean?	146
4.2.	Title: Telecommuting Could Curb the Coronavirus Epidemic	147
4.3.	Title: Quarantine Fatigue: First-Ever Decrease in Social Distancing Measures After the COVID-19 Outbreak Before Reopening United States	148
4.4.	Title: Geographical Influence of Mobile Clinics in the Southern United States.....	149
4.5.	Title: Does Density Aggravate the COVID-19 Pandemic?	150
4.6.	Title: How the Daily Smartphone is Associated With Daily Travel, Physical Activity, and Self-Perceived Health: Evidence From 2017 National Household Travel Survey	151
4.7.	Title: Cognitive Disabilities and Fitness Testing Scores in a Title I School	152
4.8.	Title: Access to Health Care: Perspectives on Transportation as a Social Determinant of Health	153
4.9.	Title: Transportation Barriers to Health Care in the United States: Findings From the National Health Interview Survey, 1997–2017	154
4.10.	Title: Effects of Walking on Self-assessed Health Status: Links Between Walking, Trip Purposes and Health	155
4.11.	Title: Gender and Education Differences in Sedentary Behavior in Canada: An Analysis of National Cross-sectional Surveys	156
4.12.	Title: Human Health and the Transportation Infrastructure.....	157

4.13.	Title: Active Transportation and Health: Understanding the Impact of Transportation-Related Physical Activity on Health	158
4.14.	Title: Open Spaces for Healthy Living	159
4.15.	Title: Healthy Climate, Healthy Bodies: Optimal Fuel Taxation and Physical Activity	160
4.16.	Title: Cost Effectiveness Analysis of Implementing Tuberculosis Screening Among Applicants for Non-immigrant U.S. Work Visas.....	161
Chapter 5. Policy and Mobility		162
5.1.	Title: E3: Evaluating Equity in Evacuation: A Practical Tool and A Case Study (Collaborative Project)	162
5.2.	Title: Does Adoption of Ridehailing Result in More Frequent Sustainable Mobility Choices? An Investigation Based on the National Household Travel Survey (NHTS) 2017 Data.....	163
5.3.	Title: Congress Should Pull the Plug on Electric Vehicle Tax Credits.....	164
5.4.	Title: What Alternatives Does Maryland Have to Curb Congestion Besides Building More Highways?.....	165
5.5.	Title: Flying Cars Will Undermine Democracy and the Environment	166
5.6.	Title: Autonomous Taxis & Public Health: High Cost or High Opportunity Cost?	167
5.7.	Title: Investigating Bias in SARS-CoV-2 Social Distancing Metrics Using Simulated Human Mobility Data?	168
5.8.	Title: The Energy and Environmental Effects of New and Future Mobility: Econometric and Simulation Analysis of Ridesourcing Services Uber and Lyft	169
5.9.	Title: SNAP Office Accessibility and its Association With Rurality	171
5.10.	Title: New and Emerging Data Forms in Transportation Planning and Policy: Opportunities and Challenges for “Track and Trace” Data	172
5.11.	Title: Transportation Infrastructure in the US.....	173
5.12.	Title: Investigating Mobility in Rural Areas of China: Features, Equity, and Factors.....	174
5.13.	Title: Knowledge Discovery and Data Mining for Shared Mobility and Connected and Automated Vehicle Applications	175
5.14.	Title: Geographic Mobility in America: Evidence from Cell Phone Data.....	177
5.15.	Title: Data-Driven Modeling Reveals the Impact of Stay-at-Home Orders on Human Mobility during the COVID-19 Pandemic in the U.S.....	178
5.16.	Title: Human Mobility Trends during the COVID-19 Pandemic in the United States.....	179
5.17.	Title: Observed Mobility Behavior Data Reveal “Social Distancing Inertia”	180
5.18.	Title: What Remains? The Influence of Light Rail Transit on Discretionary Income	181
5.19.	Title: Towards E-mobility: Strengths and Weaknesses of Electric Vehicles	182
5.20.	Title: Urban Mobility and Activity Space	183
5.21.	Title: Webinar: New Travel Demand Modeling for our Evolving Mobility Landscape	184
5.22.	Title: Investigating Individual Preferences for New Mobility Services: the Case of “Mobility as a Service” Products.....	185
5.23.	Title: An Interstate Trips Analysis During COVID-19 in the United States	187
5.24.	Title: Impact of Electric and Hybrid Vehicles on Highway Trust Fund in Alabama	188

5.25.	Title: Literature Review of Mileage-Based Road User Fees	189
5.26.	Title: Mobility Design as a Means of Promoting Non-Motorized Travel Behavior? A Literature Review of Concepts and Findings on Design Functions.....	190
5.27.	Title: Our World Accelerated: How 120 Years of Transportation Progress Affects Our Lives and Communities	191
5.28.	Title: How Different Age Groups Responded to the COVID-19 Pandemic in Terms of Mobility Behaviors: A Case Study of the United States	192
5.29.	Title: Creating Built Environments That Expand Active Transportation and Active Living Across the United States: A Policy Statement from the American Heart Association	193
5.30.	Title: A Customizable Metric to Provide a Comprehensive Picture of the Mobility Potential of a Location	194
5.31.	Title: A Reform Agenda for the U.S. Department of Transportation	195
5.32.	Title: Cross-State Comparison of Income and Vehicle-Ownership Effects on Household Mobility	196
5.33.	Title: Toward Mobility Justice: Linking Transportation and Education Equity in the Context of School Choice	197
5.34.	Title: Opinion: State Must Subsidize E-Bike Purchases.....	198
5.35.	Title: A Pileup: Surface Transportation Market Failures and Policy Solutions.....	199
5.36.	Title: Pursuing Multiple Goals in Transportation Policy: Lessons from an Integrated Model.....	200
5.37.	Title: Integrated Passenger Transport System in Rural Areas – A Literature Review	201
5.38.	Title: An Empirical Analysis and Policy Implications of Work Tours Utilizing Public Transit.....	202
5.39.	Title: Cash for Clunkers 2.0: Targeting Scrapage Subsidies to Cut Costs.....	203
5.40.	Title: Examining the Effects of King County Metro Carpool Incentive Fund	204
5.41.	Title: The Impact of Shared Mobility Options on Travel Demand.....	205
5.42.	Title: Mobile Device Location Data Reveal Human Mobility Response to State-Level Stay-at-Home Orders During the COVID-19 Pandemic in the USA	206
5.43.	Title: Reducing Vehicle Miles Traveled, Encouraging Walk Trips, and Facilitating Efficient Trip Chains Through Polycentric Development	207
5.44.	Title: An Equity Focused Study on the Trip Temporal Distributions of Vulnerable Road Users	208
5.45.	Title: Sustainable Mobility in the United States: Challenges & Opportunities from New Technologies.....	209
5.46.	Title: Modernizing Demand-Responsive Transportation for the Age of New Mobility	210
5.47.	Title: The Mismeasurement of Mobility for Walkable Neighborhoods	211
5.48.	Title: Assessing the Benefits of Micromobility	212
Chapter 6. Special Population Groups		213
6.1.	Title: Using the 2017 National Household Travel Survey Data to Explore the Elderly’s Travel Patterns.....	213
6.2.	Title: Has the Younger Population’s Vehicle Availability Changed Over the Years?: A Comparative Analysis of the Recent National Household Travel Surveys.....	214

6.3.	Title: Understanding Older Adults’ Travel Characteristics and Immobility: Findings from 2017 National Household Travel Survey Data	215
6.4.	Title: A Before and After Evaluation of Shared Mobility Projects in the San Joaquin Valley	216
6.5.	Title: How People Move: Analyzing the Travel of Vulnerable Populations in Los Angeles	218
6.6.	Title: Are Young Americans Carless Across the United States? A Spatial Analysis	219
6.7.	Title: School Buses Pricey to Replace, Maintain.....	220
6.8.	Title: America at a Glance: How Do Working-Age Adults With Travel-Limiting Disabilities Get Around?.....	221
6.9.	Title: Material Hardship among Lower-Income Households: The Role of Liquid Assets and Place	222
6.10.	Title: Exploring Motivations and Barriers for Long-Distance Trips of Adult Women Vermonters	223
6.11.	Title: Where Do the Poor Live in Cities? Revisiting the Role of Public Transportation on Income Sorting in US Urban Areas.....	224
6.12.	Title: Socio-economic Factors and Children’s Walking to and from School	225
6.13.	Title: Person-Based Micro-Simulation Demand Model for National Long-Distance Travel in the U.S.A.	226
6.14.	Title: Resources to Access Health Care for Low Socioeconomic Status Youth Athletes	227
6.15.	Title: To Drive or Not to Drive: Driving Cessation Amongst Older Adults in Rural and Small Towns in Canada.....	228
6.16.	Title: What Commute Patterns Can Tell Us About the Supply of Allied Health Workers and Registered Nurses	229
6.17.	Title: Assessment of the Travel Behaviour of a University Residential Community: Case Study of the Federal University of Technology Akure, Ondo State, Nigeria.....	230
6.18.	Title: Improving Transportation Impact Analyses for Subsidized Affordable Housing Developments: A Data Collection and Analysis of Motorized Vehicle and Person Trip Generation.....	231
6.19.	Title: Rural Transportation Conference Participants’ Opinions and Concerns Pertaining to Transit for Older Adults	232
6.20.	Title: Neighbourhood Residential Density and Childhood Obesity	233
6.21.	Title: Accessibility of Elderly Citizens to Basic Facilities in Akure Metropolis in Nigeria.....	234
6.22.	Title: An Evaluation of the Benefits of Mobile Fare Payment Technology From the User and Operator Perspectives	235
6.23.	Title: Analyzing the Acceptance of Electric Ridesharing by Drivers With and Without Local Registered Permanent Residence.....	236
6.24.	Title: Travel Patterns to Work of the Indian Population.....	237
6.25.	Title: Travel Behaviour of the Elderly in Planned and Unplanned Communities of Lagos Metropolis, Nigeria	238
6.26.	Title: A Panel Data Analysis of Tour-based University Students’ Travel Behaviour.....	239
6.27.	Title: Unequal Traveling: How School District and Family Characteristics Shape the Duration of Students’ Commute to School	240
6.28.	Title: An Analysis of the Travel Patterns of Pilgrimage Groups in Lhasa Tibet.....	241

6.29.	Title: Access Denied? Perceptions of New Mobility Services Among Disabled People in San Francisco.....	242
6.30.	Title: Gender Disparity in Travel Demand Management of University Students and Employees	243
6.31.	Title: Influence of Autonomous Vehicles on Travel Behavior of 50+ Years Population	244
6.32.	Title: School Transportation Equity for Vulnerable Student Populations through Ridehailing: An Analysis of HopSkipDrive and Other Trips to School in Los Angeles County	245
6.33.	Title: Autonomous Vehicles Should Benefit Those With Disabilities, but Progress Remains Slow	246
6.34.	Title: Decentralized Autonomous Electric Mobility-on-Demand Services for Individuals with Physical and Cognitive Disabilities	247
6.35.	Title: Children’s Health and Well Being During the Coronavirus Pandemic.....	248
6.36.	Title: Reimagining Aging in America: A Blueprint to Create Health and Economic Security for Older Adults.....	249
6.37.	Title: Self-Determination in Transportation: The Route to Social Inclusion for People with Disabilities.....	250
6.38.	Title: National Teen Driver Safety Week: Teen Driving Accidents.....	251
6.39.	Title: Will Ride-Hailing Enhance Mobility for Older Adults? A California Survey	252
6.40.	Title: Rural America’s Senior Citizens: Considerations for Transportation, Healthcare Access, Connectedness, Nutrition and Economics.....	253
6.41.	Title: Implementing Complete Streets in Small Towns and Rural Communities: Case Study: Millsboro, Delaware.....	254
6.42.	Title: “More Sidewalks, More Bus Stops”: Travel Behaviors and Opinions of Connecticut Teenagers.....	255
6.43.	Title: Rural Gerontology: Towards Critical Perspectives on Rural Ageing	256
6.44.	Title: Impacts of COVID-19 on Access to Transportation for People with Disabilities	257
6.45.	Title: Case Studies of Travel Demand Analysis on Transport Disadvantaged Communities.....	258
6.46.	Title: The Social Side of Early Human Capital Formation: Using a Field Experiment to Estimate the Causal Impact of Neighborhoods	259
Chapter 7.	Survey, Data Synthesis, and Other Applications.....	260
7.1.	Title: What Counts as Commute Travel?: Identification and Resolution of Key Issues Around Measuring Complex Commutes in the National Household Travel Survey	260
7.2.	Title: Visualization using the National Household Travel Survey	261
7.3.	Title: Predicting Travel Mode Choice Based on 2017 NHTS Trip Data with Multi-Nomial Logit Model and Light Gradient Boosting Machine.....	262
7.4.	Title: Testing Exogeneity in Nonparametric Instrumental Variables Models Identified by Conditional Quantile Restrictions	263
7.5.	Title: Data Modeling of Cities, a Machine Learning Application	264
7.6.	Title: A Data-Driven Travel Mode Share Estimation Framework based on Mobile Device Location Data.....	265
7.7.	Title: A Multiple Discrete Extreme Value Choice Model with Grouped Consumption Data and Unobserved Budgets	266
7.8.	Title: Computing the Shapley Value for Ride-Sharing and Routing Games	267

7.9.	Title: User Private Clouds.....	268
7.10.	Title: Impact of Economic Crisis on Passenger Transportation – Case of Travelling to the Greek Mainland from Crete	269
7.11.	Title: How Large is too Large? A Review of the Issues related to Sample Size Requirements of Regional Household Travel Surveys with a Case Study on the Greater Toronto and Hamilton Area (GTHA)	270
7.12.	Title: Highway Traffic Monitoring—Understanding Tomorrow’s Problems to Better Serve the Public	271
7.13.	Title: A Dynamic Taxi Ride Sharing System Using Particle Swarm Optimization	272
7.14.	Title: A Century of Travel Surveys Informing Transportation Investments.....	273
7.15.	Title: Street Commerce: Creating Vibrant Urban Sidewalks.....	274
7.16.	Title: Comparative Assessment of Accessibility Metrics Across the U.S.	275
7.17.	Title: Improved Travel Demand Modeling with Synthetic Populations	276
7.18.	Title: Road Importance Using Complex-Networks, Graph Reduction & Interpolation.....	277
7.19.	Title: Incorporating Activity Space and Trip Chaining into Facility Siting for Accessibility Maximization	278
7.20.	Title: Robust Bayesian Adjustment for Finite Population Inference: Application to Naturalistic Driving Data in SHRP2.....	279
7.21.	Title: Meeting Travel Needs: Becoming Reacquainted with a Community's Unmet Travel Needs	280
7.22.	Title: Multimodal Travel Mode Imputation based on Passively Collected Mobile Device Location Data.....	281
7.23.	Title: Socio-Economic, Built Environment, and Mobility Conditions Associated With Crime: A Study of Multiple Cities	282
7.24.	Title: Counterfactual and Welfare Analysis with an Approximate Model	283
7.25.	Title: Critical Business Decision Making for Technology Startups—A PerceptIn Case Study	284
7.26.	Title: Synthesizing Neighborhood Preferences for Automated Vehicles	285
7.27.	Title: Performance of One-Way Carsharing Systems Under Combined Strategy of Pricing and Relocations.....	286
7.28.	Title: Incorporation of Connected and Automated Vehicles (CAV) in Travel Demand Modeling Focusing on Traffic Forecasting	287
7.29.	Title: A Pervasive Framework Toward Sustainability and Smart-growth: Assessing Multifaceted Transportation Performance Measures for Smart Cities	288
7.30.	Title: Batches, Bursts, and Service Systems	289
7.31.	Title: Non-technological Challenges for the Remote Operation of Automated Vehicles	290
7.32.	Title: Trip Chain Simulation of Electric Vehicles based on NHTS Data	291
7.33.	Title: Robust and Efficient Methods of Inference for Non-Probability Samples: Application to Naturalistic Driving Data	292
7.34.	Title: On the Impact of Income, Age, and Travel Distance on the Value of Time.....	293
7.35.	Title: Proxy Reporting and Travel Diary Completion Status and their Impacts on Reported Trips in National Household Travel Surveys	294
7.36.	Title: Mining Daily Activity Chains from Large-Scale Mobile Phone Location Data.....	295
7.37.	Title: Identification of Social Aspects by Means of Inertial Sensor Data.....	296

7.38.	Title: Comparative Study on Solving the Minimum Fleet of Shared Autonomous Vehicles	297
7.39.	Title: Estimating Small Area Demand for Online Package Delivery	298
7.40.	Title: Developing Guidance for a Corridor Level Vehicle Occupancy Rate Data Collection Program	299
Chapter 8.	Traffic Safety	300
8.1.	Title: Enough is Enough	300
8.2.	Title: My Last Thought on “Enough Is Enough”	301
8.3.	Title: Comparing Distance and Time As Driving Exposure Measures to Evaluate Fatal Crash Risk Ratios	302
8.4.	Title: Sexual Violence in Transit Environments: Aims, Scope, and Context	303
8.5.	Title: Urban Cycling Expansion Is Associated With an Increased Number of Clavicle Fractures	304
8.6.	Title: Evaluation of Displaced Left-Turn Intersections	306
8.7.	Title: Driver State Monitoring for Decreased Fitness to Drive	307
8.8.	Title: Safety of Micro-mobility: Analysis of E-Scooter Crashes by Mining News Reports	308
8.9.	Title: Improving Traffic Safety and Efficiency by Adaptive Signal Control Systems Based on Deep Reinforcement Learning	309
8.10.	Title: Incorporating Demographic Proportions into Crash Count Models by Quasi-Induced Exposure Method	310
8.11.	Title: Beyond Safety Drivers: Applying Air Traffic Control Principles to Support the Deployment of Driverless Vehicles	311
8.12.	Title: Near Crash Characteristics Among Risky Drivers Using the SHRP2 Naturalistic Driving Study	312
8.13.	Title: A Bayesian Spatial Poisson-Lognormal Model to Examine Pedestrian Crash Severity at Signalized Intersections	313
8.14.	Title: Female vs. Male Relative Fatality Risk in Fatal Crashes	314
8.15.	Title: Pedestrians Under Influence (PUI) Crashes: Patterns from Correspondence Regression Analysis	315
8.16.	Title: United States Pedestrian Fatality Trends, 1977 to 2016	316
8.17.	Title: Safety Evaluation of Innovative Intersection Designs: Diverging Diamond Interchanges and Displaced Left-turn Intersections	317
8.18.	Title: Benefit-Cost Analysis of the Iowa Department of Transportation’s Safety Service Patrol Program	318
8.19.	Title: Older Driver Crash Involvement and Fatalities, by Age and Sex, 2000–2017	319
8.20.	Title: Is Bicycling Getting Safer? Bicycle Fatality Rates (1985–2017) Using Four Exposure Metrics	320
8.21.	Title: Measuring Success for Safe Routes to School Programs	321
8.22.	Title: Evaluating the Effectiveness of the Pedestrian Safety Intervention Program: Behavioral and Observational Approach	322
8.23.	Title: Investigation of Safety-in-Numbers for Pedestrians and Bicyclists at a Macroscopic Level with Various Exposure Variables	323
8.24.	Title: Injuries Related to Electric Scooter and Bicycle Use in A Washington, DC, Emergency Department	324
8.25.	Title: Safe Enough: Approaches to Assessing Acceptable Safety for Automated Vehicles	325
8.26.	Title: Waymo Public Road Safety Performance Data	326

8.27.	Title: Increased Motor Vehicle Fatalities Tuesday Through Thursday During the Us Thanksgiving Holiday (1980–2018).....	327
8.28.	Title: Cardiorespiratory Fitness and Sex Assigned at Birth Contribute to Brake Reaction Time in Older Adults	328
8.29.	Title: Fire Damage and Loss Assessment of Recreational Vehicles (RV's)	329
Chapter 9. Transit Planning.....		330
9.1.	Title: Investigating Public Transportation Use in the United States.....	330
9.2.	Title: Who’s Ditching the Bus?	331
9.3.	Title: An Algorithm for Integrating Peer-to-peer Ridesharing and Schedule-based Transit System for First Mile/Last Mile Access	332
9.4.	Title: LA Metro Possible Ridership Decline Causes and Recommendations to Reverse the Trend	333
9.5.	Title: Transit Blues in the Golden State: Analyzing Recent California Ridership Trends.....	334
9.6.	Title: Covid Flight From Transit Forces Shift to Riders Without Choices.....	335
9.7.	Title: A Philadelphia Ride-Share Story: An Investigation of Rideshare’s Impact on Transit	336
9.8.	Title: Beyond Distance: Exploring the Availability of Metro Vancouver’s Bus System and Who Can Access It.....	337
9.9.	Title: Rural Transit Fact Book, 2020	338
9.10.	Title: Transit Use for Single-Parent Households: Evidence from Maryland.....	339
9.11.	Title: Estimating Transit Ridership Using Wi-Fi Signals: An Enhanced Rule-Based Approach.....	340
9.12.	Title: Modeling Demand for Ridesourcing as Feeder for High Capacity Mass Transit Systems With an Application to the Planned Beirut BRT	341
9.13.	Title: Equity of Transit Connectivity in Tennessee Cities	342
9.14.	Title: Do For-Hire Vehicles Provide First Mile/Last Mile Access to Transit?.....	343
Chapter 10. Travel Behavior		344
10.1.	Title: The Evolution, Usage, and Trip Patterns of Taxis and Ridesourcing Services.....	344
10.2.	Title: Assessing the VMT Effect of Ridesourcing Services in the United States: Evidence from the 2017 National Household Travel Survey.....	345
10.3.	Title: Controlling for Selection and Simultaneity Biases in the Relationships Between Ridehailing Use and Vehicle Ownership in the 2017 NHTS.....	346
10.4.	Title: Adoption of Ridehailing in the United States: Evidence from the 2017 NHTS	347
10.5.	Title: Public Transportation, Transportation Network Companies (TNC) and Active Modes: An Analysis Based on 2009 and 2017 NHTS	348
10.6.	Title: Analysis of Activity-Travel Patterns and Tour Formation of Transit Users	349
10.7.	Title: Revisiting the Impact of Teleworking on Activity-Travel Behavior Using Recent Data and Sequence-Based Analytical Technique.....	350
10.8.	Title: Ridesharing, Ride-Hailing, and Transit Ridership: A National Study Using the 2017 National Household Travel Survey	351
10.9.	Title: The Impact of Shared Mobility on Trip Generation Behavior in the US: Findings from the 2017 National Household Travel Survey	352

10.10.	Title: Exploring the Relationship Between Ride-Sourcing Services and Vehicle Ownership, Using Both Inferential and Machine Learning Approaches	353
10.11.	Title: Dynamics of Travelers’ Modality Style in the Presence of Mobility-on-Demand Services	354
10.12.	Title: America on Pause: Vehicle Travel During COVID-19 and What Comes Next.....	355
10.13.	Title: Nonstandard Ridehail Use in Austin	356
10.14.	Title: Structural Equation Modelling of Household Long-Distance Flexible Travel Behavior	357
10.15.	Title: Users’ Perception of Value of Travel Time and Value of Ridesharing Impacts on Europeans’ Ridesharing Participation Intention: A Case Study Based on MoTiV European-Wide Mobility and Behavioral Pattern Dataset.....	358
10.16.	Title: Quantifying Human Mobility Behavior Changes in Response to Non-pharmaceutical Interventions During the COVID-19 Outbreak in the United States.....	359
10.17.	Title: Naturalistic Passenger Behavior: Postures and Activities.....	360
10.18.	Title: How Accumulated Wealth Affects Driving Reduction and Cessation	361
10.19.	Title: Eliciting Preferences of TNC Users and Drivers: Evidence From the United States	362
10.20.	Title: Will Autonomous Vehicles Change Auto Commuters’ Value of Travel Time?	363
10.21.	Title: Who and Where Rideshares? Rideshare Travel and Use in Los Angeles.....	364
10.22.	Title: The Impacts of Same Day Delivery Online Shopping on Local Store Shopping in Nanjing, China.....	365
10.23.	Title: An Assessment of Age and Gender Characteristics of Mixed Traffic with Autonomous and Manual Vehicles: A Cellular Automata Approach.....	366
10.24.	Title: A Study of the Impact of COVID-19 on Home Delivery Purchases and Expenditures	367
10.25.	Title: COVID-19 and Income Profile: How People in Different Income Groups Responded to Disease Outbreak, Case Study of the United States	368
10.26.	Title: Gender Differences in Commuting Travel in the U.S.: Interactive Effects of Race/Ethnicity and Household Structure	369
10.27.	Title: How Many People Come to Our Door?	370
10.28.	Title: Modeling and Analysis of Excess Commuting with Trip Chains	371
10.29.	Title: How Is COVID-19 Reshaping Activity-Travel Behavior? Evidence From a Comprehensive Survey in Chicago	372
10.30.	Title: Can the Coronavirus Bring Back the ’70s Heyday of Carpooling?	373
10.31.	Title: ICT’s Impacts on Ride-Hailing Use and Individual Travel	374
10.32.	Title: Compact Development and Adherence to Stay-at-home Order During the COVID-19 Pandemic: A Longitudinal Investigation in the United States	375
10.33.	Title: Shedding NHTS Light on the Use of “Little Vehicles” in Urban Areas.....	376
10.34.	Title: Trip Purpose Prediction Based on Hidden Markov Model with GPS and Land Use Data.....	377
10.35.	Title: Neighborhood Disparities in Access to Street Arts Festivals: Evidence from Chicago	378
10.36.	Title: Do People Walk More in Transit-Accessible Places?.....	379
10.37.	Title: Determinants of Healthcare Trips and Travel Burden in the Southwest USA	380
10.38.	Title: Cities That Have Been Taking the Most Road Trips	381

10.39.	Title: A Data-Driven Approach to Discover the Vitality around Transit Stations in the U.S.	382
10.40.	Title: Beyond Accessibility and Behavioral Outcomes: Reconceptualizing Equity in Transportation through the Capabilities Approach	383
10.41.	Title: Time Constraints and Travel Behavior	384
10.42.	Title: Children, Income, and the Impact of Home Delivery on Household Shopping Trips.....	385
Chapter 11. Trend Analysis and Market Segmentation		386
11.1.	Title: A Portrait of Zero-Car and Car-Ownning Household Mobility Trends in the United States: Insights from the 2009 and 2017 National Household Travel Survey.....	386
11.2.	Title: Webinar: The Adoption and Travel Impacts of Teleworking: Will It Be Different This Time?	387
11.3.	Title: Everything You Need to Know Before Buying an Electric Bike.....	388
11.4.	Title: Identifying Micro-Level Determinants that Influence the Transportation Network Companies (TNCs) Growth Through Analysis of Transportation Users' Preferences and Attitudes.....	389
11.5.	Title: Freight Distribution in Urban Areas: A Method to Select the Most Important Loading and Unloading Areas and a Survey Tool to Investigate Related Demand Patterns.....	390
11.6.	Title: Not Minding the Gap: Does Ride-Hailing Serve Transit Deserts?	391
11.7.	Title: Public Transit and Micro-Mobility: Identifying the Impacts of Bikeshare on Public Transit Ridership in the City of Chicago	392
11.8.	Title: Exploratory Analysis of Recent Trends in School Travel Mode Choices in the U.S.	393
11.9.	Title: Urban Air Mobility: Viability of Hub-Door and Door-Door Movement by Air	394
11.10.	Title: Telework and Daily Travel: New Evidence From Sweden.....	395
11.11.	Title: Telecommuting and its Impact on the Trips Made Daily by Telecommuters.....	396
11.12.	Title: Exploratory Analysis of Real-Time E-Scooter Trip Data in Washington, D.C.....	397
11.13.	Title: Determinants of Vehicle Ownership in Nigeria.....	398
11.14.	Title: Modeling Electric vehicle consumer behavior for improved power systems operation and planning	399
11.15.	Title: How Have Ride-Railing Applications Disrupted the Taxi Industry in New York?.....	400
11.16.	Title: E-shopping Changes and the State of E-grocery Shopping in the US— Evidence From National Travel and Time Use Surveys.....	401
11.17.	Title: Job Accessibility, Commuting Time and Travel Complexity in the Mexico City Metropolitan Area (MCMA).....	402
11.18.	Title: Public Acceptance and Adoption of Shared-Ride Services in the Ride-Hailing Industry	403
11.19.	Title: Dockless E-scooter Usage Patterns and Urban Built Environments: A Comparison Study of Austin, TX, and Minneapolis, MN	404
11.20.	Title: Know Your User: Building a Predictive Model of Consumer Preference for Driverless Cars	405
11.21.	Title: Approximate Ridesharing of Personal Vehicles Problem	406

11.22.	Title: Big Data and Unsupervised Machine Learning Approach to Understand Why People Ride E-Scooter in Nashville, Tennessee	407
11.23.	Title: Essays in Urban and Real Estate Economics	408
11.24.	Title: Marin Voice: E-Bikes Are a Perfect Fit for Our Remote-Work Lifestyle	409
11.25.	Title: Work from Home After the COVID-19 Outbreak	410
11.26.	Title: Predicting the Regional Adoption of Electric Vehicle (EV) With Comprehensive Models	411
11.27.	Title: National Association of City Transportation Officials: 136 Million US Micro-Mobility Trips in 2019	412
11.28.	Title: Delivery Robots Could Generate Trillions For U.S. Economy, Transform Last-Mile Delivery: Study	413
11.29.	Title: Electric Vehicle Adoption in Illinois.....	414
11.30.	Title: Small Business and the COVID-19 Pandemic: The Role of Work from Home.....	415
11.31.	Title: National and Metropolitan Trends in Public Transit Use, Transit-Related Walking, and Ridesharing Between 2009 and 2017.....	416
11.32.	Title: Human Mobility Trends During the Early Stage of the COVID-19 Pandemic in the United States	417
11.33.	Title: Connected and Autonomous Vehicles in Smart Cities	418
11.34.	Title: The Role of Flexibility at Work on Residential Location: From the Work-Life Balance Perspective	419
11.35.	Title: The Role of Urban Form in the Performance of Shared Automated Vehicles	420
11.36.	Title: A Framework for Evaluating the Economic Viability of Autonomous Vehicles	421

Chapter 1. Bicycle and Pedestrian Studies

1.1. Title: Barriers to Cycling, Barriers to Health: An Equity Analysis Using 2017 NHTS Data

Author(s): Braun, L.

Abstract: Cycling has become an important emphasis for the integration of transportation planning and public health. In line with this emphasis, a growing body of research has examined individual and environmental factors that serve as barriers to cycling. This work has important implications for social equity, as some have found that people of color and those with low socioeconomic status have disproportionately low access to cycling infrastructure. Research to date has been limited, however, by relatively small sample sizes and a reliance on objective environmental measures. In this analysis, these gaps are addressed by examining perceived barriers to cycling in a large, nationally representative sample ($n = 222,345$) drawn from the 2017 National Household Travel Survey. Using a combination of descriptive statistics and adjusted regression models, the following three research questions are addressed through the lens of social equity: (1) who cycles, (2) which types of cyclists report environmental barriers, and (3) do these barriers moderate the health benefits of cycling. It was found that people of color and those with low socioeconomic status were less likely than their more advantaged counterparts to cycle and more likely to face infrastructure- and safety-related barriers when they do cycle. Additionally, while cycling is positively associated with self-reported health, this association is weaker among cyclists who report environmental barriers. The results suggest that there are sociodemographic disparities in perceived barriers to cycling in the United States and that addressing these disparities is a critical focus for health equity in cycling promotion.

Subject Areas: Bicycling; Cycling infrastructure; Environmental barriers; Socioeconomic status; Health equity

Availability: Braun, L. (2020). *Barriers to Cycling, Barriers to Health: An Equity Analysis Using 2017 NHTS Data*. Transportation Research Board 99th Annual Meeting, Washington, DC. <https://annualmeeting.mytrb.org/OnlineProgramArchive/Details/13724>

1.2. Title: Perceived Barriers to Commuter and Exercise Bicycling in U.S. Adults: The 2017 National Household Travel Survey

Author(s): Porter, A.K., Kontou, E., McDonald, N.C., and Evenson, K.R.

Abstract: Introduction: Bicycling is a type of physical activity associated with positive health outcomes, but many barriers exist to regular bicycling for recreation and transportation. The objective of this study was to describe self-reported barriers to bicycling overall, and by bicycling domain, among a national sample of persons aged 16 and above that reported bicycling outside in the past week.

Methods: This analysis, conducted in 2019, utilized data from the U.S. Department of Transportation's 2017 National Household Travel Survey. Weighted point estimates and 95% confidence intervals were calculated for reported barriers to bicycling by category of bicyclist: exercise-exclusive, multi-use, and commuter.

Results: The final analytic sample was 18,189, representing approximately 7% of the U.S. population ($N = 20,911,680$). Barriers that prevented bicycling more was reported by 37.9% of the U.S. population of adult bicyclists (95% CI 37.2, 38.6). Barriers related to safety were more commonly reported (31.9% of total bicyclists) compared to barriers related to infrastructure (22.1% of total bicyclists). Safety-related barriers were more commonly reported among multi-use bicyclist (33.7% versus 30.9% of exercise-exclusive). Commuter bicyclists reported infrastructure barriers the least (13.9% versus 22.7% of exercise-exclusive). The most commonly reported single barrier to bicycling more, regardless of bicycling category, was heavy traffic (10.3% of total bicyclists) followed by no nearby paths or trails (7.6% of total bicyclists). Overall, distribution of individual barriers was similar across categories of bicyclists: exercise-exclusive, multi-use, and commuter.

Conclusions: Heavy traffic and lack of separated paths or trails were the most frequently identified barriers to bicycling more. Communities wishing to promote bicycling for transportation, recreation, or both should consider how traffic reduction strategies and changes in the built environment could make bicycling safer and more accessible.

Subject Areas: Attitudes; Bicycling; Commuters; Infrastructure; Non-motorized transportation; Physical fitness; Travel behavior; Trip purpose

Availability: Porter, A.K., Kontou, E., McDonald, N.C., and Evenson, K.R. (2020). "Perceived Barriers to Commuter and Exercise Bicycling in U.S. Adults: The 2017 National Household Travel Survey." *Journal of Transport & Health*, 16. <https://doi.org/10.1016/j.jth.2020.100820>

1.3. Title: Statewide Analysis of Individuals' Exposure to Business Establishments and Active Travel Behavior

Author(s): Yang, Y. and McAndrews, C.

Abstract: This study analyzes the association between exposure to various economic establishments, such as retail stores and schools, and walking and cycling at the individual level. Instead of using a land use mix indicator applied in many previous studies, 17 types of establishments were investigated, based on the North American Industrial Classification System, located within individuals' activity spaces. The 2017 Wisconsin Add-On to the National Household Travel Survey was used to compute the density of establishments for two different activity space measurements: (1) time-weighted one standard deviational ellipses and (2) convex hulls. Among the significant results agreed on by both activity space measurements, walking and cycling are positively associated with exposure to educational services and public administration establishments and negatively associated with exposure to finance and insurance establishments. The results indicate a possible strategy: active travel promotion could leverage the potential for schools and local government offices to serve as anchor institutions for health-promoting travel behavior. In addition to strategies for the built environment, research also suggests that physical activity encouragement could target individuals, such as workers, who probably have exposure to establishments with a negative association with active travel, such as in the finance and insurance sector.

Subject Areas: Activity centers; Bicycling; Built environment; Non-motorized transportation; School trips; Shopping facilities; Travel behavior; Walking

Availability: Yang, Y. and McAndrews, C. (2020). "Statewide Analysis of Individuals' Exposure to Business Establishments and Active Travel Behavior." *Transportation Research Record: Journal of the Transportation Research Board*, 2674(4), pp. 101–113.
<https://doi.org/10.1177/0361198120912241>

1.4. Title: The Geographic Disparities in Transportation-Related Physical Activity in the United States: An Analysis of the 2017 NHTS Data

Author(s): Dong, H.

Abstract: Research on the relationship between urbanicity and physical activity yielded mixed results despite many studies consistently showing that residents tended to undertake more transportation-related physical activity in a more urban environment. This study analyzed the 2017 National Household Travel Survey data to examine the geographic disparities in physical activity, particularly transportation-related physical activity in the United States. The analysis suggests the relationship between urbanicity and physical activity demonstrates a flat U-shape in graphed data. Residents are more physically active when they live in the areas from the two ends of the urbanization spectrum: inner cities and inner suburbs of large metropolitan areas and the rural parts of non-metropolitan areas. Suburbanites, particularly mid-ring and outer-ring suburbanites, walk the least. Only very slight geographic variation exists in the weekly rates of walk and bike trips that are strictly for exercise. The study revealed greater variation of the weekly rates of walk and bike trips that are for non-exercise purposes. This study suggests a more complicated relationship between urbanicity, active travel, and physical activity in a broader geographic context. More research needs to examine whether and how new urbanist design can promote active travel, particularly active travel strictly for exercise, in rural areas and areas of low urbanicity.

Subject Areas: Spatial analysis; Physical activity; Health; Equity; Travel patterns; Travel surveys; Urbanicity; Walk and bike trips

Availability: Dong, H. (2020). *The Geographic Disparities in Transportation-Related Physical Activity in the United States: An Analysis of the 2017 NHTS Data*. Mineta Transportation Institute, San José State University, San José, CA. <https://transweb.sjsu.edu/research/1912-Geographic-Disparities-Transportation-Related-Physical-Activity-US>

1.5. Title: Little Change Seen in Walking and Cycling in the U.S. Since 2000

Author(s): Perry, S.

Abstract: Blog.

Subject Areas: Walking and cycling; Walking rate; Cycling rate; Trends in active transportation; Car ownership; Gender; Education; Infrastructure

Availability: Perry, S. (2020). "Little Change Seen in Walking and Cycling in the U.S. Since 2000." *MinnPost*. <https://www.minnpost.com/second-opinion/2020/01/little-change-seen-in-walking-and-cycling-in-the-u-s-since-2000/>

1.6. Title: 2018 Benchmarking Report on Bicycling and Walking

Author(s): League of American Bicyclists.

Abstract: Report.

Subject Areas: Walking; Biking; Bicyclist and pedestrian road safety; Demographics of active transportation; Public health; Federal funding and planning

Availability: League of American Bicyclists. (2018). *2018 Benchmarking Report on Bicycling and Walking*. League of American Bicyclists, Washington, DC.

<https://bikeleague.org/benchmarking-report#:~:text=The%202018%20Benchmarking%20Report%20on,2012%2C%202014%2C%20and%202016>

1.7. Title: Electric Bicycle Mode Substitution for Driving, Public Transit, Conventional Cycling, and Walking

Author(s): Bigazzi, A. and Wong, K.

Abstract: The key to understanding the impacts of electric bicycles (e-bikes) on congestion, the environment, and public health is to what extent they displace travel by other (particularly motorized) modes of transportation. This study investigates the mode substitution effects of e-bikes, based on a meta-analysis of 38 observations of mode substitution patterns reported in 24 published studies from around the world. Median mode substitution reported in the literature is highest for public transit (33%), followed by conventional bicycle (27%), automobile (24%), and walking (10%), but varies widely with interquartile ranges of 31% for auto and 44% for public transit. Weighted mixed logit model results indicate a trade-off in substitution of motorized modes, with significantly greater displacement of public transit in China and greater displacement of auto travel elsewhere (Europe, North America, and Australia). Newer studies report greater displacement of driving and walking and less displacement of conventional bicycle trips, which indicates a positive trend. Results also suggest that e-bike adoption may be part of a transition away from conventional bicycle use, while displacing auto and transit travel after adoption. Further studies are needed in the context of evolving forms of micro-mobility, particularly outside of northern Europe and China.

Subject Areas: Electric bicycle; e-bike; Mode substitution; Mode shift; Sustainable transportation; Micro-mobility

Availability: Bigazzi, A. and Wong, K. (2020). “Electric Bicycle Mode Substitution for Driving, Public Transit, Conventional Cycling, and Walking.” *Transportation Research Part D: Transport and Environment*, 85. <https://doi.org/10.1016/j.trd.2020.102412>

1.8. Title: User Preferences for Bicycle Infrastructure and the Impact of Infrastructure on Bicycle Trips

Author(s): Clark, C.

Abstract: Bicycling for transportation is experiencing a resurgence in much of the United States. Consequently, the question of facility design has become a hot research topic. However, most such research is conducted in areas with strong bicycling cultures, which misses a critical link of how facility design can help shape bicycling culture. This dissertation contains analyses on data from a dual-wave survey deployed between 2016 and 2018 in communities in the southern United States. To varying degrees, these are communities where cycling is not (yet) popular and/or widely adopted, a setting that is much more representative of the nation at large. The first analysis is on a subset of the data from the first-wave survey ($N = 1,178$), in which quantitative analyses including linear regression models are used to estimate perceived comfort, perceived safety, and willingness to try bicycling facilities. Facilities that limited interaction with automobile through, turning, and parking traffic were found to be perceived as more desirable among cyclists. The second analysis contains the full first-wave sample ($N = 2,157$), including respondents in neighborhoods in Atlanta, GA. Latent class models were estimated with attitudinal factors, such as bicycle enjoyment and risk tolerance as class membership covariates, with results indicating the presence of a latent class of pro-bicycling but risk-cautious respondents whose perceptions differ from those of their pro-bicycling, risk-embracing counterparts by the relatively greater impact of protected bicycle facilities. The final analysis of the dissertation is conducted on before-and-after survey responses ($N = 807$) from all 10 sites, with 5 sites serving as treatment communities (where bicycling facility treatments were implemented over the course of the study) and 5 serving as control communities (where no such bicycling facility treatments were implemented). Linear regression and ordered logit models are estimated using respondents' perceptions of changes in bikability in their neighborhood. Those in the treatment group were more likely to rate observed changes as improvements, though the effect of on-street facilities diminished for those farther from the treatment. These results provide key takeaways regarding expectations for the impacts of bicycling facilities in places where bicycling for transportation is viewed as rare, which can provide an additional tool for planners and engineers in making the case for the implementation of bicycle facilities.

Subject Areas: Bicycling; Facility design and implementation; Linear regression; Ordered logit models

Availability: Clark, C. (2020). *User Preferences for Bicycle Infrastructure and the Impact of Infrastructure on Bicycle Trips*. Doctoral Dissertation, Georgia Institute of Technology, Atlanta, GA. <https://smartech.gatech.edu/handle/1853/62793>

1.9. Title: Distracted by “Distracted Pedestrians”?

Author(s): Ralph, K. and Girardeau, I.

Abstract: Some observers view distracted walking as a menace, while others contend that concern is overblown. Understanding these competing frames about pedestrian safety is essential because interpretive frames influence how we try to solve problems. In this study, transportation practitioners were surveyed to gauge how concerned they are about distracted walking, assess whether windshield bias and professional training influence concern, and determine whether concern influences preferred policy solutions for reducing pedestrian deaths. One-third of transportation practitioners surveyed view distracted walking as a large problem, estimating that it was responsible for 40% of pedestrian deaths. Practitioners were more concerned about distracted walking if they primarily use a car or spend little time in pedestrian-oriented areas (windshield bias) or if they work in engineering or public health (professional training). Most importantly, the distracted walking frame does indeed shape policy solutions. Practitioners concerned about distracted walking were more likely to endorse individual-level solutions (like educational campaigns) and were less likely support reducing vehicle speeds. Concern about distracted walking detracts attention from more deadly risk factors, more effective policy approaches, and, most importantly, is inconsistent with the ethos of making streets safe for all users, including children, the elderly, and vision-impaired people. Instead of focusing on educational campaigns, practitioners should focus their pedestrian safety efforts on the biggest risk factors and the most effective solutions.

Subject Areas: Pedestrian; Safety; Injury; Phone; Framing; Bias; Vision zero

Availability: Ralph, K. and Girardeau, I. (2020). “Distracted by ‘Distracted Pedestrians’?” *Transportation Research Interdisciplinary Perspectives*, 5.
<https://doi.org/10.1016/j.trip.2020.100118>

1.10. Title: Chapel Hill-Carrboro Freight Train Trail Feasibility Study

Author(s): Berolzheimer, B.

Abstract: Communities across the United States are seizing the opportunity to leverage existing railroad corridors and transform them into valuable community assets. Retrofitting rail rights-of-way into shared use paths (SUPs) has become an increasingly common way of improving and expanding infrastructure for active transportation and physical recreation across the country. These efforts have been shown to provide numerous benefits to communities including improved human health and well-being, decreased vehicle miles traveled, and increased economic development. This report assesses the feasibility for a potential rail-trail on the currently active North Carolina Railroad (NCR) right-of-way in Orange County, NC, which is used to deliver coal to the University of North Carolina at Chapel Hill's (UNC-CH) Cogeneration steam and power plant. This report will specifically analyze a 4.91-mile section of the corridor running north-south through the municipalities of Chapel Hill and Carrboro. It will assess the overall feasibility of the hypothetical project and present a conceptual framework for implementation. Additionally, this report will highlight strategies, opportunities, and challenges associated with rail-trail development generally, and more specifically related to the NCR corridor. The study includes a thorough assessment of the existing conditions within the study area and, where appropriate, will attempt to integrate and synthesize existing and future area-wide planning efforts into the study.

Subject Areas: Shared use paths; Active transportation; Physical recreation; Rail trail; Feasibility

Availability: Berolzheimer, B. (2020). *Chapel Hill-Carrboro Freight Train Trail Feasibility Study*. Master's Thesis, University of North Carolina at Chapel Hill, Chapel Hill, NC.
<https://doi.org/10.17615/j50y-j221>

1.11. Title: The Power of Reforming Streets to Boost Access for Human-Scaled Vehicles

Author(s): King, D.A. and Krizek, K.J.

Abstract: This commentary argues for strategies to rapidly increase access by small, human-scaled modes in cities through changes to street designs. Such rapid transformations are necessary as part of responses to critical environmental, economic and public health challenges cities face. We explain that even though coordinated transport and land use planning is desirable, the built environment is mature and slow to change, while streets can and have changed in character and use frequently. This suggests that access to employment, amenities, and services should be dramatically increased through reoriented street space toward human-scaled transport modes which will improve safety, reduce pollution, and save households and governments money. We then articulate the prospects of a new generation of accessibility research based on network evolution.

Subject Areas: Human-scaled transport modes; Urban design; Streets design; Accessibility

Availability: King, D.A. and Krizek, K.J. (2020). “The Power of Reforming Streets to Boost Access for Human-Scaled Vehicles.” *Transportation Research Part D: Transport and Environment*, 83. <https://doi.org/10.1016/j.trd.2020.102336>

1.12. Title: Pedestrian Transportation Research: Past and Future

Author(s): Schneider, R.J., Kothuri, S., Blackburn, L., Manaugh, K., Sandt, L., and Fish, J.

Abstract: Pedestrian travel is the universal form of human transportation and a gateway to all other modes of travel. The pedestrian research field has grown tremendously over the last two decades, and the Pedestrian Committee has expanded its connections within the Transportation Research Board organization. We analyzed the official minutes from 15 years of Pedestrian Committee meetings to identify key pedestrian-related topics, including “safety,” “data,” “street,” and “design,” and show how prominent topics have evolved over time. We grouped important pedestrian references from the last 50 years cited by 74 online survey respondents into four main categories: pedestrian safety studies, walkability and roadway design studies, pedestrian travel and the built environment studies, and pedestrian transportation guidebooks. The pedestrian transportation field is evolving, and the Pedestrian Committee will continue to identify research needs and share relevant research on enduring topics such as pedestrian safety at roadway crossings as well as emerging issues such as pedestrian interactions with autonomous vehicles (AVs) and micro-mobility devices. Moving forward, these efforts to connect research and practice will help ensure that pedestrians of all ages, abilities, and needs are included in the planning, designing, financing, and implementation of transportation systems throughout the world.

Subject Areas: Built environment; Highway design; Pedestrian areas; Pedestrian safety; Pedestrians; Walkability; Micromobility

Availability: Schneider, R.J., Kothuri, S., Blackburn, L., Manaugh, K., Sandt, L., and Fish, J. (2020). *Pedestrian Transportation Research: Past and Future*, Transportation Research Board, Washington, DC. <http://onlinepubs.trb.org/onlinepubs/centennial/papers/ANF10-Final.pdf>

1.13. Title: The Effects of a Citywide Bike Share System on Active Transportation Among College Students: A Randomized Controlled Pilot Study

Author(s): Grimes, A. and Baker, M.

Abstract: Introduction: Despite the known health benefits of biking, within the last year, 46% of college students reported not riding a bike. This trend indicates a need to explore interventions to increase bicycling. The purpose of this study was to examine how a free membership to a citywide bike share system, with a campus docking station, affected bicycling and physical activity.

Method: Undergraduate students were recruited from a Midwest university to participate in this research study in spring 2018. Each participant wore an activity-tracking device for 3 weeks and was randomly assigned to either an intervention group ($n = 29$) or a control group ($n = 27$). Participants in the intervention group received a free 1-month membership to Kansas City's bike share system, B-cycle. Data on the type of activity (e.g., biking), the frequency, duration, and overall steps were collected. A pre- and post-test survey was developed and distributed to assess perceptions and use of bicycles and the bike share system. *T*-tests were performed to identify differences between the two groups.

Results: Data analyses reveal no significant differences in overall steps or increased biking behavior between the two groups. Furthermore, only two of participants who received a free bike share membership redeemed their membership. Among other barriers, risk of overage fees or not wanting to enter credit/debit card information emerged as major themes that deterred participants.

Conclusions: Results from this study will inform future interventions to decrease barriers, increase physical activity, and increase the proportions of trips taken by bike among college students. More specifically, alternative payment methods should be explored to decrease the barriers observed.

Subject Areas: College; Health behavior; Health promotion; Interventions; Physical activity/exercise

Availability: Grimes, A. and Baker, M. (2020). "The Effects of a Citywide Bike Share System on Active Transportation Among College Students: A Randomized Controlled Pilot Study." *Health Education & Behavior*, 47(3), pp. 412–418. <https://doi.org/10.1177%2F1090198120914244>

1.14. Title: Development of Systemwide Pedestrian Safety Performance Function Using Stratified Random Sampling and a Proxy Measure of Pedestrian Exposure

Author(s): Kwayu, K.M., Kwigizile, V., and Oh, J.

Abstract: The lack of pedestrian counts at a systemwide level prompts the need to find other innovative ways of assessing pedestrian traffic crash risks using proxy measures of exposure. This study aims to formulate the methodology for developing pedestrian safety performance functions (SPF) using the proxy measure of pedestrian exposure and stratified random sampling. The case study was all urban intersections in Michigan State that comprise of collector and arterial roads. The stratified random sampling strategy was deployed to select the sample which is representative of all urban intersections in the state of Michigan. Factor analysis was used to develop a proxy measure of pedestrian exposure at urban intersections using a walkability measure (walk score), among other factors. The performances of various count models were compared using the goodness of fit measures based on the Akaike's Information Criterion (AIC), Bayesian Information Criterion (BIC), and Vuong test. The final pedestrian SPFs was formulated using the Zero-Inflated Poisson (ZIP) model with annual average daily traffic (AADT) at a major approach, AADT at the minor approach, and a proxy measure of pedestrian exposure. The proposed methodology in this study can benefit transportation agencies that have embarked on systemwide planning of pedestrian facilities to improve the safety of pedestrians but lack systemwide analytical tools and pedestrian counts to make data-driven decisions.

Subject Areas: Pedestrian traffic crash risks; Pedestrian safety; Stratified random sampling; Proxy measure

Availability: Kwayu, K.M., Kwigizile, V., and Oh, J. (2020). "Development of Systemwide Pedestrian Safety Performance Function Using Stratified Random Sampling and a Proxy Measure of Pedestrian Exposure." *International Journal of Injury Control and Safety Promotion*, 27(11), pp. 1–12. <https://doi.org/10.1080/17457300.2020.1791905>

1.15. Title: Spatiotemporal Analysis of Traffic Crashes Involving Pedestrians and Cyclists in Jefferson County, Kentucky

Author(s): Garcia, J.M.

Abstract: Walking and cycling are health-conscious, environmentally friendly modes of transportation, yet very few American trips are accomplished using these methods. A major factor behind this is the fear of being involved in a crash with an automobile. From 2009–2019, there were over 5,200 automobile crashes involving either pedestrians or cyclists in Louisville/Jefferson County, Kentucky. Researchers have found that these kinds of crashes exhibit spatiotemporal patterns in different cities across the globe. The objective of this study was to determine if there exist any spatial and/or temporal patterns regarding these kinds of crashes. Data for this study came from the Kentucky State Police and encompassed all pedestrian and cyclist crashes from 2009–2019. Geographic information systems were used to perform a network-based kernel density estimation for the spatial analysis. For the temporal analysis, the scales of time, day, and month were observed and plotted. Hot-spots were found to exist within the study area, with some locations being hot-spots for both pedestrian and cyclist crashes. These shared hot-spot locations were analyzed in detail, using the original Kentucky State Police data, as well as Google Earth and Street View imagery.

Subject Areas: Geographic information systems; Spatial; Temporal; Transportation; Louisville; Planning

Availability: Garcia, J.M. (2020). *Spatiotemporal Analysis of Traffic Crashes Involving Pedestrians and Cyclists in Jefferson County, Kentucky*. College of Arts & Sciences Senior Honors Theses, University of Louisville, Louisville, KY.

<https://ir.library.louisville.edu/honors/215>

1.16. Title: Strava Metro Data for Bicycle Monitoring: A Literature Review

Author(s): Lee, K. and Sener, I.N.

Abstract: Monitoring bicycle trips is no longer limited to traditional sources, such as travel surveys and counts. Strava, a popular fitness tracker, continuously collects human movement trajectories, and its commercial data service, Strava Metro, has enriched bicycle research opportunities over the last five years. Accrued knowledge from colleagues who have already utilized Strava Metro data can be valuable for those seeking expanded monitoring options. To convey such knowledge, this paper synthesizes a data overview, extensive literature review on how the data have been applied to deal with drivers' bicycle-related issues, and implications for future work. The review results indicate that Strava Metro data have the potential—although finite—to be used to identify various travel patterns, estimate travel demand, analyze route choice, control for exposure in crash models, and assess air pollution exposure. However, several challenges, such as the under-representativeness of the general population, bias towards and away from certain groups, and lack of demographic and trip details at the individual level, prevent researchers from depending entirely on the new data source. Cross-use with other sources and validation of reliability with official data could enhance the potentiality.

Subject Areas: Strava; Bicycle; Crowdsourced data; Fitness tracking application; Emerging travel data

Availability: Lee, K. and Sener, I.N. (2020). "Strava Metro Data for Bicycle Monitoring: A Literature Review." *Transport Reviews*, 41(1), pp. 27–47.
<https://doi.org/10.1080/01441647.2020.1798558>

1.17. Title: Increasing E-Bike Adoption Just 15 Percent Could Cut Emissions 12 Percent

Author(s): Wilson, K.

Abstract: Blog.

Subject Areas: E-bicycle; Emission reduction; Transportation infrastructure

Availability: Wilson, K. (2020). "Increasing E-Bike Adoption Just 15 Percent Could Cut Emissions 12 Percent." *StreetsBlog USA*. <https://usa.streetsblog.org/2020/08/17/increasing-e-bike-adoption-just-15-percent-could-cut-emissions-12-percent/>

1.18. Title: Exercise Study Pinpoints the Easiest Way to Stay Fit, Even if You WFH

Author(s): Pattillo, A.

Abstract: Blog.

Subject Areas: Walking; Health benefits; COVID-19; Work from home

Availability: Pattillo, A. (2020). "Exercise Study Pinpoints the Easiest Way to Stay Fit, Even if You WFH." *Inverse*. <https://www.inverse.com/mind-body/walking-with-a-purpose-helps-health>

1.19. Title: Surveying Silicon Valley on Cycling, Travel Behavior, and Travel Attitudes

Author(s): Fang, K.

Abstract: This report presents the results from a March 2020 survey of Santa Clara County residents about their current travel behavior, overall thoughts on travel, and opinions about various forms of transportation in particular. While the instrument inquired about all modes of transportation, the survey was particularly focused on attitudes and behavior related to cycling. A total of 1,009 responses were included in the analysis. Overall, the study confirms that private motor vehicle travel dominates, with approximately 90 percent of respondents reporting that they drive in an average week and own cars. However, the results also show greater use of alternatives than the census data indicate by virtue of greater trip types captured here compared to the American Community Survey. This survey shows that approximately 13 percent of respondents ride a bicycle for any purpose in an average week. Results from the attitudinal questions point to strong demand for automobile use, but they also illustrate several problematic aspects of an auto-dominated transportation system. Similarly, for cycling, the survey results indicate general support for the idea of more cycling, but they highlight several notable barriers. Notably, the survey was administered in the field from March 6 through March 13, 2020, prior to COVID-19 shelter-in-place orders covering the study area.

Subject Areas: Travel surveys, Mode choice; Attitudes; Stated preferences; Bicycling

Availability: Fang, K. (2020). "Surveying Silicon Valley on Cycling, Travel Behavior, and Travel Attitudes." *Mineta Transportation Institute Publications*.
<https://doi.org/10.31979/mti.2020.1947>

1.20. Title: Psychological Measures to Support a Shift from Individual Car Use to More Sustainable Transport Modes: The Case of Walking

Author(s): Risser, R. and Sucha, M.

Abstract: Transport is one of the sectors that contribute to global warming. To tackle this issue, one of the most important tasks is to enhance/support a mode shift from individual car use to more sustainable traffic modes. To achieve this, psychology-based measures are needed. We need to understand what keeps people from walking, and what motivates people who do walk to do so, or to define the barriers to, and the preconditions needed for, walking or cycling. These preconditions are perceived in a different way by different people. As the motivation of individual citizens differs greatly, the preconditions have to be targeted precisely. In this paper a scheme is presented that deals with this issue—i.e., to enhance/support a mode shift to sustainable traffic modes with the following steps: to identify and improve the preconditions for walking, to communicate information, and to provide opportunities or incentives. As a theoretical background we use a classical marketing model presented by Philip Kotler, which has strong connections with communication and social psychology. Through the case of supporting sustainable traffic modes—the product which will be “sold”—we present the different steps of the model (information, product, communication, incentives, and distribution). With all aspects, we emphasize that a holistic approach (a combination of all these aspects and steps) is necessary for a successful marketing process that in fact makes citizens “buy” the idea of walking (more). The main suggestion of this paper is to implement the steps suggested in it in the frame of a pilot project in a city or a province and then to evaluate. Evidence that the suggested measures work when applied appropriately and—as strongly underlined—in a concerted manner can only be achieved by trying in practice.

Subject Areas: Sustainable traffic modes; Walking; Mode choice; Traffic psychology; Pedestrians

Availability: Risser, R. and Sucha, M. (2020). “Psychological Measures to Support a Shift from Individual Car Use to More Sustainable Transport Modes: The Case of Walking.” *Prime Archives in Sustainability*. Vide Leaf, Hyderabad, India. <https://videleaf.com/wp-content/uploads/2020/08/Psychological-Measures-to-Support-a-Shift-from-Individual-Car-Use-to-More-Sustainable-Transport-Modes-The-Case-of-Walking.pdf>

1.21. Title: Simulation-Based Evaluation of a New Integrated Intersection Control Scheme for Connected Automated Vehicles and Pedestrians

Author(s): Niels, T., Mitrovis, N., Dobrota, N., Bogenberger, K., Stevanovic, A., and Bertini, R.

Abstract: In a fully connected traffic environment with automated vehicles, new traffic control strategies could replace traditional traffic signals at intersections. In recent years, several studies about reservation-based intersection control strategies have been published, and a significant increase in capacity was shown. In the strategies presented so far, other road users usually play a minor role or are not considered at all. However, many use cases of automated driving occur in urban environments, where pedestrians and bicyclists play a major role. In this paper, a novel strategy for integrating pedestrians into automated intersection management is introduced and compared with a fully actuated traffic (AT) signal control. The presented control consists of a first-come, first-serve strategy for vehicles in combination with an on-demand traffic signal for pedestrians. The proposed intersection control is explained, implemented, and tested on a four-leg intersection with several lanes coming from each direction. It dynamically assigns vehicles to lanes, and vehicles follow a protocol that enables cooperative lane-changing on the approach to the intersection. Demand-responsive pedestrian phases are included in such a way that predefined maximum pedestrian waiting times are not exceeded. A set of demand scenarios is simulated using a microsimulation platform. The evaluation shows that the presented control performs significantly better than the AT control when considering low, medium, and high traffic demand. Pedestrian waiting times are slightly improved and at the same time vehicle delays are substantially decreased. However, the control needs to be improved for scenarios with a very high vehicle demand.

Subject Areas: Automated vehicles; New traffic control; Pedestrians and bicyclists; Urban; Intersection management; Actuated traffic signal control

Availability: Niels, T., Mitrovis, N., Dobrota, N., Bogenberger, K., Stevanovic, A., and Bertini, R. (2020). "Simulation-Based Evaluation of a New Integrated Intersection Control Scheme for Connected Automated Vehicles and Pedestrians." *Transportation Research Record: Journal of the Transportation Research Board*, 2674(11), pp. 779–793.
<https://doi.org/10.1177%2F0361198120949531>

1.22. Title: Can an E-Bike Share System Increase Awareness and Consideration of E-Bikes as a Commute Mode? Results From a Natural Experiment

Author(s): Handy, S.L. and Fitch, D.T.

Abstract: Electric-assisted bicycles (e-bikes) may encourage commuters to shift from car to bike by improving perceptions of bicycling safety and increasing destination accessibility. Awareness of e-bikes is an important first step toward more widespread adoption. This article uses a natural experiment design to examine the impact of the implementation of an e-bike share system in Davis, CA, on awareness of e-bikes and consideration of the use of e-bikes for commuting. We use data from three cross-sectional surveys of employees at the University of California, Davis, to estimate the effect of the opening of the e-bike system on changes in awareness and consideration and examine other important factors associated with these outcomes. The results suggest that a shared e-bike system can substantially increase awareness of e-bikes, but that additional strategies may be needed to convert awareness into consideration of the use of e-bikes for commuting.

Subject Areas: Bicycle commuting; Bike share; E-bikes

Availability: Handy, S.L. and Fitch, D.T. (2020). “Can an E-Bike Share System Increase Awareness and Consideration of E-Bikes as a Commute Mode? Results From a Natural Experiment.” *International Journal of Sustainable Transportation*, pp. 1–16.
<https://doi.org/10.1080/15568318.2020.1847370>

1.23. Title: 95 Cycling Statistics Every Biking Buff Needs to Know

Author(s): Galic, B.

Abstract: Blog.

Subject Areas: Bicycle; Health; Environment; Bicycle accidents; Helmet; Demographics

Availability: Galic, B. (2020). “95 Cycling Statistics Every Biking Buff Needs to Know.” *Livestrong*. <https://www.livestrong.com/article/13730398-cycling-statistics/>

Chapter 2. Energy Consumption

2.1. Title: Cost of Plug-in Electric Vehicle Ownership: Understanding Vehicle Choice and Cost of Ownership Using Behavioral Data

Author(s): Chakraborty, D., Tal, G., and Hardman, S.

Abstract: There is increasing concern that even with purchase subsidies, though Plug-In Electric Vehicles (PEVs) offer fuel cost savings they may not be overall cost-efficient in comparison to Internal Combustion Engine Vehicles (ICEVs) and Hybrid Electric Vehicles (HEVs). These studies, however, ignore heterogeneity in vehicle use and charging behavior as well as the importance of non-monetary incentives on the total cost of ownership and operation (TCO) of PEVs that motivates their adoption. This project will leverage a multi-year survey of PEV vehicle owners in California done by the Plug-in Hybrid & Electric Vehicle Research Center (PH&EV) at UC Davis, in combination with a similar survey done in 36 States across the Nation in 2018 to estimate the TCO models for PEVs, ICEVs, and HEVs. The work will attempt to answer the following key questions:

- What are the factors influencing TCO of PEVs, and how do changes in these factors impact the cost estimate in comparison to ICEVs and HEVs?
- How do policies like CAFE and fuel/electricity price trends impact the comparative TCO of ICEVs and PEVs?
- What is the social benefit in terms of GHG reductions obtained from the PEV purchase decision?

Subject Areas: Automobile ownership; Choice models; Combustion; Costs; Electric vehicle charging; Electric vehicles; Forecasting; Internal combustion engines; Plug-in hybrid vehicles; Pollutants; Surveys; Travel behavior; Travel patterns

Availability: Chakraborty, D., Tal, G., and Hardman, S. (2020). *Cost of Plug-in Electric Vehicle Ownership: Understanding Vehicle Choice and Cost of Ownership Using Behavioral Data*. The National Academies of Sciences, Engineering, and Medicine, Washington, DC.

<https://trid.trb.org/View/1652792>

2.2. Title: Impact of Spatial-Temporal Driver’s Behaviours on PEV Charging Demand

Author(s): Assolami, Y.O., Gaouda, A., and El-Shatshat, R.

Abstract: This paper investigates the impact of the drivers dynamic behaviors on the demand of charging Plug-in Electric Vehicles (PEVs). The presented work in this study focuses on modeling the temporal-spatial characteristics of the drivers daily activities based on obtaining all statistical valuable information from the National Household Travel Survey (NHTS) data. The proposed work considers multiple trips per day and takes into account drivers movement, Driving Duration (DDT), Driven Distance (DDM), and Parking Duration (PDT). The trip chain, bases on the Monte Carlo Markov Chain (MCMC) process, is developed to properly model the driver states during the day. Charging facilities are assumed to be available at home, work, and Direct Current (DC) Fast Charging Stations (FCSs), within charging levels of 3.7 kW, 6.6 kW, and 50 kW, respectively. In this work, the impact of PEV charging at multi locations is discussed, and is followed by studying the impact of the market share versus Tesla S. The proposed work overcomes the disadvantages in the oversimplified models of the PEV charging demand by providing a more robust and realistic representation of driver behaviors.

Subject Areas: Mathematical model; Probability density function; Electric vehicles; Markov processes; Data mining; Entertainment industry

Availability: Assolami, Y.O., Gaouda, A., and El-Shatshat, R. (2020). “Impact of Spatial-Temporal Driver’s Behaviours on PEV Charging Demand.” *2019 IEEE Electrical Power and Energy Conference (EPEC)*, pp. 1–6, Montreal, QC, Canada.
<https://doi.org/10.1109/EPEC47565.2019.9074812>

2.3. Title: Lifetime Driving Schedules of Fuel-Efficient Vehicles

Author(s): Gohlke, D., Davis, S., Wenzel, T., and Croteau, H.

Abstract: A vehicle mileage schedule estimates the annual miles driven by a typical vehicle each year as the vehicle ages. These schedules are relevant for calculating the total mileage that vehicles are driven in their lifetimes and are therefore used in calculations of levelized cost of driving (LCOD) and cradle-to-grave environmental lifecycle assessments. However, there is a high degree of uncertainty in the vehicle mileage schedules that are typically used for these calculations. These travel schedules are low-fidelity, grouping together vehicles with disparate fuel economy ratings and typically disaggregating only to a broad vehicle type level (e.g., cars versus light trucks). Present analysis may not capture differences in how vehicles are operated—differences beyond the vehicle size—particularly for variables such as fuel economy.

This project uses travel behavior from the National Household Travel Survey (NHTS) and data from annual odometer readings in Texas and Massachusetts to generate new vehicle mileage schedules for light-duty passenger vehicles. In particular, these updated vehicle mileage schedules will be partitioned based on fuel economy to determine whether vehicles with better fuel economy are driven more intensively. Highly efficient vehicles have lower fuel costs (per mile), which may incentivize more intensive driving. If a correlation between fuel economy and driving distance is established, it would further lower the per-mile cost of efficient vehicles, as the purchase price of these vehicles would be amortized over a greater number of miles.

Subject Areas: Vehicle mileage schedule; Levelized cost of driving; Fuel economy

Availability: Gohlke, D., Davis, S., Wenzel, T., and Croteau, H. (2020). *Lifetime Driving Schedules of Fuel-Efficient Vehicles*. U.S. Department of Energy, Washington, DC.
https://www.energy.gov/sites/prod/files/2020/06/f75/VTO_2019_APR_ANALYSIS_compliant_052020.pdf#page=86

2.4. Title: Comprehensive Impact Analysis of Electric Vehicle Charging Scheduling on Load-Duration Curve

Author(s): Rahman, M.M., Al-Ammar, E.A., Das, H.S., and Ko, W.

Abstract: Within the next decade, the number of electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs) will increase exponentially owing to the environmental benefits related to their utilization. In an ideal framework condition, the vehicle-to-grid (V2G) system provides advantages such as subordinate administration of load leveling and peak shaving guidelines and minimized upgrade costs. In this paper, deterministic and probabilistic methods of scheduling PHEV charging/discharging are analyzed, and their performances are compared based on a case study. In the case of the deterministic method, an optimization model is proposed to reduce the overall grid output power consumption for utilities and operate a smart charging/discharging schedule for PHEV users. Quadratic programming (QP) is used to solve the optimization cost function. In contrast, the probabilistic method uses Monte Carlo simulation (MCS) to analyze the impact and determine a coordinated time-of-use (TOU) structure for the PHEV charging/discharging schedule. Both methods suggest V2G feasibility for the smart grid system.

Subject Areas: Plug-in hybrid electric vehicles; Vehicle-to-grid; Smart charging/discharging; Peak shaving and load leveling; Monte-Carlo simulation; Quadratic programming

Availability: Rahman, M.M., Al-Ammar, E.A., Das, H.S., and Ko, W. (2020). "Comprehensive Impact Analysis of Electric Vehicle Charging Scheduling on Load-Duration Curve." *Computers & Electrical Engineering*, 85. <https://doi.org/10.1016/j.compeleceng.2020.106673>

2.5. Title: Optimal Design of Grid Connected PV Battery System for Probabilistic EVCS Load

Author(s): Rahman, M.M., Al-Ammar, E.A., Das, H.S., and Ko, W.

Abstract: Fossil fuel-based power generation systems are harmful to the environment, and the depleting stage of fossil fuels compelled the researchers to search for alternative ways of power generation. Solar energy is the most prospective way for alternative power generation. Photovoltaic (PV) panels can convert solar energy into electricity, and with the technological evolution, PV panels have high efficiency now. Thus, a grid-connected PV system can be a good choice. In this research, an Electric Vehicle Charging Station (EVCS) carries out the economic feasibility of a PV battery-based system at a commercial site. The location for the project has selected a supermarket in Riyadh, Saudi Arabia. The HOMER software provides the technical as well as economic results of the project considering the initial cost, net present cost (NPC), cost of energy (COE) with respect to renewable energy (RE) fraction, and a different ratio of tariff (ROT). From all these data, sensitivities analyzed are performed to choose the best scenario for EVCS.

Subject Areas: Electric vehicles; Photovoltaic (PV) panels; Charging Station; Probabilistic load; RES; HOMER; Microgrid

Availability: Rahman, M.M., Al-Ammar, E.A., Das, H.S., and Ko, W. (2020). "Optimal Design of Grid Connected PV Battery System for Probabilistic EVCS Load." *2020 Advances in Science and Engineering Technology International Conferences (ASET)*, pp. 1–6, Dubai, United Arab Emirates. <https://doi.org/10.1109/ASET48392.2020.9118225>

2.6. Title: Optimal Driving Range for Battery Electric Vehicles Based on Modeling Users' Driving and Charging Behavior

Author(s): Lu, Z., Zhang, Q., Yuan, Y., and Tong, W.

Abstract: This paper proposes a simulation approach for the optimal driving range of battery electric vehicles (BEVs) by modeling the driving and charging behavior. The driving and charging patterns of BEV users are characterized by reconstructing the daily travel chain based on the practical data collected from Shanghai, China. Meanwhile, interdependent behavioral variables for daily trips and each trip are defined in the daily trip chain. To meet the goal of the fitness of driving range, a stochastic simulation framework is established by the Monte Carlo method. Finally, with consideration of user heterogeneity, the optimal driving range under different charging scenarios is analyzed. The findings include the following: (1) the daily trip chain can be reconstructed through the behavioral variables for daily trips and each trip, and there is a correlation between the variables examined by the copula function; (2) users with different daily travel demand have a different optimal driving range. When choosing a BEV, users are recommended to consider that the daily vehicle kilometers traveled are less than 34% of the battery driving range; (3) increasing the charging opportunity and charging power is more beneficial to drivers who are characterized by high daily travel demand; and (4) on the premise of meeting travel demand, the beneficial effects of increased fast-charging power will gradually decline.

Subject Areas: Battery electric vehicles; Driving and charging behavior; Daily trips; Stochastic simulation; Monte Carlo method

Availability: Lu, Z., Zhang, Q., Yuan, Y., and Tong, W. (2020). "Optimal Driving Range for Battery Electric Vehicles Based on Modeling Users' Driving and Charging Behavior." *Journal of Advanced Transportation*, 2020. <https://doi.org/10.1155/2020/8813137>

2.7. Title: Effects of Heterogeneity, Technological Progress and Interaction on Carbon Mitigation Costs

Author(s): Das, S.

Abstract: As many societal needs compete with sustainability for a finite pool of public resources, understanding the cost of mitigating greenhouse gas emissions has become a critical sustainability question. The Marginal Abatement Cost Curve (MACC) is a widely used approach to characterize mitigation costs. It is constructed by ordering technological and other interventions to mitigating an emission from lowest to highest cost, indicating the cumulative mitigation possible for each intervention. It is clearly a simplification of a complex techno-economic system and has been criticized for neglecting factors such as dynamics, consumer behavior, non-cost barriers to adoption, and interactions between technologies. However, as long as the limitations of the information provided by a MACC are understood, it does provide valuable and easily comparable information on costs and mitigation potential.

In this thesis, I try to address some of the issues with the abatement cost curve, namely three. (1) Heterogeneity: The traditional MACC assumes all users to have an average behavior and hence have an average (same) gain from the adoption of a technology. However, gains from adoption vary widely between users and merits inspection. (2) Learning: MAC curves neglect technology progress, the reduction in price to later adopters due to capacity addition brought about by early adopters. (3) Interaction: Technologies that interact with each other would impact the abatement cost of each other depending on where they are placed in the adoption order. For example, renewable technologies would reduce emission intensity of the grid. If they are succeeded by electric vehicles (EVs), EVs would displace more CO₂ since they are now operating off a cleaner grid. I analyze three sectors and several technologies: electricity generation (utility-scale wind and utility-scale photovoltaic), single-family residential buildings (furnace, central AC, wall insulation, attic insulation, and air sealing) and transportation (battery electric vehicles (BEVs), Plugin hybrids vehicles (PHEV), and Hybrid vehicles (HEV)). I use an iterative cost minimization methodology which chooses the lowest abatement cost technology for each round based on the impact of the previous technology on the carbon intensity of the grid. Heterogeneity mixes technologies in the MACC for EVs and home efficiency measures such that particulars of users is far more relevant in the ordering of the MACC that specific technologies accounting for interactions has mixed impacts. Adding technologies that increase electricity demand (e.g., BEVs) increases the carbon benefits (reduces abatement cost) of subsequent efficiency technologies like residential efficiency technologies while reducing the carbon benefits of their subsequent counterparts. The opposite is true with technologies that reduce energy demand, reducing the carbon benefits of subsequent efficiency technologies while increasing the benefits from electric vehicles. Learning reduces cost of abatement. The net impact toward emission reduction potential in the integrated model with learning is positive, increasing abatement potential from 1.07 billion to 1.24 billion tonnes when compared with a traditional MACC. Also, by accounting for heterogeneities, although the potential for “free carbon” does not change much, the potential for savings can go up by as much as 50%. Moreover, total cost of meeting various mitigation targets in the integrated model is significantly lower than the traditional MACC.

Accounting for heterogeneity and interaction significantly alters the priority for technology disbursement from an emission reduction perspective. It shows the importance of targeted marketing as a more effective mechanism as opposed to technology-based subsidy. It also shows that the initial adopters make the technology cheaper for the latter adopters. This work significantly improves the accuracy of the MACC in both emission and cost saving potential, making it more applicable in policy decision making.

Subject Areas: Emission; Energy demand; Efficiency; Electric vehicles; Battery electric vehicle; Plug-in hybrid electric vehicles; Hybrid electric vehicles; Marginal Abatement Cost Curve

Availability: Das, S. (2020). *Effects of Heterogeneity, Technological Progress and Interaction on Carbon Mitigation Costs*. Rochester Institute of Technology, Rochester, NY.
<https://scholarworks.rit.edu/theses/10389>

2.8. Title: Advanced Control and Energy Management Schemes for Power Grids with High Proliferation of Renewables and Electric Vehicles

Author(s): Wang, B.

Abstract: A power grid transformation is needed to integrate large-scale variable renewable energies (VREs) and electric vehicles (EVs) in order to address environmental concerns. Organizations and governments have set ambitious targets for the integration of these emerging resources into the modern power grids to build, plan, and operate a clean and sustainable energy landscape. This dissertation proposes an integrated control and energy management scheme for power grids with massive integration of VREs and EVs.

We firstly propose a new EV charging station (EVCS) control scheme and a holistic approach to evaluate the electrical safety of the large-scale EVCSs. Our approach mainly focuses on several topics on the operational safety of EVCS primarily concerning: (1) the facility degradation which could potentially result in a compromised EVSE reliability performance and EVCS protection failure, (2) the cyber-attack challenges when the smart charging and the communication between EVCSs and electric utilities are enabled, and (3) the potential mismatch between the renewable output and EVCS demand, which could trigger the system stability challenges during normal operation and inability to supply the critical EV loads during outages.

A two-stage energy management system (EMS) for power grids is proposed. The first stage economic dispatch determines the optimal operating points of charging stations and battery swapping stations (BSS) for EVs under plug-in and battery swapping modes, respectively. The proposed stochastic model predictive control (SMPC) problem in this stage is characterized through a chance-constrained optimization formulation that can effectively capture the system and the forecast uncertainties. A distributed algorithm, the alternating direction method of multipliers (ADMM), is applied to accelerate the optimization computation through parallel computing. The second stage is aimed in coordinating the EV charging mechanisms to continuously follow the first-stage solutions i.e., the target operating points, v and meeting the EV customers' charging demands captured via the Advanced Metering Infrastructure (AMI). The proposed solution offers a holistic control strategy for large-scale centralized power grids in which the aggregated individual parameters are predictable and the system dynamics do not vary sharply within a short time-interval.

Based on this new control and energy management schemes, we propose a new data-driven approach for EV charging load modeling. We first introduce a mathematical model that characterizes the flexibility of EV charging demand. Advanced simulation procedures are then proposed to identify the parameters of different EV load models and simulate EV charging demand under different electricity market realizations. The proposed EV load modeling approach can simulate different EV operation schedules, charging levels, and customer participation as a benchmark system.

Eventually, a restoration approach for EVCSs is also proposed to utilize the flexibility of the aggregated EV loads to enhance the power grid resilience against extremes. A framework is also introduced to offer adaptive operation strategies for the EVCS operators. As a result, the system

can effectively manage the EVCS under different penetration levels of EVs, considering both normal operating conditions and restoration processes during interruptions and emergencies. The proposed adaptive operation mechanism could bring significant advantages to the operation and control of smart power grids with high penetration of renewables and EVs when facing different operating conditions.

Subject Areas: Variable renewable energies; Electric vehicles; Power grid transformation; Energy management system; Electric vehicles charging station control system; Electric vehicles; Charging loading modeling

Availability: Wang, B. (2020). *Advanced Control and Energy Management Schemes for Power Grids with High Proliferation of Renewables and Electric Vehicles*. The George Washington University, Washington, DC.

<https://search.proquest.com/openview/31b87d5f737a537277154b3eb602ed66/1?pq-origsite=gscholar&cbl=18750&diss=y>

2.9. Title: Plug-in Electric Vehicle Behavior Modeling in Energy Market: A Novel Deep Learning-Based Approach with Clustering Technique?

Author(s): Jahangir, H., Gougheri, S.S., Vatanhoush, B., Golkar, M.A., Ahmadian, A., and Hajizadeh, A.

Abstract: Growing penetration of Plug-in Electric Vehicles (PEVs) in the transportation fleet and their subsequent charging demands introduce substantial intermittency to the electric load profile which imposes techno-economic challenges on power distribution networks. To address the uncertainty in demand, a novel, deep learning-based approach equipped with a hybrid classification task is developed which can take into account the travel characteristics of the PEV owners. The classification structure helps us scrutinize PEVs demand by allocating a specific forecasting network to each cluster of travel behavior patterns. In our hybrid classification task, first, an unsupervised classifier discerns hidden travel-behavior patterns between the historical PEVs data by clustering them; then, a supervised classifier directs new PEV data to their appropriate cluster-specific forecasting network. The deep learning-based forecasting and classification networks are constructed based on Long Short-Term Memory networks to investigate long-and short-term features in PEV behaviors. The data-driven structure of our proposed method enables us to observe and preserve the correlation between PEV travel data parameters (departure time, arrival time, and traveled distance) and avoid the generation of unrealistic travel samples found in scenario-based approaches. To verify the effectiveness of the proposed method in practical environments, we have studied the impact of the precise forecasting of the PEVs demand in an aggregator's financial profit in the energy market of the California Independent System Operator market. The numerical results confirm the outstanding performance of our proposed deep learning-based method in forecasting PEVs demand against benchmark approaches in this field such as Monte Carlo, Quasi-Monte Carlo, and Copula with only a 6.77% error in comparison with real data.

Subject Areas: Forecasting; Logic gates; Task analysis; Artificial neural networks; Predictive models; Feature extraction; Correlation; Deep learning; Classification; Plug-in electric vehicles; Travel behavior; Energy market

Availability: Jahangir, H., Gougheri, S.S., Vatanhoush, B., Golkar, M.A., Ahmadian, A., and Hajizadeh, A. (2020). "Plug-in Electric Vehicle Behavior Modeling in Energy Market: A Novel Deep Learning-Based Approach with Clustering Technique?" *IEEE Transactions on Smart Grid*. <https://doi.org/10.1109/TSG.2020.2998072>

2.10. Title: A Decentralized, Non-iterative Smart Protocol for Workplace Charging of Battery Electric Vehicles

Author(s): Muñoz, E.R. and Jabbari, F.

Abstract: Battery electric vehicles can help reduce fossil fuel consumption and greenhouse gas emissions. Specifically, workplace charging can alleviate the curtailment of renewable resources while providing charging opportunities to long-range commuters. In this work, a comprehensive smart-charging protocol for workplace charging is proposed. The protocol first uses an ordering strategy, based on each vehicle's load shifting flexibility, to develop a queue. Next, a decentralized smart-charging strategy is used that allows battery electric vehicles to generate their own charging profile via linear programming. By using an appropriate cost signal, the proposed smart-charging strategy can generate a parking structure demand load with desirable characteristics. Finally, an assignment algorithm is proposed to assign battery electric vehicles to octopus chargers. Driving patterns from the National Household Travel Survey are used to simulate workplace charging for parking structures under various charging scenarios. The proposed ordering strategy resulted in improved peak reductions for all simulated charging scenarios when compared with chronological ordering. Furthermore, monthly electricity costs and the number of required chargers were both reduced in all cases where smart charging was combined with the proposed ordering strategy, compared to uncontrolled charging. Thus, the proposed protocol can reduce electricity and charging infrastructure costs associated with workplace charging.

Subject Areas: Battery electric vehicle; Plug-in electric vehicle; Smart charging; Utility cost; Demand charge; Octopus charger

Availability: Muñoz, E.R. and Jabbari, F. (2020). "A Decentralized, Non-iterative Smart Protocol for Workplace Charging of Battery Electric Vehicles." *Applied Energy*, 272. <https://doi.org/10.1016/j.apenergy.2020.115187>

2.11. Title: A Comprehensive Study of the Parameters Impacting the Fuel Economy of Plug-in Hybrid Electric Vehicles

Author(s): Taherzadeh, E., Radmanesh, H., and Mehrizi-sani, A.

Abstract: Plug-in hybrid electric vehicles (PHEVs) are one of the most promising solutions that can improve the fuel economy and reduce emissions. The fuel consumption of PHEVs is affected by various factors. This paper identifies four primary factors with significant impact on PHEV fuel consumption. In this paper, after a brief discussion of different types of PHEV configurations, energy management strategies for PHEVs are classified and reviewed in detail. Moreover, the impact of driving conditions, including traffic congestion, road profile, driving distance, weather conditions, and charging behavior, on PHEV fuel economy are comprehensively analyzed. The data regarding the trip can be obtained utilizing intelligent transportation system (ITS) technologies. Finally, commonly used energy storage devices in PHEVs are presented, and their advantages and disadvantages are highlighted.

Subject Areas: Industrial internet of things; Data transmission; Radar-communication integration; Channel status information; Arbitrary geometrical array; Engines; Energy management; Energy storage; Fuel economy; Topology; Electric motors

Availability: Taherzadeh, E., Radmanesh, H., and Mehrizi-sani, A. (2020). "A Comprehensive Study of the Parameters Impacting the Fuel Economy of Plug-in Hybrid Electric Vehicles." *IEEE Transactions on Intelligent Vehicles*. <https://doi.org/10.1109/TIV.2020.2993520>

2.12. Title: A Fuzzy Random Scheduling Model of Islanded Microgrid Considering Dual Uncertainty of EV

Author(s): Ma, Y., Deng, F., Song, X., and Piao, C.

Abstract: Response uncertainty and power uncertainty of electric vehicle (EV) charging/discharging will lead to a new type of high complexity and strong uncertainty in the economic dispatch of EV microgrid. Thus, a fuzzy random economic scheduling model considering dual uncertainty of EV is proposed for islanded EV-source-storage-load microgrid. The uncertainty of EV discharge response is characterized by fuzzy membership function, and the parting model of SOC initial value is established by probability theory, thus a hybrid opportunity-constrained programming model with both fuzzy and random parameters is constructed based on credibility measure. The genetic algorithm combined with fuzzy random simulation technology is given to calculate the operation cost of EV microgrid under different operation conditions. The simulation results verify the feasibility of the proposed method, in which the operation cost is reduced clearly than other several scenarios.

Subject Areas: Fuzzy random scheduling; Electric vehicle; Microgrid; Response uncertainty; Power uncertainty

Availability: Ma, Y., Deng, F., Song, X., and Piao, C. (2020). *A Fuzzy Random Scheduling Model of Islanded Microgrid Considering Dual Uncertainty of EV*. 2020 Asia Energy and Electrical Engineering Symposium (AEEES), Chengdu, China.
<https://doi.org/10.1109/AEEES48850.2020.9121528>

2.13. Title: EV Charging Load Simulation and Forecasting Considering Traffic Jam and Weather to Support the Integration of Renewables and EVs

Author(s): Yan, J., Zhang, J., Liu, Y., Lv, G., Han, S., and Alfonzo, E.G.

Abstract: With the rapid development of electric vehicles (EVs), EV charging load simulation is of significance to tackle the challenges for planning and operating a highly penetrated power system. However, the lack of historical charging data, as well as consideration on the temperature and traffic, pose obstacles to establish an accurate model. This paper presents a spatial-temporal EV charging load profile simulation method considering weather and traffics. First, the impacts of temperature on battery capacity and air-conditioning power are formulated. Second, the energy consumed by air conditioning and car-driving under various traffic conditions is formulated after defining two traffic-related indices. Third, the refined probabilistic models regarding the spatial-temporal vehicle travel pattern are established to improve accuracy. Daily charging load profiles at multiple regions are generated with inputs of refined models and formulations based on Monte Carlo. The real-world data are used to validate the proposed model under various scenarios. The results show that the magnitude, profile shape, and peak time of the charging loads have significant differences in different seasons, traffics, day type, and regions. Optimal planning of the distributed wind and solar capacities is made to improve the renewable power supply to the EV charging based on the simulated regional profiles.

Subject Areas: Electric vehicle; Charging load profile; Spatial-temporal simulation; Traffic condition; Renewable planning; Temperature and air conditioning

Availability: Yan, J., Zhang, J., Liu, Y., Lv, G., Han, S., and Alfonzo, E.G. (2020). “EV Charging Load Simulation and Forecasting Considering Traffic Jam and Weather to Support the Integration of Renewables and EVs.” *Renewable Energy*, 159, pp. 623–641.
<https://doi.org/10.1016/j.renene.2020.03.175>

2.14. Title: Quantifying the Benefits of Electric Vehicles on the Future Electricity Grid in the Midwestern United States

Author(s): Zhang, C., Greenblatt, J.B., MacDoughall, P., Saxena, S., and Prabhakar, A.J.

Abstract: Rising numbers of electric vehicles (EVs) along with increasing renewable electricity will create challenges for electricity grids, potentially leading to significant increases in peak load, overgeneration of renewables during low load periods, and increased ramping requirements. However, controlled EV charging could largely mitigate these issues, transforming EVs from a grid liability into a valuable asset. In this study, we model the evolution of the Midcontinent Independent System Operator grid located in the Midwestern United States with large numbers of forecasted EVs and renewable generation by the late 2030s, over the period of 2019–2039. Uncontrolled charging leads to peak load increases of up to 10% or 8 GW, and exacerbated ramping requirements. In contrast, controlled charging significantly ameliorates these challenges, with unidirectional (“V1G”) charging largely avoiding peak load increases, filling valley loads and reducing ramp rates. Bidirectional (“V2G”) charging provides much larger load flexibility to dramatically reduce peak loads and ramp rates. This study investigates EV load growth in the Midwestern United States and the impact that different types of controlled charging can have on mitigating the grid challenges presented both by large numbers of EVs and increasing levels of renewable generation. Moreover, above ~3 million EVs, V2G charging can exhibit multi-day optimization behavior and very high load flexibility, suggesting the possibility of new load planning tools extending over multiple days. Such capabilities would provide significant aid in optimally scheduling resources with a larger percentage of intermittent renewables.

Subject Areas: Vehicle-to-grid; Electric vehicle; Peak shaving; Controlled charging; Multi-day optimization

Availability: Zhang, C., Greenblatt, J.B., MacDoughall, P., Saxena, S., and Prabhakar, A.J. (2020). “Quantifying the Benefits of Electric Vehicles on the Future Electricity Grid in the Midwestern United States.” *Applied Energy*, 270. <https://doi.org/10.1016/j.apenergy.2020.115174>

2.15. Title: Estimation of Distribution System Capability for Accommodating Electric Vehicles

Author(s): Zeng, B., Zhu, Z., Zhu, X., Qin, L., Liu, J., and Zhang, M.

Abstract: The increasing penetration of electric vehicles (EVs) brings out great challenges to the performance of distribution systems (DSs). To address these challenges, determining the maximum hosting capacity of EVs in DSs becomes an important task for DS operators. In this work, a new methodological framework is proposed to determine the maximum capacity of DSs for accommodating EVs. For this aim, two typical charging scenarios, namely uncontrolled and controlled charging schemes are taken into consideration. In the uncontrolled charging scenario, use load profile of EVs and additional available power (AAP) to determine the maximum hosting capacity. A probabilistic method is utilized to simulate the EV load profiles by using the data of daily travel distance, arrival time and departure time. In the controlled charging scenario, the maximum hosting capacity is calculated by the daily AAP and the energy consumption of EVs charging. A hybrid algorithm based on Monte Carlo simulations is used to determine the maximum capability of DSs for accommodating EVs. The evaluation results confirm the effectiveness of the proposed method.

Subject Areas: Distribution network; Electric vehicles; Charging strategy; Voltage constraint; Monte-Carlo simulation

Availability: Zeng, B., Zhu, Z., Zhu, X., Qin, L., Liu, J., and Zhang, M. (2020). "Estimation of Distribution System Capability for Accommodating Electric Vehicles." *Journal of Electrical Systems*, 16(2), pp. 131–141. http://journal.esrgroups.org/jes/papers/16_2_1.pdf

2.16. Title: Joint Planning of EV Fast Charging Stations and Power Distribution Systems with Balanced Traffic Flow Assignment

Author(s): Yang, W., Liu, W., Chung, C.Y., and Wen, F.

Abstract: To tackle the challenges introduced by the fast-growing charging demand of electric vehicles (EVs), the power distribution systems (PDSs) and fast charging stations (FCSs) of EVs should be planned and operated in a more coordinated fashion. However, existing planning approaches generally aim to minimize investment costs in PDSs while ignoring the risk of worsening traffic conditions. To overcome this research gap, this paper integrates the interests of traffic networks into PDS and FCS joint planning model to mitigate negative impacts on traffic conditions caused by installing FCSs. First, a novel microscopic method that is different from traditional assignment methods is proposed to simulate the influences of FCSs on traffic flows and EV charging loads. Then, a multi-objective joint planning model is developed to minimize both the planning costs and unbalanced traffic flows. A new bilayer Benders decomposition algorithm is designed to solve the proposed joint planning model. Numerical results on two practical systems in China validate the feasibility of our microscopic method by comparing the simulated results with real data. Compared with existing approaches, it is also demonstrated that the proposed joint planning approach helps to balance traffic flow assignments and relieve traffic congestion.

Subject Areas: Electric vehicle (EV); Bilayer expanded Benders decomposition; Multi-agent-based microscopic traffic assignment model (MMTAM); Joint planning; Traffic flow assignment; Load modeling

Availability: Yang, W., Liu, W., Chung, C.Y., and Wen, F. (2020). “Joint Planning of EV Fast Charging Stations and Power Distribution Systems with Balanced Traffic Flow Assignment.” *IEEE Transactions on Industrial Informatics*. <https://doi.org/10.1109/TII.2020.2995742>

2.17. Title: CyDER: A Cyber Physical Co-simulation Platform for Distributed Energy Resources in Smartgrids

Author(s): Gehbauer, C.

Abstract: The CyDER project aimed at developing an open-source, modular, and scalable co-simulation platform for power grids with large shares of Distributed Energy Resources (DERs). The project partners are the Lawrence Berkeley National Lab (LBNL), Lawrence Livermore National Lab (LLNL), PG&E, SolarCity, and ChargePoint. The prime recipient is LBNL; SolarCity and ChargePoint were partners for the project's first 2 years.

Increased DER integration introduces a number of challenges in power grid operation, including a more dynamic interaction between the transmission grid and distribution grids and increased modeling complexity. Although specialized software exists to precisely model different components of the power system, it is far from trivial to integrate all various models and perform a holistic simulation. Instead of replicating all models in a common simulation program, a commonly accepted approach to tackle this model diversity is to couple third-party simulators and models through a co-simulation platform that coordinates information exchange among the various components.

Following this line of research, this project's objective was to develop a co-simulation platform based on a widely accepted industrial standard called Functional Mockup Interface (FMI). Within this process, the project developed models compliant with the FMI standard, called Functional Mockup Units (FMUs), and used them to perform various operational and planning power system analyses. Relying and building upon an industrial standard is the main differentiation of this project compared with previous or parallel efforts in the co-simulation area. Particular emphasis was put on delivering software utilities to facilitate setting up and running co-simulations by end-users. Furthermore, a strong aspect of this project is demonstrating that co-simulation techniques can be used to perform Hardware-in-the-Loop (HIL) simulations that couple software components (e.g., simulated models) with hardware components (e.g., real devices such PV systems and batteries). The long-term goal of CyDER project is to help establish FMI as a powerful standard for co-simulation and promote adoption by electric utilities and other interested stakeholders.

The main accomplishments of the project include the development of several FMUs including distribution and transmission grid models, PV inverters with Volt/Var/Watt controllers, batteries, and predictive optimal controllers. Additionally, a unique software package was developed, called SimulatorToFMU, which is capable of exporting any Python-driven simulator or Python script as an FMU. This is an important contribution toward establishing FMI as one of the main co-simulation standards because more and more third-party programs for sub-system modeling and simulation are delivered with Python APIs. The CyDER platform was used to perform PV hosting capacity analyses in real utility feeders with and without smart inverter controls, battery storage, and EV charging. Smart inverter controls include conventional Volt/Var/Watt controls for reactive power support and active power curtailment, but also predictive controls that optimize the charging and discharging profile of the battery connected on the DC side in order to minimize the customer's economic benefit. Finally, an important result of this project is

delivering an experimental setup that consists of residential-scale PV inverters with battery storage, a real-time grid simulator with an ideal voltage source as grid emulator, and micro Phasor Measurement Units (PMUs). All these components and additional software modules are coupled to one another using the FMI standard and can be co-simulated with the CyDER platform.

Subject Areas: Distributed energy resources (DERs); Power grid operation; Functional mockup interface (FMI); Functional mockup units (FMUs)

Availability: Gehbauer, C. (2020). *CyDER: A Cyber Physical Co-simulation Platform for Distributed Energy Resources in Smartgrids*. Department of Energy, Washington, DC.
https://escholarship.org/content/qt50p006g8/qt50p006g8_noSplash_03f1316cb411f7cae3858bac7d9aaa7b.pdf

2.18. Title: A Data Decomposition Approach to Design a Dynamic Pricing Mechanism for Residence-Based Plug-in Electric Vehicles in Wind Energy-Rich Grids

Author(s): Eldali, F.A., Vadana, D.P., Burkhardt, J., and Suryanarayanan, S.

Abstract: Grid-level energy storage presents a potential mechanism for storing excess wind energy in wind energy-rich grids. However, the current economic infeasibility of grid-level storage hinders widespread practical application. Alternatively, plug-in electric vehicles (PEVs) present a potentially adaptable load that can facilitate managing excess wind energy. Our previous research justifies the need for a pricing mechanism that can coordinate wind energy and PEVs charging. In this paper, we employ a data decomposition approach (i.e., the dynamic mode decomposition) to design a dedicated pricing mechanism for PEVs. We use data from a city with relatively high current and projected PEV adoption rates (Austin, TX) located in a wind-rich electricity grid (ERCOT). Our results indicate that a dedicated seasonal time of use pricing for PEVs can reduce wind energy curtailments, reduce emissions from electricity generation and PEV charging, and potentially avoid wind energy output curtailments.

Subject Areas: Customer incentive pricing; Dynamic mode decomposition; Plug-in electric vehicles; Time of use; Time-varying pricing; Wind power curtailment

Availability: Eldali, F.A., Vadana, D.P., Burkhardt, J., and Suryanarayanan, S. (2020). "A Data Decomposition Approach to Design a Dynamic Pricing Mechanism for Residence-Based Plug-in Electric Vehicles in Wind Energy-Rich Grids." *eTransportation*, 4. <https://doi.org/10.1016/j.etrans.2020.100062>

2.19. Title: On-Demand Automotive Fleet Electrification Can Catalyze Global Transportation Decarbonization and Smart Urban Mobility

Author(s): Bauer, G., Zheng, C., Greenblatt, J.B., Shaheen, S., and Kammen, D.M.

Abstract: Mobility on-demand vehicle (MODV) services have grown explosively in recent years, threatening targets for local air pollution and global carbon emissions. Despite evidence that on-demand automotive fleets are ripe for electrification, adoption of battery electric vehicles (BEVs) in fleet applications has been hindered by lack of charging infrastructure and long charging times. Recent research on electrification programs in Chinese megacities suggests that top-down policy targets can spur investment in charging infrastructure, while intelligent charging coordination can greatly reduce requirements for battery range and infrastructure, as well as revenue losses due to time spent charging. Such capability may require labor policy reform to allow fleet operators to manage their drivers' charging behavior, along with collection and integration of several key data sets, including: (1) vehicle trajectories and energy consumption, (2) charging infrastructure installation costs, and (3) real-time charging station availability. In turn, digitization enabled by fleet electrification holds the potential to enable a host of smart urban mobility strategies, including integration of public transit with innovative transportation systems and emission-based pricing policies.

Subject Areas: Redox reactions; Batteries; Mathematical methods; Computational chemistry; Fossil fuels

Availability: Bauer, G., Zheng, C., Greenblatt, J.B., Shaheen, S., and Kammen, D.M. (2020). "On-Demand Automotive Fleet Electrification Can Catalyze Global Transportation Decarbonization and Smart Urban Mobility." *Environmental Science & Technology*, 54 (12), pp. 7027–7033. <https://doi.org/10.1021/acs.est.0c01609>

2.20. Title: Charge Scheduling of Electric Vehicles in Smart Parking-Lot Under Future Demands Uncertainty

Author(s): Fallah-Mehrjardi, O., Yaghmaee, M.H., and Leon-Garcia, A.

Abstract: In this study, a public parking lot is assumed to schedule the charging of Electric Vehicles (EVs). Each EV owner upon arriving gives the energy demand as well as departure time to the system and immediately receives feedback, fulfilling or adjusting the request. The system designed in this study decides based on the previously admitted requests and the uncertain future demands in both Admission Control (AC) and Charge Scheduling (CS) mechanisms. We formulate a multi-stage stochastic programming model to minimize the expected total energy costs over the finite time horizon. Next, we approximate the model using a finite scenario tree. However, this model is computationally intractable, even for a moderate number of stages. Therefore, we customize a well-known decomposition procedure, Stochastic Dual Dynamic Programming (SDDP), to be matched the time-dependent charging conditions. Since the procedure takes several hours to obtain a high-quality solution, we run it once in the offline mode and employing the results for the online mode. The simulation results indicate that the proposed method outperforms the myopic approach and obtains a close solution to the theoretical optimal value in terms of total costs and rejected demands.

Subject Areas: Stochastic processes; Uncertainty; Schedules; Computational modeling; Charging stations; Pricing; Optimization; Electric vehicle; Admission control; Parking lot; Decomposition

Availability: Fallah-Mehrjardi, O., Yaghmaee, M.H., and Leon-Garcia, A. (2020). “Charge Scheduling of Electric Vehicles in Smart Parking-Lot Under Future Demands Uncertainty.” *IEEE Transactions on Smart Grid*, 11(6), pp. 4949–4959. <https://doi.org/10.1109/TSG.2020.3000850>

2.21. Title: Impact of EV on the Icelandic Power System: A General Analysis and Cost Estimate

Author(s): Haraldsson, H.V.

Abstract: The increasing problem of reducing global warming has led to a demand for less polluting transport; this is usually in the form of electric vehicles. But what impact do larger percentages of EVs have on both pollution and on the power system in general? This study aims to answer some of the questions as they relate to these problems in Iceland—what is the total benefit in greenhouse gas emissions, and, more importantly, what is the total cost for the Icelandic power system in relation to system upgrades and how do we estimate it? The entire Icelandic power system was simulated in MATPOWER using two models (the current system and a future development plan) and several methods for estimating both the cost of system upgrades and what part the electric load from EVs had in that cost. The results show which parts of the system need to be upgraded and when. Finally, the cost for each simulated case is summarized and put forth as a total number. It can be concluded that the cost of increasing EVs is considerable in worst case scenarios where future location of power production uncertainty are taken into account.

Subject Areas: Pollution; Power system; Electric vehicles

Availability: Haraldsson, H.V. (2020). *Impact of EV on the Icelandic Power System: A General Analysis and Cost Estimate*. Reykjavík University, Iceland. <http://hdl.handle.net/1946/36419>

2.22. Title: Levelized Cost of Charging Electric Vehicles in the United States

Author(s): Borlaug, B., Salisbury, S., Gerdes, M., and Muratori, M.

Abstract: The cost to charge an electric vehicle (EV) varies depending on the price of electricity at different charging sites (home, workplace, and public), vehicle use, region, and time of day, as well as for different charging power levels and equipment and installation costs. This paper provides a detailed assessment of the current (2019) levelized cost of light-duty EV charging in the United States, considering the purchase and installation costs of charging equipment and electricity prices from real-world utility tariffs. We find national averages of \$0.15/kWh for battery EVs and \$0.14/kWh for plug-in hybrid EVs in the United States. Costs, however, vary considerably (e.g., \$0.08/kWh to \$0.27/kWh for battery EVs) for different charging behaviors and equipment costs, corresponding to a total projected fuel cost savings between \$3,000 and \$10,500 compared with gasoline vehicles (over a 15-year time horizon). Regional heterogeneities and uncertainty on lifetime vehicle use and future fuel prices produce even greater variations.

Subject Areas: Electric vehicles; Cost of electricity; Fuel costs; Utility rate analysis; Demand charges; Time of use; Electric vehicles; Electric vehicle charging; Utility tariffs; Cost of charging

Availability: Borlaug, B., Salisbury, S., Gerdes, M., and Muratori, M. (2020). "Levelized Cost of Charging Electric Vehicles in the United States." *Joule*, 4(7), pp. 1470–1485.

<https://doi.org/10.1016/j.joule.2020.05.013>

2.23. Title: An Investigation on the Feasibility of Near-Zero and Positive Energy Communities in the Greek Context

Author(s): Sougkakis, V., Lympelopoulos, K., Nikolopoulos, N., Margaritis, N., Giourka, P., and Angelakoglou, K.

Abstract: Near Zero Energy and Positive Energy communities are expected to play a significant part in EU's strategy to cut greenhouse gas emissions by 2050. Within this context, the work presented in this paper aims to investigate the feasibility of: (a) a new-built positive energy neighborhood and (b) the retrofit of an existing neighborhood to near zero energy performance in the city of Alexandroupolis, Greece. Proposed measures involve the rollout at the community scale of renewable energy technologies (PV, geothermal heat pump), energy efficiency (fabric insulation, district heating and cooling networks) and storage systems (batteries). A parametric analysis is conducted to identify the optimum combination of technologies through suitable technical and financial criteria. Results indicate that zero and near zero emissions targets are met with various combinations that impose insulation levels, according to building regulations or slightly higher, and consider renewable energy production with an autonomy of half or, more commonly, one day. In addition, the advantages of performing nearly zero energy retrofit at the district, rather than the building level, are highlighted, in an attempt to stimulate interest in community energy schemes.

Subject Areas: Near Zero Energy communities; Positive energy communities; Renewable energy; Energy storage; District heating and cooling

Availability: Sougkakis, V., Lympelopoulos, K., Nikolopoulos, N., Margaritis, N., Giourka, P., and Angelakoglou, K. (2020). "An Investigation on the Feasibility of Near-Zero and Positive Energy Communities in the Greek Context." *Smart Cities*, 3(2), pp. 362–384.
<https://doi.org/10.3390/smartcities3020019>

2.24. Title: Reliability Improvement of Distribution System Considering EV Parking Lots

Author(s): Guner, S. and Ozdemir, A.

Abstract: Metropolitan cities have hundreds of parking lots (PLs), where each PL may have a capacity to hold hundreds of cars. Large-scale use of electric vehicles coupled with technological advancements in battery storage systems provide several technical and economic benefits of integrating PLs into the grid. This study presents the impacts of electric vehicle PLs on the distribution system reliability. The reliability indices of the distribution feeder are determined using recently proposed novel storage capacity model of a PL that accounts for the load and component outage data of the distribution feeder. The paper uses average interruption duration, average interruption frequency, and energy not served as feeder reliability indices. For load point reliability indices interruption frequency, interruption duration and energy not served are used. Numerical results, thus attained, show that for the backup operation mode of the PL; the feeder reliability indices and load point reliability indices improve up to 26% and 44% respectively.

Subject Areas: Electric vehicle; Parking lots; Distributed energy resources; Energy storage capacity; Reliability assessment; Distribution system

Availability: Guner, S. and Ozdemir, A. (2020). “Reliability Improvement of Distribution System Considering EV Parking Lots.” *Electric Power Systems Research*, 185.
<https://doi.org/10.1016/j.epsr.2020.106353>

2.25. Title: Encouraging Electrification through Energy Service Subscriptions

Author(s): Cleary, K. and Palmer, K.

Abstract: Energy-as-a-Service (EaaS) is a private business model that enables consumers to subscribe to an energy service (such as lighting) rather than purchasing the equipment necessary to provide that service (such as light fixtures). In the past, EaaS has helped encourage the deployment of low-carbon technologies like energy-efficient equipment by eliminating high upfront costs for consumers. In this paper, we assess how the EaaS model can be used to help overcome barriers for electrification of energy end-uses like vehicles and water heaters, which is critical for reducing carbon emissions from transportation and buildings. We explore the potential of two basic hypothetical EaaS business models: a subscription for energy management, which involves optimizing energy usage in order to minimize costs, and a subscription for energy services, which enables consumers to use an energy service such as hot water without purchasing the necessary devices. These business models are possible under two different frameworks, a time-varying pricing variant and a demand-response variant, that allow service companies and customers to benefit from these business models. Our main findings are as follows:

- EaaS improves access to low-carbon technologies by removing or reducing high up-front costs for expensive electrical equipment or devices, such as electric vehicles or grid-connected water heaters, by converting the payment into a monthly subscription fee.
- EaaS enables consumers and businesses to take advantage of benefits of electrification through device management, such as providing grid services or saving money on energy expenses, that may not be available to consumers under private ownership.
- A subscription for electric energy services can also mitigate some of the grid-related issues that arise with electrification, such as reducing the need for more peaking capacity.
- An absence of companies in this space could indicate that barriers to entry exist; policy intervention and regulatory changes can help remove some of these potential barriers and enable more EaaS companies to thrive.

Subject Areas: Energy-as-a-Service; Subscription; Low-carbon technologies; Energy management; Energy services

Availability: Cleary, K. and Palmer, K. (2020). *Encouraging Electrification through Energy Service Subscriptions*. Resources for the Future, Washington, DC.

https://media.rff.org/documents/WP_20-09_EaaS.pdf

2.26. Title: Optimal Coordination of Electric Vehicles for Virtual Power Plants with Dynamic Communication Spectrum Allocation

Author(s): Zhou, B., Zhang, K., Chan, K.W., Li, C., Lu, X., Bu, S., and Gao, X.

Abstract: This paper proposes an optimal coordinated scheduling of electric vehicles (EVs) for a virtual power plant (VPP) considering communication reliability. Recent advancements on wireless technologies offer flexible communication solutions with wide coverage and low-cost deployment for smart grid. Nevertheless, the imperfect communication may deteriorate the monitoring and controlling performance of distributed energy resources. An interactive approach is presented for combined optimization of dynamic spectrum allocation and EV scheduling in the VPP to coordinate charging/discharging strategies of massive and dispersed EVs. In the proposed approach, a dynamic partitioning model of the multi-user multi-channel cognitive radio is used to cope with the vehicle-to-grid (V2G) communication issue due to variable EV parking behaviors, and a two-stage V2G dispatch scheme is proposed for the wind-solar-EV VPP to maximize its overall daily profit. Furthermore, the effects of packet loss probability on the VPP scheduling performance and battery degradation cost are thoroughly analyzed and investigated. Comparative studies have been implemented to demonstrate the superior performance of the proposed methodology under various imperfect communication conditions.

Subject Areas: Vehicle-to-grid; Real-time systems; Batteries; Wireless communication; Monitoring; Packet loss; Smart grid; Stochastic optimization; Virtual power plant

Availability: Zhou, B., Zhang, K., Chan, K.W., Li, C., Lu, X., Bu, S., and Gao, X. (2020). "Optimal Coordination of Electric Vehicles for Virtual Power Plants with Dynamic Communication Spectrum Allocation." *IEEE Transactions on Industrial Informatics*. <https://doi.org/10.1109/TII.2020.2986883>

2.27. Title: Optimal Public Parking Lot Allocation and Management for Efficient PEV Accommodation in Distribution Systems

Author(s): Zeng, B., Zhu, Z., Xu, H., and Dong, H.

Abstract: Progressive popularization of plug-in electric vehicles (PEVs) calls for synergistic deployment of public charging infrastructures to serve the recharging needs in future urban systems. For this end, a new planning framework to facilitate efficient accommodation of PEVs via gridable parking lots (PLs) is proposed in this study. Different from most previous works, the presented method explicitly considers the potential uncertainties in users' behaviors in PL planning, which will allow decision-makers to better assess the effect of human factors on the efficiency of their investment. Moreover, the concerned PL allocation problem has been investigated in conjunction with the optimal contract offer for PEV users to obtain the final planning scheme. The overall problem is formulated as a two-stage stochastic programming model, where the first-stage mainly deals with the planning decisions associated with PLs, including siting and sizing of PLs and contractual arrangements, while the second stage evaluates the operational performance of the suggested PL system under different scenario realizations of PEV behaviors. A combinatorial optimization algorithm is used to solve the problem. The proposed framework is demonstrated on an illustrative testing system and numerical results verify the effectiveness of our method.

Subject Areas: Plug-in electric vehicle; Parking lot; Allocation planning; Physical-social system; Stochastic programming; Planning; Resource management; Vehicle-to-grid; Uncertainty; Batteries

Availability: Zeng, B., Zhu, Z., Xu, H., and Dong, H. (2020). "Optimal Public Parking Lot Allocation and Management for Efficient PEV Accommodation in Distribution Systems." *IEEE Transactions on Industry Applications*, 56(5), pp. 5984–5994.
<https://doi.org/10.1109/TIA.2020.2986980>

2.28. Title: A Probabilistic Evaluation Method of Household EVs Dispatching Potential Considering Users Multiple Travel Needs

Author(s): Gan, L., Chen, X., Yu, K., Zheng, J., and Du, W.

Abstract: With the explosion of on-road electric vehicles (EVs), private EVs become the most majority of the EV population and also turns out to have the most flexible dispatching potential for power system. Accurate potential analysis of the flexibility has great significance for charging infrastructure upgrade, power system operation, and market mechanism design. A probabilistic evaluation method of household EVs dispatching potential is proposed here considering users' multiple travel needs. Based on a realistic investigation on driving pattern of domestic cars, the probability distributions of multiple trip parameters are fitted with a proposed least-square-estimation based parameter optimization method. Sequentially, the sampling of random trip parameters is conducted considering the plug-in rate and coupling characteristics of trip parameters with a copula-based sampling method. Based on evaluating the shifting potential of EV charging load, the influence on the shifted load, brought by the implementation of time-of-use (TOU) price mechanism, is quantified by taking residential energy-consumption behavior into account. Numerical result shows the accuracy and rationality to simulate the charging load considering multiple daily travel needs and the effectiveness of TOU price on EV load shifting based on the dispatching potential evaluation.

Subject Areas: Electric vehicle charging; Probabilistic logic; Load modeling; Dispatching; Electric potential; Batteries; Multiple travel needs; Price mechanism

Availability: Gan, L., Chen, X., Yu, K., Zheng, J., and Du, W. (2020). "A Probabilistic Evaluation Method of Household EVs Dispatching Potential Considering Users Multiple Travel Needs." *IEEE Transactions on Industry Applications*, 56(5), pp. 5858–5867.
<https://doi.org/10.1109/TIA.2020.2989690>

2.29. Title: Coordinating EV Charging via Blockchain

Author(s): Ping, J., Yan, Z., Chen, S., Yao, L., and Qian, M.

Abstract: The increasing electric vehicle (EV) penetration in a distribution network triggers the need for EV charging coordination. This paper firstly proposes a hierarchical EV charging coordination model and an algorithm based on Lagrangian relaxation. A barrier to the implementation of the coordination algorithm is that there usually does not exist a reliable coordinator of charging stations. This paper shows that an unreliable coordinator may collude with some charging stations and behave dishonestly by disobeying the coordination algorithm. Thus, the collusion coalition can gain more profits while lowering the profits of others and the total social welfare. To provide reliable coordination of charging stations, a novel blockchain-based coordination platform via Ethereum is established, including a coordination structure and a smart contract. A mathematical analysis is given to show that the proposed platform can mitigate the collusion behaviors in the coordination. Simulation results show the consequence of collusion and how blockchain can prevent the collusion.

Subject Areas: Electric vehicle (EV) charging coordination; Collusion; Blockchain; Smart contract

Availability: Ping, J., Yan, Z., Chen, S., Yao, L., and Qian, M. (2020). “Coordinating EV Charging via Blockchain.” *Journal of Modern Power Systems and Clean Energy*, 8(3), pp. 573–581. <https://doi.org/10.35833/MPCE.2019.000393>

2.30. Title: Charging Strategy Unifying Spatial-Temporal Coordination of Electric Vehicles

Author(s): Zhang, J., Pei, Y., Shen, J., Wang, L., Ding, T., and Wang, S.

Abstract: This paper focuses on how to make a charging guidance for urgent-charging electric vehicles (EVs) to fast charging stations. To avoid charging overload in the spatial-temporal scale and excessive waiting time for EV users, a charging guidance strategy based on the virtual service range is proposed. Considering the mutual influence among EV charging selections, the proposed strategy can unify the temporal shift and spatial shift of the charging load into the same time scale to control rather than other works only do the temporal shift. Specifically, the proposed strategy has two stages: the charging arrangement and the spatial-temporal shift. The charging arrangement stage is to determine whether an EV can be allowed to charge at a certain time and a given charging station, while the spatial-temporal shift stage is to regulate the charging time or charging location. Besides, a bucket sort-based algorithm is proposed to solve the formulated problem in the charging arrangement stage. Finally, three scenarios have been designed to demonstrate the feasibility of the proposed strategy and the performance of the presented algorithm is compared with the other decentralized algorithms.

Subject Areas: Charging stations; Electric vehicle charging; Pricing; Analytical models; Games; Charging load; Driving time; Electric vehicle; Spatial-temporal; Waiting time

Availability: Zhang, J., Pei, Y., Shen, J., Wang, L., Ding, T., and Wang, S. (2020). "Charging Strategy Unifying Spatial-Temporal Coordination of Electric Vehicles." *IEEE Access*, 8, pp. 74853–74863. <https://doi.org/10.1109/ACCESS.2020.2987607>

2.31. Title: Two Trillion Gallons: Fuel Savings From Fuel Economy Improvements to US Light-Duty Vehicles, 1975–2018

Author(s): Greene, D.L., Sims, C.B., and Muratori, M.

Abstract: Since 1975, the fuel economy of new light-duty vehicles sold in the United States has almost doubled. Fuel economy improvements on laboratory tests gradually became real improvements on the road as newer, more efficient vehicles replaced older less efficient ones. Fleet-wide fuel economy gains produced large fuel savings. In this paper, we show that fuel economy gains measured on laboratory test cycles, adjusted for on-road conditions and weighted by the distribution of vehicles by age and their relative use, closely match estimates by the Federal Highway Administration based primarily on traffic counts and motor fuel tax records. Adjusting for the rebound effect of fuel economy on vehicle miles traveled, we estimate the fuel savings, CO₂ emissions reductions, and dollars saved on fuel due to fuel economy improvements over the past 43 years. Through the end of 2018, estimated cumulative fuel savings amount to approximately 2 trillion gallons of gasoline. We estimate that roughly one-fifth of the savings can be attributed to gasoline price increases over the period and four-fifths to fuel economy and greenhouse gas (ghg) standards.

Subject Areas: Fuel economy; Rebound effect; Energy efficiency; Corporate Average Fuel Economy (CAFE) standards; Greenhouse gas regulations; Light-duty vehicles

Availability: Greene, D.L., Sims, C.B., and Muratori, M. (2020). “Two Trillion Gallons: Fuel Savings From Fuel Economy Improvements to US Light-Duty Vehicles, 1975–2018.” *Energy Policy*, 142. <https://doi.org/10.1016/j.enpol.2020.111517>

2.32. Title: Electric Factor—A Comparison of Car Usage Profiles of Electric and Conventional Vehicles by a Probabilistic Approach

Author(s): Niklas, U., von Behren, S., Chlond, B., and Vortisch, P.

Abstract: To counteract climate change, electric vehicles are replacing vehicles with internal combustion engine on the automotive market. Therefore, electric vehicles must be accepted and used like conventional vehicles. This study aims to investigate to which extent electric vehicles are already being used like conventional vehicles. To do this, we present a supervised method where we combine usage data from conventional vehicles (from car use model based on survey data) and electric vehicles (from sensor data) in Germany and California. Based on conventional vehicles, eight car usage profiles were defined by hierarchical clustering in a previous study. Using a softmax regression, we estimate for each electric vehicle a probability of assignment for every car usage profile. Comparison of conventional and electric vehicles with a high probability reveals that electric vehicles are used similar for long-distance travel (>100 km) and different for short-distance travel (<10 km) to conventional vehicles. This implies that electric vehicles are indeed used for long-distance travel but are still not entirely used for everyday mobility. This could be because electric vehicles are not yet suitable for all trip purposes (e.g., transport of larger items).

Subject Areas: Electric vehicles; Conventional vehicles; Car usage profiles; Supervised learning; Softmax regression; Germany; California

Availability: Niklas, U., von Behren, S., Chlond, B., and Vortisch, P. (2020). “Electric Factor—A Comparison of Car Usage Profiles of Electric and Conventional Vehicles by a Probabilistic Approach.” *World Electric Vehicle Journal*, 11(2). <https://doi.org/10.3390/wevj11020036>

2.33. Title: Power Optimized Battery Swap and Recharge Strategies for Electric Aircraft Operations

Author(s): Justin, C.Y., Payan, A.P., Briceno, S.I., German, B.J., and Mavris, D.N.

Abstract: Electric propulsion for commuter air transportation is a promising technology because of significant strides in battery-specific energy and motor-specific power. Energy storage and rapid battery recharge remain nonetheless challenging owing to the significant energy and power requirements of even small aircraft. By modifying algorithms developed in the field of scheduling theory, we propose power-optimized and power-investment–optimized strategies for electric aircraft battery swaps and recharges. Several aspects are considered: electric energy expenditures, capital expenditures, and flight schedule integrity. The first strategy optimizes the swaps and recharges to minimize the peak power draw from the grid and reduce electric energy expenditures. The second strategy optimizes the swaps and recharges to minimize electricity expenditures and capital expenditures associated with battery and charger procurement. In both cases, the optimization is decomposed into two steps. The first step determines the combinations of numbers of chargers and batteries that yield a feasible recharge schedule. It is based on a network flow representation of the battery swap and recharge. The second step builds a recharge schedule for the previously determined numbers of chargers and batteries. Together, they enable the estimation of peak power demand, electric expenditures, and capital expenditures used to implement the power optimized and power-investment–optimized strategies. Both strategies are applied to the operations of two commuter airlines and are contrasted with a benchmark non-optimized power-as-needed strategy. Promising results are obtained with up to 61% reduction in peak power draw and up to 25% reduction in electricity costs.

Subject Areas: Electric aircraft; Battery recharge; Battery swap; Scheduling; Electricity price

Availability: Justin, C.Y., Payan, A.P., Briceno, S.I., German, B.J., and Mavris, D.N. (2020). “Power Optimized Battery Swap and Recharge Strategies for Electric Aircraft Operations.” *Transportation Research Part C: Emerging Technologies*, 115. <https://doi.org/10.1016/j.trc.2020.02.027>

**2.34. Title: Why Do Some Consumers Not Charge Their Plug-in Hybrid Vehicles?
Evidence From Californian Plug-in Hybrid Owners**

Author(s): Chakraborty, D., Hardman, S., and Tal, G.

Abstract: The environmental benefits of plug-in hybrid electric vehicles (PHEVs) are closely related to the driving and charging behavior of vehicle owners. It is often wrongly assumed that PHEV drivers plug in once per day. Using data from drivers of the vehicles, we show this is not the case and that some drivers rarely charge their PHEV. If the vehicle is not plugged in regularly, the vehicle will drive fewer electric miles and more gasoline miles, thereby losing out on potential emission savings. Analyzing 30-day charging behavior of 5,418 PHEV owners using a logistic regression model, we explore the factors that influence drivers' decisions to not charge their vehicle. Several factors play a role in drivers' decisions to plug in their PHEV or not, including vehicle characteristics and the availability and cost of charging at various locations. Higher home electricity prices, lower electric driving range, lower electric motor power to vehicle weight ratios, lower potential cost savings from charging, and living in an apartment or condo, among other factors, are related to not plugging in a PHEV. The findings have important implications in terms of future policy and vehicle design including which PHEVs policymakers should incentivize and what measures can encourage PHEV owners to plug in their vehicles to help realize the environmental benefits of the technology.

Subject Areas: Plug-in hybrid electric vehicles; Driving and charging behavior; Environmental benefits

Availability: Chakraborty, D., Hardman, S., and Tal, G. (2020). "Why Do Some Consumers Not Charge Their Plug-in Hybrid Vehicles? Evidence From Californian Plug-in Hybrid Owners." *Environmental Research Letters*, 15. <https://doi.org/10.1088/1748-9326/ab8ca5>

2.35. Title: Vehicle Air Conditioner Temperature Regulation-based Orderly Charging Strategy for Electric Vehicles

Author(s): Piao, C., Liu, Z., Zhao, C., Song, W., and Long, H.

Abstract: Due to high-power load peaks and long durations in extreme weather conditions, as well as large-scale unscheduled electric vehicles charging, it may cause “peak plus peak” loading in local areas of the power grid, moreover, lead to transformer substations overload operation in local areas, which is not good for distribution safe and stable operation of the power grid. Considering the driver’s willingness, this study proposes an orderly charging strategy based on the temperature control of electric vehicle on-board air conditioner. The proposed strategy first constructs the temperature control model for electric vehicle cabins with considering the temperature of entire electric vehicle and the special characteristics of urban roads. Then, multi-objective function is formed with minimum user charging cost and variance of grid load fluctuations. Finally, electric vehicle orderly charging period is optimized by combining with electric vehicle travel chains, charge constraints, time-of-use electricity prices, and substation capacity constraints. The results show that temperature-controlled dispatching can effectively reduce the electric vehicle disorderly charging load. It can serve the power grid “cut peaks and fill valleys” and smooth the overall grid load curve using an improved Lagrange relaxation algorithm to optimize the electric vehicle charging period.

Subject Areas: Power grid; Overload; Electric vehicle charging; On-board air conditioner; Temperature-controlled dispatching; Lagrange relaxation algorithm; Optimization

Availability: Piao, C., Liu, Z., Zhao, C., Song, W., and Long, H. (2020). “Vehicle Air Conditioner Temperature Regulation-based Orderly Charging Strategy for Electric Vehicles.” *IOP Conference Series: Materials Science and Engineering*, 782. <https://doi.org/10.1088/1757-899X/782/3/032050>

2.36. Title: Algorithmic and Simulated Based Transmission Ratio Optimization of A Two-Speed Electric Vehicle For Car-sharing

Author(s): Ma, J., Wu, L., Gong, Z., and Cao, Y.

Abstract: This paper proposes an approach to optimize the fuel economy of a two-speed electric vehicle (EV) in car sharing business through Genetic Algorithm and ADVISOR co-simulation. The ADVISOR simulation model was built, including dynamics, fuel cell, storage battery, and motor. Under NEDC working conditions, the two-speed gearbox modeled, modeled, and the optimal combination of transmission ration and main reduction ratio is found by genetic algorithm to improve fuel economy.

Subject Areas: Two-speed electric vehicle; Fuel economy; Genetic algorithm; Optimization; ADVISOR co-simulation

Availability: Ma, J., Wu, L., Gong, Z., and Cao, Y. (2020). "Algorithmic and Simulated Based Transmission Ratio Optimization of A Two-Speed Electric Vehicle For Car-sharing." *IOP Conference Series: Materials Science and Engineering*, 782. <https://doi.org/10.1088/1757-899X/782/3/032074>

2.37. Title: A Holistic Analysis of Passenger Travel Energy and Greenhouse Gas Intensities

Author(s): Schäfer, A.W. and Yeh, S.

Abstract: Transportation is a major energy consumer and emitter of greenhouse gases (GHGs). Exploring the opportunities for energy savings and GHG emissions reductions requires understanding transportation energy or GHG intensity, which is defined as energy use or GHG emissions per unit activity, here passenger-kilometers traveled. This aggregate indicator quantifies the amount of energy required or GHGs emitted to provide a generic transportation service. We show that the range of observed energy and GHG intensities of major transportation modes is remarkably similar and that occupancy explains about 70–90% of the variation around the mean; only the remaining 10–30% is explained by differences in trip distances and other factors such as technology and operating conditions. Whereas average occupancy levels differ vastly, they translate into roughly similar levels of energy and GHG intensity for nearly all major transportation modes.

Subject Areas: Greenhouse gas intensity; Energy savings; Occupancy

Availability: Schäfer, A.W. and Yeh, S. (2020). “A Holistic Analysis of Passenger Travel Energy and Greenhouse Gas Intensities.” *Nature Sustainability*, 3, pp. 459–462.
<https://doi.org/10.1038/s41893-020-0514-9>

2.38. Title: A Multi-Objective Coordinated Charging and Discharging Strategy for Electric Vehicles Based on Stackelberg Game

Author(s): Xu, H. and Huang, X.

Abstract: For the negative impact of large-scale electric vehicles (EVs) disorderly charging on the power grid, a multi-objective optimization strategy for coordinated charging and discharging of EVs based on Stackelberg game is proposed. As the leader, the grid company aims to stabilize load fluctuations and formulate a reasonable electricity price strategy to guide EVs to participate in vehicle-to-grid (V2G). As followers, EV users optimize their charging plans based on electricity price information with the objective of reducing costs and obtaining good comfort. This paper uses the MOPSO algorithm to solve the proposed multi-objective Stackelberg problem and calculates the optimization results under various preferences, which proves the effectiveness of the proposed model and method.

Subject Areas: Vehicle-to-grid (V2G); Stackelberg game; Electric vehicle (EV); Optimal dispatch

Availability: Xu, H. and Huang, X. (2020). "A Multi-Objective Coordinated Charging and Discharging Strategy for Electric Vehicles Based on Stackelberg Game." *Energy and Power Engineering*, 12(4B), pp. 63–72. <https://doi.org/10.4236/epe.2020.124B007>

2.39. Title: Mitigating Transformer Loss of Life and Reducing the Hazard of Failure by the Smart EV Charging

Author(s): Soleimani, M. and Kezunovic, M.

Abstract: The impacts of uncoordinated charging of electrical vehicles (EVs) under high penetration on distribution transformers is studied. It is shown that it may cause prolonged overload condition leading to accelerated assets loss of life and increased hazard of failure. To mitigate the impact, a fuzzy logic-based algorithm is devised. It provides a performance index for distribution grid operator using four main inputs: (1) EV battery state of charge, (2) required state of charge for the next trip, (3) estimated time of EV departure, and (4) customer comfort level. A decision-support tool is proposed by which the distribution grid operators can utilize the output of the fuzzy systems to receive a suggestion whether to delay the charging of each EV and pay the incentive to the EV owner. The data for the city of College Station, TX, including temperature, price of electricity, and load profile, are collected from various sources to simulate different use cases. The example illustrates how the proposed EV management approach could mitigate the impact of EV charging on the transformer loss of life and hazard of failure. The main advantage of the proposed approach is the low cost and ease of design implementation. The information that needs to be sent from the consumer to the distribution system operator is minimized, which helps in maintaining costumers' privacy.

Subject Areas: Hazards; State of charge; Electric vehicle charging; Fuzzy logic; Temperature distribution; Stress; Batteries

Availability: Soleimani, M. and Kezunovic, M. (2020). "Mitigating Transformer Loss of Life and Reducing the Hazard of Failure by the Smart EV Charging." *IEEE Transactions on Industry Applications*, 56(5), pp. 5974–5983. <https://doi.org/10.1109/TIA.2020.2986990>

2.40. Title: A Packetized Energy Management Macromodel With Quality of Service Guarantees for Demand-side Resources

Author(s): Espinosa, L.A.D. and Almassalkhi, M.

Abstract: Using distributed energy resources (DERs), such as thermostatically controlled loads (TCLs), electric vehicles (EVs), and energy storage systems (ESSs), as a way to manage demand has been known for decades. A demand management scheme that explicitly considers the individual DER's local quality of service (QoS) is known as demand dispatch. Packetized energy management (PEM) is a demand dispatch paradigm that borrows packet-based concepts from wireless communications to dynamically manage fleets of DER at-scale and in real time via small, discrete, fixed-duration/fixed-power energy packets. PEM addresses QoS in a bottom-up fashion by having a coordinator authorize/deny incoming requests from DERs to consume energy packets. This manuscript extends prior work on modeling a large-scale population (i.e., macro-model) of homogeneous TCLs and ESSs operating under the PEM paradigm. In particular, we extend the macro-model methodology to include deferrable loads (DLs), such as EVs, together with analysis of QoS guarantees. Comparisons between an agent-based (micromodel) simulation and the proposed macromodel are presented to validate modeling accuracy and QoS guarantees.

Subject Areas: Quality of service; Energy management; Load modeling; Water heating; Sociology; Statistics; Power system dynamics; Distributed energy resources; Packetized energy management; Demand dispatch; Relay control

Availability: Espinosa, L.A.D. and Almassalkhi, M. (2020). "A Packetized Energy Management Macromodel With Quality of Service Guarantees for Demand-side Resources." *IEEE Transactions on Power Systems*, 35(5), pp. 3660–3670.

<https://doi.org/10.1109/TPWRS.2020.2981436>

2.41. Title: Energy and Information Management of Electric Vehicular Network: A Survey

Author(s): Chen, N., Wang, M., Zhang, N., and Shen, X.

Abstract: The connected vehicle paradigm empowers vehicles with the capability to communicate with neighboring vehicles and infrastructure, shifting the role of vehicles from a transportation tool to an intelligent service platform. Meanwhile, the transportation electrification pushes forward the electric vehicle (EV) commercialization to reduce greenhouse gas emissions by petroleum combustion. The unstoppable trends of connected vehicles and EVs transform the traditional vehicular system to an electric vehicular network (EVN), a clean, mobile, and safe system. However, due to the mobility and heterogeneity of the EVN, improper management of the network could result in charging overload and data congestion. Thus, energy and information management of the EVN should be carefully studied. In this paper, we provide a comprehensive survey on the deployment and management of EVN considering all three aspects of energy flow, data communication, and computation. We first introduce the management framework of EVN. Then, research works on the EV aggregator (AG) deployment are reviewed to provide energy and information infrastructure for the EVN. Based on the deployed AGs, we present the research work review on EV scheduling that includes both charging and vehicle-to-grid (V2G) scheduling. Moreover, related works on information communication and computing are surveyed under each scenario. Finally, we discuss open research issues in the EVN.

Subject Areas: Vehicle-to-grid; Cellular networks; Connected vehicles; Electric vehicle charging; Satellites; Commercialization; Information management; Electric vehicular network; Energy scheduling; Communication; Computing

Availability: Chen, N., Wang, M., Zhang, N., and Shen, X. (2020). "Energy and Information Management of Electric Vehicular Network: A Survey." *IEEE Communications Surveys & Tutorials*, 22(2), pp. 967–997. <https://doi.org/10.1109/COMST.2020.2982118>

2.42. Title: Electric Vehicles in Ridehailing Applications: Insights From a Fall 2019 Survey of Lyft and Uber Drivers in Los Angeles

Author(s): Rajagopal, D. and Yang, A.

Abstract: Battery electric vehicles (simply EVs here) are considered a critical piece in a sustainable personal transportation infrastructure. Basic economic intuition suggests that the more intensive the utilization of a capital investment, the quicker the return on that investment. From this simple logic, it is evident that EVs that are driven more will payback faster (relative to a gasoline or diesel-powered vehicle) and, furthermore, also deliver greater lifecycle cost savings and emissions reductions relative to EVs that are driven less. However, public policies to support EV adoption to date have not tried to target those individuals or applications that entail greater vehicle utilization, such as taxi and ridehailing vehicles (like those driven for Lyft and Uber) and related on-demand services (e.g., food delivery). Furthermore, since vehicle owners in such services tend to have lower incomes than the typical EV-owning household today, shifting policies to help such users adopt EVs would not only deliver greater fuel and cost savings and environmental benefits, but also make EV and alternative vehicle policies more equitable. Last but not least, new research shows that electrification of ridehailing and taxi fleets could be achieved at little or no additional cost of service.

The State of California has long been a leader in devising a comprehensive and multi-pronged approach to increase the adoption of zero-emission vehicles (ZEVs) for personal transportation (specifically, through policies such as the ZEV regulation, the Clean Vehicle Rebate Project (CVRP), and the more recently adopted SB1014—*The Clean Miles Standard*). Even more uniquely, California seeks to ensure that public investments in pollution reduction benefit disadvantaged and low-income groups directly through a suite of legislations and programs including SB535, AB1550, SB1275, and, again, CVRP. Notwithstanding this impressive suite of policies, there is still a need for additional targeted measures aimed at lower-income and high-mileage drivers.

Given this context, the objective of our research was to understand the potential of, as well as the barriers to, the adoption of EVs in ridehailing and related high-use applications. As our detailed literature review shows, there has been limited empirical assessment in this specific context of EVs. In this report, we describe the results and findings from a structured questionnaire-based survey of 195 Lyft and Uber drivers in Los Angeles and an online survey of 396 individuals (not exclusively from Los Angeles region) who report driving more than 60 miles per day but are not employed in the ride-hailing services sector. These surveys were conducted from September through December 2019.

Our work reveals the following. A substantial portion of ridehailing vehicles clock over three times the miles of the typical household vehicle and possibly even four times that of the average EV vehicle today. Electrifying these vehicles would therefore deliver three to four times faster payback, environmental benefits, and greater lifecycle cost savings. Owners of these vehicles are lower income relative to the typical EV owner, so the upfront cost barrier looms larger. Our findings also show that ridehailing drivers care for the environment and want to contribute to reducing pollution from driving and be socially responsible citizens. However, they are concerned

about running out of charge and having easy access to fast charging, do not mind spending an hour to charge up provided their charging stations offer some amenities to rest up and refresh, and desire additional compensation for green miles among other suggestions they offer. Finally, they also seem to have incomplete and outdated information about EVs, tax incentives, and short-term rental leasing options.

Subject Areas: Battery electric vehicles; Ridehailing; Zero-emission vehicles; Clean Vehicle Rebate Project; Policy

Availability: Rajagopal, D. and Yang, A. (2020). *Electric Vehicles in Ridehailing Applications: Insights From a Fall 2019 Survey of Lyft and Uber Drivers in Los Angeles*. University of California, Los Angeles, CA. https://www.ioes.ucla.edu/wp-content/uploads/rajagopal_ucla_ev_tnc-survey-report.pdf

2.43. Title: Optimization of Pricing Policy of Electric Vehicle Charging Station Based on Big Data

Author(s): Tian, X., Xu, Y., Zhang, X., Ma, X., and Zhang, S.

Abstract: The guideless charging behavior of electric vehicles (EVs) will lead to load fluctuation and increase the difficulty of power system control. By formulating a reasonable pricing strategy, the orderly charging behavior of EVs can be fully encouraged, which is conducive to improving the stability of the system and the economic benefits of charging stations. Compared with the current pricing strategy optimization method, the pricing strategy based on big data will provide a research methodology to capture the relationship between charging load and pricing strategy. Firstly, by analyzing EV users' behavior with big data, a charging load predicting model is proposed. Secondly, a causality model is built to study the relationship between pricing strategy and EV load. Thirdly, the optimization model about pricing strategy of charging station is established under three angles of minimum loss in power system, highest user satisfaction, and maximum benefit of charging station. Then, the optimization problem is solved by using particle swarm optimization. Finally, by taking IEEE9 as an example, the validity of the EV charging load predicting model and the feasibility of the charging station pricing strategy optimization model are analyzed and verified.

Subject Areas: Electric vehicle; Load forecasting; Big data; Charging station pricing policy

Availability: Tian, X., Xu, Y., Zhang, X., Ma, X., and Zhang, S. (2020). "Optimization of Pricing Policy of Electric Vehicle Charging Station Based on Big Data." *International Journal of Smart Grid and Clean Energy*, 9(3), pp. 596–606.

<http://www.ijsgce.com/index.php?m=content&c=index&a=show&catid=88&id=623>

2.44. Title: An Analysis of California's Intercity Travel Demand at Highway Rest Areas

Author(s): Sheldon, F.A.

Abstract: Environmental policy in California necessitates that transportation-related emissions be reduced in the coming decades. One of the most logical solutions for achieving this target for light-duty vehicles is to adopt zero-emission vehicles (ZEVs) in place of traditional internal combustion engine vehicles. For this change to be possible, the growing ZEV fleet needs a widespread and reliable network of refueling infrastructure. This study proposes a modified flow capture location model for analyzing long-distance travel in order to aid transportation planners in efficiently siting alternative fueling stations. The specific case of long-distance travel demand from battery electric vehicles (BEVs) in California at highway rest areas is explored for all hours of the year in 2017, 2030, and 2050. The model produces two profiles for each rest area: a charging demand profile in terms of kilowatt-hour/hour needed at rest area for recharging and a total vehicles profile that indicates the total number of vehicles utilizing the rest area each hour. The charging demand distribution for the whole State shows that a large amount of long-distance travel occurs during daylight hours, which indicates that solar power can be utilized to provide refueling energy. While charging demand generally increases with increasing BEV penetration, the charging demand varies significantly between each rest area, and the needed charging infrastructure at each rest area is best considered on an individual basis. Additionally, with increasing vehicle range, fewer roadside charging locations will be needed.

Subject Areas: Long-distance travel; Alternative fueling station siting; Zero-emission vehicles; Travel flow modeling; Battery electric vehicles

Availability: Sheldon, F.A. (2020). *An Analysis of California's Intercity Travel Demand at Highway Rest Areas*. Master's Thesis, University of California, Davis, CA.

<https://search.proquest.com/openview/a84adf178febaedf4cda6005f456d3cc/1?pq-origsite=gscholar&cbl=51922&diss=y>

2.45. Title: Sustainability Prospects for Autonomous Vehicles: Environmental, Social, and Urban

Author(s): Martin, G.T.

Abstract: The autonomous vehicle (AV) has been strongly heralded as the most exciting innovation in automobility for decades. AVs are no longer an innovation of the future (seen only in science fiction) but are now being road-tested for use. And yet while the technical and economic success and possibilities of the AV have been widely debated, there has been a notable lack of discussion around the social, behavioral, and environmental implications. This book is the first to address these issues and to deeply consider the environmental and social sustainability outlook for the AV and how it will impact on communities. Environmental and social sustainability are goals unlike those of technical development (a new tool) and economic development (a new investment). The goal of sustainability is development of societies that live well and equitably within their ecological limits. Is it reasonable and desirable that only technical and economic success comprise the swelling AV parade, or should we be looking at the wider impacts on personal well-being, wider society, and the environment? The uptake for AVs looks to be lengthy, disjointed, and episodic in large measure because it faces a range of known and unknown risks. This book assesses the environmental and social sustainability potential for AVs based on their prospective energy use and their impacts on climate change, urban landscapes, public health, mobility inequalities, and individual and social well-being. It examines public attitudes about AV use and its risk of fostering a rebound effect that compromises potential sustainability gains. The book concludes with a discussion of critical issues involved in sustainable AV diffusion.

Subject Areas: Autonomous vehicle; Environmental sustainability; Social sustainability

Availability: Martin, G.T. (2019). *Sustainability Prospects for Autonomous Vehicles: Environmental, Social, and Urban*. Routledge, Abingdon, United Kingdom.
https://books.google.com/books/about/Sustainability_Prospects_for_Autonomous.html?id=pu6aDwAAQBAJ&source=kp_book_description

2.46. Title: How Do US Passenger Vehicle Fuel Economy Standards Affect New Vehicle Purchases?

Author(s): Dou, X. and Linn, J.

Abstract: Like many energy efficiency standards, passenger vehicle fuel economy and greenhouse gas standards apply to new but not used products. In theory, such vintage differentiated regulation could reduce demand for new vehicles, which would reduce the social welfare gains of tighter standards. Using household data from 1996 to 2016, which includes periods of stable standards and periods of tightening standards, we provide the first direct evidence of the effects of standards on new vehicle purchases. Tighter standards induce statistically and economically significant reductions in new vehicle purchases, which raises welfare costs of tighter standards modestly.

Subject Areas: Passenger vehicles; Fuel tax; Fuel economy standard; Greenhouse gas emissions standard; Consumer demand; Vintage differentiated regulation; Used vehicles

Availability: Dou, X. and Linn, J. (2020). “How Do US Passenger Vehicle Fuel Economy Standards Affect New Vehicle Purchases?” *Journal of Environmental Economics and Management*, 102. <https://doi.org/10.1016/j.jeem.2020.102332>

2.47. Title: A Framework for the Impact of Highly Automated Vehicles with Limited Operational Design Domains

Author(s): Bin-Nun, A.Y. and Binamira, I.

Abstract: Highly automated vehicles (AVs) are in the early stages of deployment and are likely to have significant impacts on the United States transportation system. In particular, a broad deployment of shared, on-demand AVs might significantly impact vehicle ownership and transportation energy consumption; projecting these impacts is essential for climate, infrastructure, and policy planning. However, it seems increasingly likely that AVs will be deployed gradually over a period of decades, in which case there may be geographic or functional variation in their availability. This might occur for a combination of technological, policy, and economic reasons.

This manuscript seeks to advance a new framework for projecting AV impacts, with a particular focus on energy consumption impacts. Specifically, we introduce a framework for AV impacts that allows for AVs catering to specific operating environments or ride types. As a demonstration of this framework, we use the 2009 National Household Transportation Survey (NHTS) to segment US household travel demand based on built environment and ride length. Our framework allows us to specify AV “availability” for each population segment and ride type and use that information to predict the impact of AVs. We analyze a case scenario where shared, on-demand AVs are mostly suited for short trips in highly urbanized environments. We project the impact on household relocation, private vehicle ownership, induced travel demand, and fuel consumption. Utilization of this framework would help identify policy levers for sustainable deployment of AVs.

Subject Areas: Autonomous vehicles; Ridesharing; Energy; Sustainable transportation; Operation design domain; Urban impacts; Operational design domain

Availability: Bin-Nun, A.Y. and Binamira, I. (2020). “A Framework for the Impact of Highly Automated Vehicles with Limited Operational Design Domains.” *Transportation Research Part A: Policy and Practice*, 139, pp. 174–188. <https://doi.org/10.1016/j.tra.2020.06.024>

2.48. Title: A Review of the Population-based and Individual-based Approaches for Electric Vehicles in Network Energy Studies

Author(s): Borray, A.F.C., Merino, J., Torres, E., and Mazón, J.

Abstract: The growing trend of introducing electric vehicles (EVs) into power systems to reduce the environmental emissions in the transport sector is gaining significant attention among electrical power system agents for two reasons: the potential grid services the EVs can offer in an aggregated manner and the possible undesirable effects of massive integration in grid operation that can increase the requirement for investment in new assets. In this context, the aggregator is the representative entity that needs to maximize the benefits in the management of these sizeable quantities of vehicles while fulfilling the requirements of grid services requested by the distribution system operator. In this study, we review the concept of EV aggregators and their potential services to the distribution network. Several studies related to EVs aggregation modelling have been analyzed and classified into three groups: individual-based, population-based, and hybrid approaches. We present the current status of EVs aggregation modelling as well as future research trends. Furthermore, we discussed the performance comparison of EVs models from several manufacturers utilized in network integration studies, likewise the most relevant databases and surveys. Finally, we arranged and annexed the most relevant mathematical expressions of the reviewed approaches, thereby simplifying the comprehension of the methods.

Subject Areas: Aggregator; Electric vehicles; Grid services; Individual-based approach; Population-based approach; Vehicle surveys

Availability: Borray, A.F.C., Merino, J., Torres, E., and Mazón, J. (2020). “A Review of the Population-based and Individual-based Approaches for Electric Vehicles in Network Energy Studies.” *Electric Power Systems Research*, 189. <https://doi.org/10.1016/j.epsr.2020.106785>

2.49. Title: A Review on Charging Behavior of Electric Vehicles: Data, Model, and Control

Author(s): Jia, Q. and Long, T.

Abstract: The adoption and usage of electric vehicles (EVs) have emerged recently due to the increasing concerns on the greenhouse gas issues and energy revolution. As a part of the smart grid, EVs can provide valuable ancillary services beyond consumers of electricity. However, EVs are gradually considered as non-negligible loads due to their increasing penetration, which may result in negative effects such as voltage deviations, lines saturation, and power losses. Relationship and interaction among EVs, charging stations, and micro grid have to be considered in the next generation of smart grid. Therefore, the topic of smart charging has been the focus of many works where a wide range of control methods have been developed. As one of the bases of simulation, the EV charging behavior and characteristics have also become the focus of many studies. In this work, we review the charging behavior of EVs from the aspects of data, model, and control. We provide the links for most of the data sets reviewed in this work, based on which interested researchers can easily access these data for further investigation.

Subject Areas: Electric vehicle; Charging behavior; Data and model

Availability: Jia, Q. and Long, T. (2020). “A Review on Charging Behavior of Electric Vehicles: Data, Model, and Control.” *Control Theory and Technology*, 18, pp. 217–230.
<https://doi.org/10.1007/s11768-020-0048-8>

2.50. Title: Active Distribution Network Expansion Planning Considering the Uncertainty of Electric Vehicles' Load

Author(s): Shajarehpour, M.S. and Maghouli, P.

Abstract: Integrating electric vehicles into distribution systems introduce new challenges both in operation and planning of electric distribution systems. In the planning process, these vehicles mainly affect load uncertainty in the grid. A new method for Active Distribution Network (ADN) expansion planning is proposed considering the uncertainty of bus loadings because of electric vehicle (EV) integration. The approach taken in this paper includes the initial cost of investment and operation. A probabilistic model is proposed for extracting the effect of electric vehicles integration on future loading of network buses. Different scenarios are defined based on electric vehicle entrance time, charging delays and their overall penetration level. Particles colony algorithm is used for handling the proposed mixed integer and nonlinear optimization model. Also, a graph theory based method for detecting radial structures is implemented for faster convergence. Finally, the effectiveness of the proposed algorithm is examined by implementing it on the modified IEEE 33 bus standard distribution network.

Subject Areas: Distribution system expansion planning; Uncertainty; Plug-in electric vehicles; Graph theory

Availability: Shajarehpour, M.S. and Maghouli, P. (2020). "Active Distribution Network Expansion Planning Considering the Uncertainty of Electric Vehicles' Load." *Electromechanical Energy Conversion Systems*, 1(2), pp. 75–86. <https://dx.doi.org/10.30503/eecs.2019.110970>

2.51. Title: Are Travel Surveys a Good Basis for EV Models? Validation of Simulated Charging Profiles Against Empirical Data

Author(s): Pareschi, G., K ng, L., Georges, G., and Boulouchos, K.

Abstract: The impending uptake of electric vehicles (EVs) in worldwide car fleets is urging stakeholders to develop models that forecast impacts and risks of this transition. The most common modelling approaches rely on car movements provided in household travel surveys (HTSs), despite their large data bias towards internal combustion engine vehicles. The scientific community has long wondered whether this characteristic of HTSs would undermine the conclusions drawn for EV mobility. This work applies state-of-the-art modelling techniques to the Swiss national HTS to conclusively prove, by means of validation, the reliability of these commonly used approaches. The cars tracked in the survey are converted to EVs, either pure battery or plug-in hybrids, and their performance is simulated over 4 consecutive days randomly sampled from the survey. EVs are allowed to charge at both residential and public locations at an adjustable charging power. Charging events are determined by a finely calibrated plugging-in decision scheme that depends on the battery's state of charge. The resulting charging loads corroborate the validation, as these successfully compare with measurements obtained from several EV field tests. In addition, the study includes a sensitivity analysis that highlights the importance of accurately modelling various input parameters, especially EVs battery sizes and charging power. This work provides evidence that conventional HTSs are an appropriate instrument for generating EV insights, yet it adds guidelines to avoid modelling pitfalls and to maximize the simulation accuracy.

Subject Areas: Electric vehicles; Charging profiles; Household travel survey; Charging behavior; Validation; Sensitivity analysis

Availability: Pareschi, G., K ng, L., Georges, G., and Boulouchos, K. (2020). "Are Travel Surveys a Good Basis for EV Models? Validation of Simulated Charging Profiles Against Empirical Data." *Applied Energy*, 275. <https://doi.org/10.1016/j.apenergy.2020.115318>

2.52. Title: Assessment of Light-Duty Plug-in Electric Vehicles in the United States, 2010–2019

Author(s): Gohlke, D. and Zhou, Y.

Abstract: This report examines properties of plug-in electric vehicles (PEVs) sold in the United States from 2010 to 2019, exploring vehicle sales, miles driven, electricity consumption, petroleum reduction, vehicle manufacturing, and battery production, among other factors. Over 1.4 million PEVs have been sold, driving over 37 billion miles on electricity since 2010, thereby reducing national gasoline consumption by 0.34% in 2019 and 1.4 billion gallons cumulatively through 2019. In 2019, PEVs used 4.1 terawatt-hours of electricity to drive 12.7 billion miles, offsetting 470 million gallons of gasoline. Since 2010, 69% all PEVs have been assembled in the United States, and over 60 gigawatt-hours of lithium-ion batteries have been installed in vehicles to date.

Subject Areas: Electric vehicles; Electricity; Energy consumption; Lithium batteries; Manufacturing; Plug-in hybrid vehicles; Sales; Vehicle miles of travel

Availability: Gohlke, D. and Zhou, Y. (2020). *Assessment of Light-Duty Plug-in Electric Vehicles in the United States, 2010–2019*. The National Academies of Sciences, Engineering, and Medicine, Washington, DC. <https://trid.trb.org/view/1725566>

2.53. Title: Automatic Charging Control for Electric Vehicle to Grid Operations

Author(s): Lehtola, T. and Zahedi, A.

Abstract: Electric vehicles, whether fueled by chemical batteries or by liquid or fuel cells providing electricity onboard, provide benefits to grid operators as battery storages and power resources. In vehicle to grid operations, batteries provide ancillary services such as regulation up and down services to electric utilities. Balancing voltage frequency keeps power grids stable and sustainable. Vehicle to grid operations provide economic benefits to power grid operators, aggregators and to electric vehicle owners. An electric vehicle operator shares battery power with the power grid, an electric vehicle operator provides information about the coming journey, departure time and traveling distance as next trip requires. An automatic charging control can mitigate communication, and estimate the next trip with automatic charging control. Electric vehicle operators are not required to share information about planned travel as battery management charges batteries automatically. The proposed topic is interesting and worthy of investigation in order that the impact of vehicle to grid operations on battery durability plays a key role for the convenience of electric vehicle owners in supporting the electricity network with this kind of ancillary services. Main findings are lifetime reduction is decreased in vehicle to grid operations and a lifetime can be extended. For electric utilities, the increased battery storage provides benefits such as power system reliability and lower costs and facilitates the integration of intermittent renewable energy resources such as solar energy and wind power.

Subject Areas: Automatic charging control; Battery cycle; Aging; Battery management; Electric vehicle; Frequency regulation; Optimization

Availability: Lehtola, T. and Zahedi, A. (2020). "Automatic Charging Control for Electric Vehicle to Grid Operations." *Journal of Automation and Control Engineering*, 8(1), pp. 1–8. https://www.researchgate.net/publication/342833336_Automatic_Charging_Control_for_Electric_Vehicle_to_Grid_Operations

2.54. Title: Can Electricity Pricing Leverage Electric Vehicles and Battery Storage to Integrate High Shares of Solar Photovoltaics?

Author(s): Schwarz, M., Auzépy, Q., and Knoeri, C.

Abstract: Leveraging electric vehicles with controlled charging has the potential to advance the integration of high shares of residential solar photovoltaics. Time-varying electricity pricing is a promising tool to control EV charging indirectly through price signals, but also affects the diffusion and usage of other residential technologies. In this article, we develop an agent-based model to simulate California’s residential market for electric-vehicle charging, and the adoption of solar photovoltaics and battery storage, between 2005 and 2030. We show that time-of-use and hourly rates have a substantial impact on the further diffusion and integration of these technologies. Time-of-use rates trigger the adoption of battery storage, but over-coordinate electric-vehicle charging. Hourly rates, in contrast, slow down the diffusion of solar photovoltaics temporarily, but concentrate electric-vehicle charging around midday, thereby reducing the need for fast-ramping generation capacity and carbon emissions. Using real-world driving patterns, we show that 80% of EVs shift charging to midday hours with home charging alone. However, EVs only reduce the need for ramping capacity and thus advance PV integration, when users also have access to workplace and public charging. Further, we demonstrate that electric vehicles mitigate the increase in retail electricity prices, and thus counteract the utility death spiral. Our results indicate that controlling EV charging with electricity pricing decreases utility costs but increase retail electricity prices.

Subject Areas: Electric vehicles; Solar photovoltaics; Battery storage; Controlled charging; Electricity pricing; California

Availability: Schwarz, M., Auzépy, Q., and Knoeri, C. (2020). “Can Electricity Pricing Leverage Electric Vehicles and Battery Storage to Integrate High Shares of Solar Photovoltaics?” *Applied Energy*, 277. <https://doi.org/10.1016/j.apenergy.2020.115548>

2.55. Title: Dynamic Real-Time Pricing Structure for Electric Vehicle Charging Considering Stochastic Microgrids Energy Management System

Author(s): Aljohani, T., Ebrahim, A., and Mohammed, O.

Abstract: Managing electric vehicle charging activities during times when the electrical grid is congested is a challenging task. In this work, we propose a fair, real-time, demand-influenced dynamic pricing structure to accurately allocate more fairness to the billing strategy to reflect updated energy prices during real-time operation of the microgrids. This pricing structure is composed of two pricing fractions: retail energy price that follows time-of-use (ToU) rates and congested energy price that is allocated solely for billing EVs charging events during congested timeslots. The proposed methodology is implemented in a hierarchal multi-agent architecture with a stochastic energy management system that aims to provide a cost-efficient microgrid operation. The inputs to the optimization problem are day-ahead PV forecast as well as stochastic EVs energy levels and connectivity times prediction models based on a discrete-time Markov chain. Moreover, a predictive model of daily load demand is also presented based on adaptive Artificial Neural Network (ANN). We develop these models based on historical data for Miami Dade County, South Florida. Through numerical simulations, we attest that the proposed pricing structure achieves significant energy prices reduction when compared with results from previous well-established pricing policies.

Subject Areas: Electric vehicle charging; Real-time dynamic pricing structure; Stochastic energy management and control; Adaptive artificial neural network (ANN); Discrete-time Markov chain; Real-time dynamics of microgrids

Availability: Aljohani, T., Ebrahim, A., and Mohammed, O. (2020). "Dynamic Real-Time Pricing Structure for Electric Vehicle Charging Considering Stochastic Microgrids Energy Management System." *2020 IEEE International Conference on Environment and Electrical Engineering and 2020 IEEE Industrial and Commercial Power Systems Europe (EEEIC/I&CPS Europe)*, pp. 1–8, Madrid, Spain. <https://ieeexplore.ieee.org/document/9160754>

2.56. Title: Fleet Re-Balancing with In-Route Charging for Multi-Class Autonomous Electric MoD Systems

Author(s): Yamin, N., Smith, L., Belakaria, S., Sorour, S., and Abdel-Rahim, A.

Abstract: Autonomous electric mobility on demand (AEMoD) services are anticipated to be the future of private transportation, serving tens of thousands of requests per minute in large cities. To cope with this massive demand, a decentralized (i.e., zone-based) and multi-class management framework of AEMoD fleets was recently introduced. Yet, the inter-zone management of such approach has not been investigated. This paper thus fills this gap by studying the fleet re-balancing problem, with possible in-route charging, in decentralized multiclass AEMoD systems. A queuing model for multi-class re-balancing and possible in-route charging is developed on top of the system's decentralized fleet management. The stability conditions of this model are first derived, then the optimal inter-zone multi-class re-balancing and in-route charging decisions are derived so as to minimize the maximum response time in each deficient zone. Closed-form solutions are derived using Lagrangian analysis and simulations in a realistic setting in the city of Seattle are employed to illustrate the merits of our proposed re-balancing scheme as opposed to different baseline rebalancing approaches.

Subject Areas: Stability analysis; Urban areas; Time factors; Charging stations; Optimization; Queuing analysis; Thermal stability

Availability: Yamin, N., Smith, L., Belakaria, S., Sorour, S., and Abdel-Rahim, A. (2020). "Fleet Re-Balancing with In-Route Charging for Multi-Class Autonomous Electric MoD Systems." *2020 IEEE International Conference on Communications (ICC)*, pp. 1–7, Dublin, Ireland.
<https://doi.org/10.1109/ICC40277.2020.9149235>

2.57. Title: Machine Learning Model to Project the Impact of COVID-19 on US Motor Gasoline Demand

Author(s): Ou, S., He, X., Ji, W., Chen, W., Sui, L., Gan, Y., Lu, Z., Lin, Z., Deng, S., Przesmitzki, S., and Bouchard J.

Abstract: Owing to the global lockdowns that resulted from the COVID-19 pandemic, fuel demand plummeted and the price of oil futures went negative in April 2020. Robust fuel demand projections are crucial to economic and energy planning and policy discussions. Here we incorporate pandemic projections and people’s resulting travel and trip activities and fuel usage in a machine-learning-based model to project the US medium-term gasoline demand and study the impact of government intervention. We found that under the reference infection scenario, the US gasoline demand grows slowly after a quick rebound in May, and is unlikely to fully recover prior to October 2020. Under the reference and pessimistic scenario, continual lockdown (no reopening) could worsen the motor gasoline demand temporarily, but it helps the demand recover to a normal level quicker. Under the optimistic infection scenario, gasoline demand will recover close to the non-pandemic level by October 2020.

Subject Areas: COVID-19; Energy modelling; Energy supply and demand

Availability: Ou, S., He, X., Ji, W., Chen, W., Sui, L., Gan, Y., Lu, Z., Lin, Z., Deng, S., Przesmitzki, S., and Bouchard J. (2020). “Machine Learning Model to Project the Impact of COVID-19 on Us Motor Gasoline Demand.” *Nature Energy*, 5, pp. 666–673.
<https://doi.org/10.1038/s41560-020-0662-1>

2.58. Title: Optimizing Workplace Charging Facility Deployment and Smart Charging Strategies

Author(s): Li, S., Xie, F., Huang, Y., Lin, Z., and Liu, C.

Abstract: This study introduces a workplace charging (WPC) optimization model that maximizes the total satisfied electric miles of employees' plug-in electric vehicles, subject to a given annual budget. The model optimizes both planning decisions of charger number and power levels and operation decisions of charging spot assignment and charging schedule for the given temporal distribution of charging demands and varied electricity prices. Results of experiments based on national average travel data indicate that the actual WPC strategy varies by budget level. Through optimization, the strategy could reduce impacts of the varied electricity price by shifting charging schedules to periods when electricity prices are low. Also, the model is expanded to study the trade-off between providing WPC and addressing consequence of degraded charging service by including the per-mile shadow cost of unsatisfied charging demand. We observe that their relative competitiveness mainly depends on the actual shadow cost of WPC.

Subject Areas: Workplace charging; Optimization model; Electricity price; Charging schedules; Per-mile shadow cost

Availability: Li, S., Xie, F., Huang, Y., Lin, Z., and Liu, C. (2020). "Optimizing Workplace Charging Facility Deployment and Smart Charging Strategies." *Transportation Research Part D: Transport and Environment*, 87. <https://doi.org/10.1016/j.trd.2020.102481>

2.59. Title: Probabilistic Assessment of Voltage Quality on Solar-Powered Electric Vehicle Charging Station

Author(s): Angelim, J.H. and Affonso, C.M.

Abstract: This paper evaluates the potential benefits the connection of photovoltaic generation can bring to a commercial building with electric vehicles charging stations considering voltage quality issues. Monte Carlo simulation is applied to model system uncertainties, and uncontrolled charging Level 2 is considered. Simulations are performed in the modified IEEE 37 node test feeder using OpenDSS software, using real load data and meteorological measurements, considering the seasonality effect of photovoltaic generation. Different scenarios are analyzed, varying the size of photovoltaic generation and electric vehicles connection time. The obtained results show voltage unbalance is not a major issue when charging at Level 2. Also, the use of photovoltaic generation can potentially reduce the probability of occurrence of under-voltage problems, transformer overload and losses, according to the penetration level of photovoltaic generation and daily electric vehicles charging demand.

Subject Areas: Plug-in electric vehicles; Monte Carlo simulation; Distribution system; Voltage quality

Availability: Angelim, J.H. and Affonso, C.M. (2020). “Probabilistic Assessment of Voltage Quality on Solar-Powered Electric Vehicle Charging Station.” *Electric Power Systems Research*, 189. <https://doi.org/10.1016/j.epsr.2020.106655>

2.60. Title: Spatial Load Forecasting of Distribution Network Based on Artificial Intelligent Algorithm

Author(s): Shao, Y., Peng, P., Liu, W., Wei, L., and Wang, B.

Abstract: For the influence of the popularity of rooftop photovoltaic (PV) and the use of large-scale electric vehicles (EVs) on the power grid load, a space load forecasting method of urban distribution power grid was proposed, which took into account the spatial and temporal distribution of PV and EVs. Through analytic hierarchy process and fuzzy comprehensive evaluation method, various factors affecting the rooftop distributed PV output power were fully considered, and the rooftop PV output power of each planning area was forecasted by combining the least squares support vector machine and particle swarm optimization. Based on the time-space transfer probability matrix of EVs in different planning areas, a Monte Carlo algorithm was used to simulate the time-space distribution of charging load with high probability. Taking an urban area as an example, the forecasted rooftop PV output power, EV charging load, and traditional power load are superimposed on different planning areas to obtain the forecasted spatial load values.

Subject Areas: Load forecasting; Fuzzy comprehensive evaluation; Rooftop photovoltaic; Electric vehicle; Spatial and temporal distribution; Urban distribution network planning

Availability: Shao, Y., Peng, P., Liu, W., Wei, L., and Wang, B. (2020). "Spatial Load Forecasting of Distribution Network Based on Artificial Intelligent Algorithm." *2020 Chinese Control and Decision Conference (CCDC)*, pp. 5483–5488.
<https://doi.org/10.1109/CCDC49329.2020.9164641>

2.61. Title: Sustainable Energy System Analysis Modeling Environment: Analyzing Life Cycle Emissions of the Energy Transition

Author(s): Gençera, E., Torkamani, S., Miller, I., Wu, Y.W., and O’Sullivan, F.

Abstract: One of the global community’s most significant contemporary challenges is the need to satisfy growing energy demand while simultaneously achieving very significant reductions in the greenhouse gas (GHG) emissions associated with the production, delivery, and consumption of energy. The energy sector is transforming via the convergence of power, transportation, and industrial sectors and inter-sectoral integration. To assess the level of decarbonization achieved through this change, one needs to study the carbon footprint of the energy system as a whole. Here, we present a novel, system-scale energy analysis tool, the Sustainable Energy System Analysis Modelling Environment (SESAME), to assess the pathway- and system-level GHG emissions of today’s changing energy system. The underlying analytic tool constitutes more than a thousand individual energy pathways. SESAME provides a consistent platform to estimate life cycle GHG emissions of all stages of the energy sector. Furthermore, the system representation is embedded into the tool for power and transportation sectors. The developed novel architecture and implications of energy choices for example scenarios (vehicle fleet projections for US and generator-level hourly power generation) are presented to demonstrate SESAME’s high-resolution analysis capabilities. Impact of operational variations, such as partial loading of power generation units, and technology choices, such as treatment of the same crude oil in different refinery configurations, is explored.

Subject Areas: Life cycle analysis; Renewable energy; Energy conversion; Carbon footprint; Environmental impact

Availability: Gençera, E., Torkamani, S., Miller, I., Wu, Y.W., and O’Sullivan, F. (2020). “Sustainable Energy System Analysis Modeling Environment: Analyzing Life Cycle Emissions of the Energy Transition.” *Applied Energy*, 277. <https://doi.org/10.1016/j.apenergy.2020.115550>

2.62. Title: Building the Computing System for Autonomous Micromobility Vehicles: Design Constraints and Architectural Optimizations

Author(s): Yu, B., Hu, W., Xu, L., Tang, J., Liu, S., and Zhu, Y.

Abstract: This paper presents the computing system design in our commercial autonomous vehicles and provides detailed performance, energy, and cost analyses. Drawing from our commercial deployment experience, this paper has two objectives. First, we highlight design constraints unique to autonomous vehicles that might change the way we approach existing architecture problems. Second, we identify new architecture and systems problems that are perhaps less studied before but are critical to autonomous vehicles.

Subject Areas: Autonomous vehicles; self-driving cars; Design constrains

Availability: Yu, B., Hu, W., Xu, L., Tang, J., Liu, S., and Zhu, Y. (2020). “Building the Computing System for Autonomous Micromobility Vehicles: Design Constraints and Architectural Optimizations.” *2020 53rd Annual IEEE/ACM International Symposium on Microarchitecture (MICRO)*, pp. 1067–1081, Athens, Greece.
<https://doi.org/10.1109/MICRO50266.2020.00089>

2.63. Title: Self-Healing Enhancement Through Co-Deployment of Automatic Switches and Electric Vehicle Parking Lots in Electricity Distribution Network

Author(s): Mohammadi-Hosseininejad, S.M., Fereidunian, A., Mirsaeedi, H., Heydari, S., and Lesani, H.

Abstract: Accomplishing highly reliable distribution grids is more and more important to today's modern society. Along the same line, self-healing is one of the most distinguishing features of the smart grid that could improve the reliability of the system up to a logical extent. In this study, the reliability of the electrical distribution grid has been improved by optimal allocation of automatic switches and parking lots (PLs). Thus, the optimal places of switches and PLs are determined with the purposes of minimizing a combined effect of the customer-based (system average interruption duration index) and cost-based [total reliability cost (TRC)] reliability indices. The TRC includes customer interruption costs, PLs and automatic switches investment costs, and the total cost of PLs incorporation in the service restoration process. The proposed approach is implemented in three different planning scenarios: switch placement, PL placement, and joint switch and PL placement. The particle swarm optimization method is employed to solve optimization problems. Finally, a standard reliability test system bus number four of the Roy Billinton test system (RBTS 4) is used to demonstrate the efficacy of the proposed method.

Subject Areas: Self-healing; Power system reliability; Distribution system restoration; Plug-in electric vehicles; Particle swarm optimization (PSO)

Availability: Mohammadi-Hosseininejad, S.M., Fereidunian, A., Mirsaeedi, H., Heydari, S., and Lesani, H. (2020). "Self-Healing Enhancement Through Co-Deployment of Automatic Switches and Electric Vehicle Parking Lots in Electricity Distribution Network." *IET Generation Transmission & Distribution*, 14(17), pp. 3508–3517. <https://doi.org/10.1049/iet-gtd.2019.1235>

2.64. Title: Optimization of Vehicle to Grid System in a Power System with Unit Commitment

Author(s): Uko, C.

Abstract: This thesis provides a comprehensive overview and analysis of the benefits of using plug-in electric vehicles (PEVs) in solving the unit commitment problem. PEVs are becoming more attractive and a rapid replacement of conventional fuel vehicles due to their environmental-friendly operation. Through collective control by an aggregator, PEVs batteries can also provide ancillary services such as load leveling and frequency regulation to improve the quality of power supplied in the power grid and reduce the cost of power generation. This study presents the modeling, simulation, and analysis of a vehicle-to-grid (V2G) system connected to a smart power grid. The model considers different penetration levels of PEVs in a system and investigates the economic and technical effects of using PEVs to support the grid. The model is tested using an Institute of Electrical and Electronics Engineers (IEEE)-24 bus network to verify the effects that PEVs penetration has on generation cost in power systems. A comparison has been made between a system without V2G and a system with V2G to produce justification for the role that V2G can play in solving the unit commitment problem. The results of this study show that the optimal scheduling of PEVs was effective in flattening the load profile through valley filling and peak load reduction.

Subject Areas: Plug-in electric vehicles; Unit commitment; Vehicle-to-grid

Availability: Uko, C. (2020). *Optimization of Vehicle to Grid System in a Power System with Unit Commitment*. Doctoral Dissertation, University of South Carolina, Columbia, SC.
<https://scholarcommons.sc.edu/etd/5964>

2.65. Title: Phase Unbalance and Par Constrained Optimal Active and Reactive Power Scheduling of Virtual Power Plants (VPPs)

Author(s): Jha, B.K., Singh, A., Kumar, A., Misra, R.K., and Singh, D.

Abstract: In the near future, the integration of unknown and unpredictable quantity of Electric Vehicles (EVs) can violate reliable and quality power service of distribution system. In spite of that, the ability to simultaneously regulate active and reactive power by Plug-in-Hybrid Electric Vehicles (PHEVs) in quick response time without affecting the batteries can help to ensure reliable and quality power service in distribution system. This paper investigates the optimal active and reactive power scheduling of PHEVs and Distributed Generations (DGs) in Virtual Power Plants (VPPs), considering unbalance and Peak-to-Average Ratio (PAR) constraints. To compute stochastic model of PHEVs, we consider the dynamic nature of driving patterns based on NHTS 2017 data. The proposed approach is implemented on IEEE-25 bus unbalanced distribution system. The developed planning and operational investigation of VPPs also presents dependencies of cost and losses in terms of Unbalance factor and PAR.

Subject Areas: Plug-in-hybrid electric vehicle (PHEV); Virtual power plants (VPPs); Distributed generation; Unbalanced distribution system; Peak-to-average ratio (PAR)

Availability: Jha, B.K., Singh, A., Kumar, A., Misra, R.K., and Singh, D. (2020). "Phase Unbalance and Par Constrained Optimal Active and Reactive Power Scheduling of Virtual Power Plants (VPPs)." *International Journal of Electrical Power & Energy Systems*, 125. <https://doi.org/10.1016/j.ijepes.2020.106443>

2.66. Title: Co-Optimization of Energy Losses and Transformer Operating Costs Based on Smart Charging Algorithm for Plug-in Electric Vehicle Parking Lots

Author(s): Madahi, S.S.K., Nafisi, H., Abyaneh, H.A., and Marzband, M.

Abstract: The global transport sector has a significant share of greenhouse gas emissions. Thus, plug-in electric vehicles (PEVs) can play a vital role in the reduction of pollution. However, high penetration of PEVs can pose severe challenges to power systems, such as an increase in energy losses and a decrease in the transformers expected life. In this paper, a new day-ahead co-optimization algorithm is proposed to reduce the unwanted effects of PEVs on the power system. The aim of the proposed algorithm is minimizing the cost of energy losses as well as transformer operating cost by the management of active and reactive powers simultaneously. Moreover, the effect of harmonics, which are produced by the charger of PEVs, are considered in the proposed algorithm. Also, the transformer operating cost is obtained from a method that contains the purchase price, loading, and losses cost of the transformer. Another advantage of the proposed algorithm is that it can improve power quality parameters, e.g., voltage and power factor of the distribution network by managing the reactive power. Afterward, the proposed algorithm is applied to a real distribution network. The results show that the proposed algorithm optimizes the daily operating cost of the distribution network efficiently. Finally, the robustness of the proposed algorithm to the number and distribution of PEVs is verified by simulation results.

Subject Areas: Plug-in electric vehicle (PEV); Transformer aging; Energy losses; Daily operating cost reduction; Energy loss; Reactive power; Harmonic analysis; Aging; Windings; Transportation

Availability: Madahi, S.S.K., Nafisi, H., Abyaneh, H.A., and Marzband, M. (2020). "Co-Optimization of Energy Losses and Transformer Operating Costs Based on Smart Charging Algorithm for Plug-in Electric Vehicle Parking Lots." *IEEE Transactions on Transportation Electrification*. <https://doi.org/10.1109/TTE.2020.3020690>

2.67. Title: Shared Autonomous Vehicle Fleet Performance: Impacts of Trip Densities and Parking Limitations

Author(s): Yan, H., Kockelman, K.M., and Gurumurthy, K.M.

Abstract: This study micro-simulates 2% and 5% of the region's 9.5 million daily person-trips and 20% of trips in the central Twin Cities with shared autonomous vehicles (SAVs) in the 7-county Minneapolis–Saint Paul region using MATSim to appreciate the effects of different trip-making densities and curb-use restrictions. Results suggest the average SAV in this region can serve at most 30 person-trips per day with less than 5 min average wait time but generates 13% more vehicle-miles traveled (VMT). With dynamic ride-sharing (DRS), SAV VMT fell, on average, by 17%, and empty VMT (eVMT) fell by 26%. Compared to idling-at-curb scenarios, parking-restricted scenarios generated 8% more VMT. Relying on 52 mi/gallon hybrid electric SAVs, as opposed to a 31 mi/gallon conventional drivetrain SAV, is estimated to lower travelers' energy use by 21% and reduce tailpipe emissions by 30%, assuming no new or longer trips. Similarly, a 106 mi/gallon equivalent battery-electric fleet does much better by lowering energy use by 64%.

Subject Areas: Shared autonomous vehicles; Dynamic ride-sharing; Agent-based modeling; Curb parking; Empty vehicle-miles traveled; Energy analysis

Availability: Yan, H., Kockelman, K.M., and Gurumurthy, K.M. (2020). "Shared Autonomous Vehicle Fleet Performance: Impacts of Trip Densities and Parking Limitations." *Transportation Research Part D: Transport and Environment*, 89. <https://doi.org/10.1016/j.trd.2020.102577>

2.68. Title: Decarbonizing US Passenger Vehicle Transport Under Electrification and Automation Uncertainty Has a Travel Budget

Author(s): Alarfaj, A.F., Griffin, W.M., and Samaras, C.

Abstract: The transportation sector is at the beginning of a transition represented by electrification, shared mobility, and automation, which could lead to either increases or decreases in total travel and energy use. Understanding the factors enabling deep decarbonization of the passenger vehicle sector is essential for planning the required infrastructure investments and technology adoption policies. We examine the requirements for meeting carbon reduction targets of 80% and higher for passenger vehicle transport in the United States (US) by midcentury under uncertainty. We model the changes needed in vehicle electrification, electricity carbon intensity, and travel demand. Since growth in fleet penetration of electric vehicles (EVs) is constrained by fleet stock turnover, we estimate the EV penetration rates needed to meet climate targets. We find for a base case level of passenger vehicle travel, midcentury deep decarbonization of US passenger transport is conditional on reducing the electricity generation carbon intensity to close to zero along with electrification of about 67% or 84% of vehicle travel to meet decarbonization targets of 80% or 90%, respectively. Higher electricity generation carbon intensity and degraded EV fuel economy due to automation would require higher levels of fleet electrification and/or further constrain the total vehicle travel allowable. Transportation deep decarbonization not only depends on electricity decarbonization, but also has a total travel budget, representing a maximum total vehicle travel threshold that still enables meeting a midcentury climate target. This makes encouraging ride sharing, reducing total vehicle travel, and increasing fuel economy in both human-driven and future automated vehicles increasingly important to deep decarbonization.

Subject Areas: Transportation; Energy; Electrification; Automation; Climate change; Decarbonization

Availability: Alarfaj, A.F., Griffin, W.M., and Samaras, C. (2020). “Decarbonizing US Passenger Vehicle Transport Under Electrification and Automation Uncertainty Has a Travel Budget.” *Environmental Research Letters*, 15(9). <https://doi.org/10.1088/1748-9326/ab7c89>

2.69. Title: A New Spatial Load Forecasting Method Considering Photovoltaic Output and Electric Vehicle Access

Author(s): Li, X., Xia, M., Wang, J., Zhang, Q., Wei, L., and Wang, B.

Abstract: With the development of distributed photovoltaic (PV) and the impact of electric vehicle (EV) access on the distribution network, the traditional spatial load forecasting can no longer meet the requirements. Therefore, a spatial load forecasting method considering PV output and EV access is proposed. Firstly, the traditional spatial load was predicted based on least-squares support-vector machines (LS-SVM) and load density index method, and then the photovoltaic output power is predicted according to the photovoltaic influence factors in the planning area. Monte Carlo algorithm is adopted to simulate the charging load of electric vehicles, and finally the photovoltaic output power, electric vehicle charging power, and traditional space load are superimposed to obtain the total space load. Taking a certain urban area of Shaoxing as an example, the prediction results show that the accuracy of spatial load predicting can be significantly improved by considering PV output and EVs access.

Subject Areas: Spatial load forecasting; Load density index method; Distributed photovoltaic; Electric vehicles; Charging pile load; Least-squares support-vector machines

Availability: Li, X., Xia, M., Wang, J., Zhang, Q., Wei, L., and Wang, B. (2020). "A New Spatial Load Forecasting Method Considering Photovoltaic Output and Electric Vehicle Access." *2020 39th Chinese Control Conference (CCC)*, pp. 5322–5327, Shenyang, China.
<https://doi.org/10.23919/CCC50068.2020.9188821>

2.70. Title: Modeling the External Effects of Air Taxis in Reducing the Energy Consumption of Road Traffic

Author(s): Lin, Z., Xie, F., and Ou, S.

Abstract: Air taxis are currently being demonstrated. Few studies have quantified their external effects in reducing on-road vehicle fuel consumption. The hypothesis of this paper is that air taxis may divert some drivers away from congested traffic corridors, improve traffic speed and fuel economy, and reduce congestion-induced energy consumption. A model is developed that links several key components: mode choice, the relationship between travel demand and traffic speeds, the relationship between traffic speeds and fuel economies, and the heterogeneous value of travel time. It is applied to the route from downtown Los Angeles to Los Angeles International Airport, where at peak hours 38,200 vehicles attempt to use the route that has an hourly capacity of 17,200 vehicles. The model estimates that, with conservative assumptions and near-term technologies, diverting 3.2% of the traffic to air taxis could produce a 15% reduction in traffic vehicle fuel use. With optimistic assumptions and mature technologies, the study estimates that diverting 20% of traffic could reduce the traffic vehicle fuel use by about 74%. The key insight is that if a small share of congested travelers switched to air taxis, motivated by private benefits of time savings, significant external benefits for other road travelers (time savings and fuel savings) and to society (reduced energy use and emissions), would ensue creating a win-win-win outcome. These estimates (which are not intended as predictions because of the stated limitations) strongly suggest the need to consider the external energy effect in future cost-benefit analyses of air taxi technologies.

Subject Areas: Air taxis; On-road vehicle fuel consumption; Fuel economy; Congestion reduction

Availability: Lin, Z., Xie, F., and Ou, S. (2020). "Modeling the External Effects of Air Taxis in Reducing the Energy Consumption of Road Traffic." *Transportation Research Record: Journal of the Transportation Research Board*, 2674(12), pp. 176–187.
<https://doi.org/10.1177/0361198120952791>

2.71. Title: Comprehensive Pricing Scheme of the EV Charging Station considering Consumer Differences Based on Integrated AHP/DEA Methodology

Author(s): Ji, X., Yin, Z., Zhang, Y., Zhang, X., Gao, H., and Zhang, X.

Abstract: Scientific pricing of the electric vehicle charging station is closely related to consumer behavior inevitably. Existing studies have not considered the impacts of consumer differences on the charging price, which will fail to meet the interests of various types of consumers. This paper proposes a novel pricing method based on consumer classification and comprehensive evaluation strategies. First, the basis for consumer classification is established according to a single factor sensitivity analysis of the consumer benefit model; then, the nonlinear expression of the basis is piecewise linearized. Additionally, with the principle of least fitting error to determine consumers' classification, the initial charging price schemes for various types of consumers are formulated. Second, this paper defines evaluation indices and establishes the hierarchy model for comprehensive evaluation schemes. Finally, the integrated analytic hierarchy process and data envelopment analysis are adopted for comprehensive evaluation of schemes. Simulations results illustrate that the proposed method can formulate the comprehensive optimal charging price considering consumer differences, and the method can reflect the impacts of both subjective and objective factors conveniently and accurately.

Subject Areas: Electric vehicle charging station; Consumer differences; Pricing method

Availability: Ji, X., Yin, Z., Zhang, Y., Zhang, X., Gao, H., and Zhang, X. (2020).

“Comprehensive Pricing Scheme of the EV Charging Station considering Consumer Differences Based on Integrated AHP/DEA Methodology.” *Mathematical Problems in Engineering*, 2020.

<https://doi.org/10.1155/2020/8657258>

2.72. Title: Estimate the Rebound Effect for Household Vehicle Usage Choice by Regression Models

Author(s): Lin, S.

Abstract: The recent Notice of Proposed Rulemaking (NPRM) published by the Environmental Protection Agency (EPA) proposed less stringent fuel economy standards for a safer affordable fuel-efficient (SAFE) vehicle rule for passenger vehicles and light trucks. With the advancements in the vehicle technology and improving fuel efficiency, the per-mile driving cost of passenger vehicles will reduce. However, this reduction in the driving cost may result in the rise of vehicle miles traveled, which is referred to as the rebound effect. Motivated by observing this unusual behavior on vehicle miles traveled (VMT) as a result of vehicle-related taxation schemes, this study aims at understanding the elasticity of VMT to fuel economy, which will be the reflection of the rebound effect, as well as the difference between elasticity of VMT to fuel price and fuel economy using 2017 National Household Travel Survey (NHTS). The magnitude of the elasticity of VMT to fuel economy is estimated to be between 0.19 and 0.37. This study aids in contemplating the effectiveness of the standards at reducing fuel utilization and related greenhouse gas emissions.

Subject Areas: Safer affordable fuel-efficient (SAFE); Rebound effect; Vehicle-related taxation schemes; Elasticity; Fuel economy; Vehicle miles traveled (VMT)

Availability: Lin, S. (2020). *Estimate the Rebound Effect for Household Vehicle Usage Choice by Regression Models*. Thesis, University of Maryland, College Park, MD.
<http://hdl.handle.net/1903/26542>

2.73. Title: Demand-side Price Responsive EV Charging Strategy based on Stochastic Model

Author(s): Yu, Y., Dong, K., Zhao, J., Gong, L., and Liu, W.

Abstract: This paper is primarily aimed at building a stochastic model considering the probabilistic distribution of relative factors in charging electric vehicles (EVs), including the start time of charging progress, the initial state of charge, and the length of charging. Following a brief introduction to the battery market and the common battery types utilized in the EV industry, the charging characteristics of a single battery are carefully analyzed. Four user groups are classified depending on the purpose of their use of EVs: commuting, business, public service, and taxi. The distribution of the stochastic parameters of each group is analyzed using probability density functions. The Monte Carlo method is employed to model the daily load pattern of multiple EVs with three different penetration levels: 10%, 20%, and 30%. To optimize the results, a state variable is also introduced which reflects the state of charge (SOC). By utilizing a management strategy, the impact of real-time electricity rates on the distribution of the initial SOC of EVs is analyzed by comparing the coordinated and uncontrolled load profiles.

Subject Areas: Battery-powered vehicles; Demand-side management; Electric vehicle charging; Monte Carlo methods; Pricing; Uncertainty model; Stochastic processes; Real-time tariff

Availability: Yu, Y., Dong, K., Zhao, J., Gong, L., and Liu, W. (2020). "Demand-side Price Responsive EV Charging Strategy based on Stochastic Model." *2020 12th IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC)*, pp. 1–5, Nanjing, China. <https://doi.org/10.1109/APPEEC48164.2020.9220334>

2.74. Title: Techno-Economic Design of EV Powertrain Based on Customer Perspective

Author(s): Godi, M. and Vishwanath, D.S.

Abstract: In this thesis work, literature studies were done related to the customer preferences based on their driving patterns to identify and define potential electric vehicle buyers. From this study, the customers were adopted and performance matrix for those customers is defined. Based on the adoption of customers, four different drivelines (city driving customer, mixed driving customer, long-range driving customer, and shared mobility customer) with three different battery pack options were designed after performance requirements with data on existing battery electric vehicles as a frame of reference. The acceleration performance, energy consumption, traction battery sizing, and electric machine sizing was determined and analyzed for the standard Worldwide Harmonized Light Vehicles Test Cycles (WLTC) drive cycle. Acceleration requirement turned out to be dominant over other factors such as top speed while powertrain sizing regarding torque and power. The entire modeling and simulation was done via a 1D Computational fluid dynamics (CFD) commercial software GT-SUITE.

Further, important step was to compute consumer centric total cost of ownership (TCO) for twelve powertrains with two different charging preferences (cost focused customer, premium customer) which includes virtual costs over five years of ownership. TCO analysis consider electricity cost, maintenance cost and depreciation cost. Investigation of battery full cycle life helped in finding the deprecation of the battery. To compute virtual cost such as cost of waiting time and cost for have to stop for fast charging a unique model of driving range distribution and energy distribution is used which is based on National household Travel Survey (NHTS) database. TCO is presented in terms of per year and per km which helps in comparing between the customers. Our findings suggest that virtual cost attributes such as cost of having to stop and cost for charging is not a big for electric vehicle buyers.

Subject Areas: Battery electric vehicle; Lithium ion battery; Electric motor; Battery thermal management; Total cost of ownership; Energy distribution curve; Driving range distribution; Cost of waiting time for charging; Electricity cost; Customer

Availability: Godi, M. and Vishwanath, D.S. (2020). *Techno-Economic Design of EV Powertrain Based on Customer Perspective*. Master's Thesis, Chalmers University of Technology, Gothenburg, Sweden. <https://hdl.handle.net/20.500.12380/301855>

2.75. Title: Risk Assessment of Flexible Distribution District Considering Large-scale Fast Charging Load

Author(s): Liu, G., Zhu, Y., Xu, H., Wang, Y., and Xu, G.

Abstract: This paper presents a risk assessment method of flexible distribution district based on fast charging load of largescale electric vehicle. First of all, based on the “parking & charging” mode, considering the different charging needs of residential areas and commercial areas, the simulation of the fast charging load of electric vehicles is carried out; secondly, the traditional way of decentralized access of the fast charging load in the distribution district and the new flexible district scheme are given, and based on this, the control strategy of AC/DC converter and energy storage equipment is proposed, and the district interconnection is established. Finally, taking the transformer as the center, the risk indexes, including the cost of heavy load, overload, and load shedding cost of distribution transformer, are put forward, and the risk assessment system of distribution district is established. Taking a demonstration project as an example, this paper discusses and analyzes the safe operation risk of distribution district under different topological structure and fast charging load scale.

Subject Areas: Flexible distribution district; Fast charging load of electric vehicle; Risk assessment; Overload risk of distribution transformer; AC/DC distribution network

Availability: Liu, G., Zhu, Y., Xu, H., Wang, Y., and Xu, G. (2020). “Risk Assessment of Flexible Distribution District Considering Large-scale Fast Charging Load.” *2020 12th IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC)*, pp. 1–5, Nanjing, China. <https://doi.org/10.1109/APPEEC48164.2020.9220719>

2.76. Title: Demand Contracting Strategy for Charging Stations Based on Load Forecasting

Author(s): Fang, C., Liu, Z., Wang, H., Zhao, Y., Shi, S., and Gui, Q.

Abstract: Since the stochasticity of the charging of electric vehicles (EVs) may bring impact to the grid, there is a high possibility that the demand charge will be applied to charging stations. Therefore, a load forecasting-based demand contracting strategy is proposed for charge stations in this paper. A stochastic optimization model is established by regarding the maximal demand as a stochastic parameter, and the object of the model is to minimize the expectation of demand charge, and the analytic solution is derived. To obtain the distribution of actual maximal demand, a Monte-Carlo-based charge load forecasting method is proposed. It gives the distribution of the daily maximal demand based on which the distribution of monthly maximal demand is also derived. The case study illustrates the feasibility and the validity of the proposed strategy.

Subject Areas: Electric vehicles; Charging stations; Load forecasting-based demand contracting strategy; Stochastic optimization mode; Monte Carlo method

Availability: Fang, C., Liu, Z., Wang, H., Zhao, Y., Shi, S., and Gui, Q. (2020). "Demand Contracting Strategy for Charging Stations Based on Load Forecasting." *E3S Web of Conferences*, 194. <https://doi.org/10.1051/e3sconf/202019403024>

2.77. Title: Optimal Fuel Taxation with Suboptimal Health Choices

Author(s): Sulikavo, S., van den Bijgaart, I., Klenert, D., and Mattauch, L.

Abstract: Transport has a large number of significant externalities, including carbon emissions, air pollution, accidents, and congestion. Active travel, such as cycling and walking, can reduce these externalities. Moreover, public health research has identified additional social gains from active travel due to health benefits of increased physical exercise. In fact, on a per-mile basis, these benefits dominate the external social costs from car use by two orders of magnitude. We introduce health benefits and active travel options into an optimal taxation model of transport externalities to study appropriate policy responses. We characterize the optimal second-best fuel tax analytically: when physical exercise is considered welfare-enhancing, the optimal fuel tax increases. Under central parameter assumptions, it rises by 49% in the US and 36% in the UK. This is due to the low fuel price elasticity of active travel. We argue that fuel taxes should be implemented jointly with other policies aimed at increasing the uptake of active travel to reap its full health benefits.

Subject Areas: Transport externalities; Congestion; Active travel; Fuel; Health behavior; Optimal taxation

Availability: Sulikavo, S., van den Bijgaart, I., Klenert, D., and Mattauch, L. (2020). *Optimal Fuel Taxation with Suboptimal Health Choices*. INET Oxford Working Paper No. 2020-22, University of Oxford, Oxford, UK.

https://www.inet.ox.ac.uk/files/Sulikova_vdBijgaart_Klenert_Mattauch_2020.pdf

2.78. Title: Carbon Neutrality Study 1: Driving California’s Transportation Emissions to Zero

Author(s): Brown, A.L., Fleming, K.L., Lipman, T., Fulton, L., Saphores, J.D., Tal, G., Murphy, C., Shaheen, S., Austin, B., Garcia Sanchez, J.C., Martin, E., Miller, M., Hyland, M., Handy, S. Delucchi, M.A., Coffee, D., and DeShazo, J.R.

Abstract: The purpose of this study overall is to explore the policy pathways to achieve a zero carbon transportation system in California by 2045. The purpose of this synthesis report is to describe the existing state of knowledge and policy related to energy use and greenhouse gas (GHG) emissions in the transportation sector, especially in California. It is an interim product of the larger study, which will use this report as the baseline and policy context sections. The report comprises four sections. Section 1 provides an overview of the major components of transportation systems and how those components interact. Section 2 explores key underlying concepts in transportation, including equity, health, employment, and environmental justice (EJ). Section 3 discusses California’s current transportation-policy landscape. Section 4 analyzes projected social, environmental, and economic outcomes of transportation under a “business as usual (BAU)” scenario—i.e., a scenario with no significant transportation-policy changes.

Subject Areas: Greenhouse gas; Environmental justice; Transportation policy; Equity; Health; Employment

Availability: Brown, A.L., Fleming, K.L., Lipman, T., Fulton, L., Saphores, J.D., Tal, G., Murphy, C., Shaheen, S., Austin, B., Garcia Sanchez, J.C., Martin, E., Miller, M., Hyland, M., Handy, S. Delucchi, M.A., Coffee, D., and DeShazo, J.R. (2020). *Carbon Neutrality Study 1: Driving California’s Transportation Emissions to Zero*. University of California Institute of Transportation Studies. <https://doi.org/10.7922/G2222S1B>

2.79. Title: Second-order Cone Programming Based Methods for Two Variants of Optimal Power Flow

Author(s): Kayacık, S.E.

Abstract: Optimal Power Flow (OPF) is a fundamental optimization problem in power system operations. In this thesis, we focus on two variants of the OPF problem: Reactive Optimal Power Flow (ROPF) and Multi-Period Optimal Power Flow (MOPF). In Chapter 2, we provide an overview of the classical OPF formulations. In Chapter 3, we present an alternative mixed-integer non-linear programming formulation of the ROPF problem. We utilize a mixed-integer second-order cone programming (MISOCP)-based approach to find globally optimal solutions of the proposed ROPF problem formulation. We strengthen the MISOCP relaxation via the addition of convex envelopes and cutting planes. Computational experiments on challenging test cases show that the MISOCP-based approach yields promising results with small optimality gaps compared to a semidefinite programming based approach from the literature. In Chapter 4, we focus on the MOPF problem with electric vehicles (EVs) under emission considerations. Our model integrates three different real data sets: household electricity consumption, marginal emission factors, and EV driving profiles. We present a systematic solution approach based on SOCP to find globally optimal solutions. Our computational experiments on instances with up to 2000 buses demonstrate that our solution approach leads to globally optimal solutions with very small optimality gaps, in addition to significant emission savings and reductions in cost with the coordination of EV charging.

Subject Areas: Optimal power flow; Reactive optimal power flow; Multi-period optimal power; Mixed-integer second-order cone; Electric vehicles; Emission savings; Electric vehicles charging

Availability: Kayacık, S.E. (2020). *Second-order Cone Programming Based Methods for Two Variants of Optimal Power Flow*. Master's Thesis, Sabancı University, Istanbul, Turkey. <http://research.sabanciuniv.edu/41189/>

2.80. Title: Modelling of Workplace Electric Vehicle Charging Profiles based on Trip Chain Generation

Author(s): Walz, K., Contreras, D., Rudion, K., and Wiest, P.

Abstract: Increasing penetration of electric vehicles leads to new challenges for the power grid. Due to limited measured data, the generation of charging profiles from journey data of conventional cars—called trip chain generation—is a possibility for considering them in grid planning. In this paper, the method of trip chain generation is applied to the field of workplace charging. Therefore, parameters as distances, different car models, and home charging possibilities are introduced and varied. Their effects in grid planning are validated using a journey survey from Germany and a commonly used European MV-grid model. Simulation results show the importance of the improved modelling approach.

Subject Areas: Adaptation models; Analytical models; Employment; Europe; Planning; Automobiles; Load modeling; Charging profile; Electric vehicle; Grid planning; Journey data; Trip chain; Workplace charging

Availability: Walz, K., Contreras, D., Rudion, K., and Wiest, P. (2020). “Modelling of Workplace Electric Vehicle Charging Profiles based on Trip Chain Generation.” *2020 IEEE PES Innovative Smart Grid Technologies Europe (ISGT-Europe)*, pp. 459–463, The Hague, Netherlands. <https://doi.org/10.1109/ISGT-Europe47291.2020.9248962>

2.81. Title: Assessing the Efficiency Implications of Renewable Fuel Policy Design in the United States

Author(s): Zhong, J. and Khanna, M.

Abstract: The Renewable Fuel Standard (RFS) has failed to achieve its original goal of inducing the consumption of E85 (with up to 74% blend in gasoline) even though the market share of flexfuel vehicle is significant. Blenders chose to comply with the RFS mandate by increasing the blending of biomass-based biodiesel beyond originally-targeted levels, instead of creating market demand for E85 by pricing E85 at an energy-equivalent level with E10 fuel for flex-fuel vehicle owners in the US. This paper develops a welfare-economic framework and a simulation model to analyze the implications of the design of the RFS (specifically, its nested structure and the accompanying cellulosic waiver credit and biodiesel tax credit) for the mix of biofuels blended and for social welfare. We show that the RFS's flexibility for achieving compliance reduced incentives for the higher blend of corn ethanol and cellulosic ethanol and led to an overall blend wall for ethanol. It led to E85 being priced 15% higher than the energy-equivalent price of E10. The flexibility indeed increases social welfare by \$564 million in 2017 relative to otherwise, but it imposed a compliance cost of \$2.8 billion on taxpayers and marginal effect on the GHG emission reduction. Our analysis informs policymakers about the policy changes needed to overcome the blend wall, to generate demand for second-generation biofuels, and to significantly decrease gasoline consumption in the US.

Subject Areas: Renewable fuel standard; Blend wall; Nested structure; Biodiesel tax credit; Renewable Identification Number (RIN); Biodiesel overproduction

Availability: Zhong, J. and Khanna, M. (2020). *Assessing the Efficiency Implications of Renewable Fuel Policy Design in the United States*. University of Illinois at Urbana-Champaign, Urbana, IL. https://ace.illinois.edu/sites/ace.illinois.edu/files/JMP103020_0.pdf

2.82. Title: Optimal Demand Control of Electric Water Heaters to Accommodate the Integration of Plug-in Electric Vehicles in Residential Distribution Networks

Author(s): Moradzadeh, M. and Abdelaziz, M.

Abstract: The large-scale adoption of PEVs can result in an increased peak demand of the residential distribution network and in an increased distribution transformer loss of life. This study investigates the potential use of household electric water heaters (EWHs) to eliminate such adverse impacts. To this end, we propose optimizing the thermostat set-points of the EWHs in residential houses with the objective of minimizing the energy cost associated with the residential houses having plug-in electric vehicles (PEVs). The problem is formulated as a mixed integer linear programming (MILP) problem. The proposed MILP problem considers the random behavior of the PEVs charging demand as well as the uncertainty associated with the hot water consumption rate of the EWHs. The developed MILP model was built in GAMS environment solved using CPLEX solver.

Subject Areas: Water heating; Resistance heating; Optimization; Distribution networks; Power transformer insulation; Oil insulation; Autoregressive processes; Electric water heater (EWH); Demand management; Plug-in electric vehicle (PEV); Residential transform

Availability: Moradzadeh, M. and Abdelaziz, M. (2020). “Optimal Demand Control of Electric Water Heaters to Accommodate the Integration of Plug-in Electric Vehicles in Residential Distribution Networks.” *2020 IEEE Canadian Conference on Electrical and Computer Engineering (CCECE)*, pp. 1–6, London, ON, Canada.
<https://doi.org/10.1109/CCECE47787.2020.9255743>

2.83. Title: Two-Stage Stochastic Programming Model to Locate Capacitated EV-Charging Stations in Urban Areas Under Demand Uncertainty

Author(s): MirHassani, S.A., Khaleghi, A., and Hooshmand, F.

Abstract: Due to the dangerous effects of fossil fuels, policymakers tend to substitute fossil-fuel-based vehicles with electric ones. Thus, the optimal design of a charging station network providing convenient access for the users is of great importance. This paper presents a two-stage stochastic programming model for the problem of locating charging stations in urban areas. Parking lots around the buildings which may be visited by people during the day are considered as potential locations for charger installation. The model determines the parking lots that should be equipped with chargers and the number as well as the type of chargers that must be placed in each parking lot considering the demand as an uncertain parameter. The proposed model is examined on the dataset of a midtown area, taken from the literature, and an efficient heuristic algorithm based on Benders decomposition is utilized to solve the model. The results indicate that the heuristic method can find a near-optimal solution (with the optimality gap of at most 0.05%) in a short time.

Subject Areas: Charging station location problem; Electric vehicle; Uncertain demand; Two-stage stochastic programming; Benders decomposition

Availability: MirHassani, S.A., Khaleghi, A., and Hooshmand, F. (2020). "Two-Stage Stochastic Programming Model to Locate Capacitated EV-Charging Stations in Urban Areas Under Demand Uncertainty." *EURO Journal on Transportation and Logistics*, 9(4).
<https://doi.org/10.1016/j.ejtl.2020.100025>

2.84. Title: A Review of Electric Vehicle Load Open Data and Models

Author(s): Amara-Ouali, Y., Goude, Y., Massart, P., Poggi, J., and Yan, H.

Abstract: The field of electric vehicle charging load modelling has been growing rapidly in the last decade. Various models have been applied to this new industrial problem. In light of the Paris Agreement, it is crucial to keep encouraging better modelling techniques for successful electric vehicle adoption. Additionally, numerous papers highlight the lack of charging station data available in order to build models that are consistent with reality. In this context, the purpose of this article is threefold. First, to provide the reader with an overview of the open datasets available and ready to be used in order to foster reproducible research in the field. Second, to review electric vehicle charging load models with their strengths and weaknesses. Third, to provide suggestions on matching the models reviewed to six datasets found in this research that have not previously been explored in the literature. The open data search covered more than 860 repositories and yielded around 60 datasets that are relevant for modelling electric vehicle charging load. These datasets include information on charging point locations, historical and real-time charging sessions, traffic counts, travel surveys and registered vehicles. The models reviewed range from statistical characterization to stochastic processes and machine learning and the context of their application is assessed.

Subject Areas: Electric vehicles; Charging point; Load modelling; Smart charging; Open data; Statistical learning

Availability: Amara-Ouali, Y., Goude, Y., Massart, P., Poggi, J., and Yan, H. (2020). *A Review of Electric Vehicle Load Open Data and Models*. University of Paris, Paris, France.
<https://hal.inria.fr/hal-03028375>

2.85. Title: A Data-Driven Mobility–Energy Typology Framework for New York State

Author(s): Rames, C., Wilson, A.M., Zimny-Schmitt, D., Neri, C., Sperling, J. and Romero-Lankao, P.

Abstract: Exploring multidimensional aspects of differences in technology adoption, travel, and vehicle ownership across settlement types can help inform energy-efficient and affordable mobility system goals. At the same time, mapping key enablers, barriers, and risks for successfully meeting ambitious goals and targets (e.g., by geography, age, income, education, and population density) offer important explanatory power as to context-specific challenges and opportunities. This paper explores how a highly geographically resolved understanding of social, economic, techno-infrastructure, environmental, and governance (SETEG) factors shape variations in technology adoption and associated mobility and energy outcomes in diverse communities of New York State in terms of electric vehicle adoption rates, alternative commute mode choices, vehicles per household, and vehicle fuel economy. Results indicate the range of two to three times higher adoption rates for electric vehicles by more highly educated, wealthier, “Core Urban” populations relative to the other identified typologies, given the labels “Rural,” “Suburban,” and “Urban” populations. Additionally, commute mode choice is closely linked with population and employment density—more than 89% of Core Urbanites use transit or active modes, compared with just 26% and 18% of Suburban and Rural residents, respectively. Household vehicle ownership varies from approximately 1.9 vehicles per household in Rural areas to only 0.6 in Core Urban settings. Findings on differences among the four settlement types, which go beyond simply rural to urban contexts, suggest an important need to explore how best to manage and anticipate very different types of services that may be supportive in achieving energy-efficient and affordable mobility systems statewide.

Subject Areas: Energy-efficient mobility; Socio-demographics; High-resolution geospatial analysis; New York State

Availability: Rames, C., Wilson, A.M., Zimny-Schmitt, D., Neri, C., Sperling, J. and Romero-Lankao, P. (2020). “A Data-Driven Mobility–Energy Typology Framework for New York State.” *Environment and Planning B: Urban Analytics and City Science*.
<https://doi.org/10.1177%2F2399808320974032>

2.86. Title: Impact of COVID-19 on Mobility and Electric Vehicle Charging Load

Author(s): Palomino, A., Parvania, M., and Zane, R.

Abstract: The COVID-19 pandemic has depressed overall mobility across the country. The changes seen reflect responses to new COVID-19 cases, local health guidelines, and seasonality, making the relationship between mobility and COVID-19 unique from region to region. This paper presents a data-driven case study of electric vehicle (EV) charging and mobility in the wake of COVID-19. The study shows that the number of EV charging sessions and total energy consumed per day dropped by 40% immediately after the arrival of the first COVID-19 case in Utah. By contrast, the energy consumed per charging session fell by just 8% over the same period, and the distribution of session start and end times remained consistent throughout the year. While EV mobility dropped more dramatically than total vehicle mobility during the first wave of COVID-19 cases, and returned more slowly, both returned to stable levels near their mean values by September 2020 despite a dramatic third wave in new infections.

Subject Areas: COVID-19; Electric vehicles; Mobility

Availability: Palomino, A., Parvania, M., and Zane, R. (2020). *Impact of COVID-19 on Mobility and Electric Vehicle Charging Load*. arXiv, Cornell University, Ithaca, NY.
<https://arxiv.org/abs/2011.10182>

2.87. Title: Assessing the Impact of Urban Form on the Greenhouse Gas Emissions from Household Vehicles: A Review

Author(s): Tian, X.L., An, C.J., and Chen, Z.K.

Abstract: Urban growth is associated with a number of environmental issues. One of the most serious environmental concerns is air pollutants and increasing greenhouse gas (GHG) emissions. This study presents a comprehensive review of the impact of urban form on the GHG emissions from household vehicles. A comparative study encompassing the methods used for identifying the relationship between urban form and vehicle GHG emissions was conducted. Household vehicle GHG emissions in different urban forms were investigated, drawing upon various existing studies. The internal variables that define urban form, such as density, connectivity, land use mix, and accessibility, were further discussed with respect to their degree of influence on household vehicle GHG emissions. Finally, a discussion of opportunities in urban form which may be conducive to household vehicle GHG emission mitigation in the long term was presented.

Subject Areas: Urban form; Greenhouse gas emissions; Household vehicles; Urban planning

Availability: Tian, X.L., An, C.J., and Chen, Z.K. (2020). “Assessing the Impact of Urban Form on the Greenhouse Gas Emissions from Household Vehicles: A Review.” *Journal of Environmental Informatics Letters*, 3(2), pp. 70–85. <http://dx.doi.org/10.3808/jeil.202000029>

2.88. Title: An Overview on Costs of Shifting to Sustainable Road Transport: A Challenge for Cities Worldwide

Author(s): Santos A.S., de Abreu V.H.S., de Assis T.F., Ribeiro S.K., and Ribeiro G.M.

Abstract: The transport sector plays a fundamental role in economic and social development in the urban context; however, it has a significant impact on air pollutants and greenhouse gas emissions and the natural resource depletion. Therefore, this chapter seeks to identify, through a bibliographic review on road transportation and the Sustainable Development Goals, synergies and trade-offs between climate policies and transportation. Some actions to mitigate the impacts of road transportation on the environment were identified, based on the ASI (Avoid, Shift and Improve) approach considering aspects as high energy efficiency, low pollution, and high capacity. Finally, this chapter presents some mitigation measures for the road transportation based on six categories and discuss the cost of shifting to road sustainable transport, which is a gap in the current literature. The results indicate that it is necessary to establish a rational transport structure with a good governance, opportunities for finance, transparency and a medium and long-term vision, prioritizing actions to incentive active transportation, that in general, has low-medium costs, in comparison to great transformations in the infrastructure of cities to implement Metro and Light-rail transit (LRT) systems, for example, that is also urgent and has a (very) high cost. All actions are important to promote sustainable cities toward a low carbon transport.

Subject Areas: Road transportation; Greenhouse gas emissions; Resource depletion; Sustainable development goals; Mitigation actions; Climate policies; Avoid, shift and improve (ASI) approach; Costs

Availability: Santos A.S., de Abreu V.H.S., de Assis T.F., Ribeiro S.K., and Ribeiro G.M. (2020). “An Overview on Costs of Shifting to Sustainable Road Transport: A Challenge for Cities Worldwide.” *Carbon Footprint Case Studies*, pp. 93–121. https://doi.org/10.1007/978-981-15-9577-6_4

2.89. Title: Daily Electric Vehicle Charging Load Profiles Considering Demographics of Vehicle Users

Author(s): Zhang, J., Yan, J., Liu, Y., Zhang, H., and Lv, G.

Abstract: Travel patterns of an electric vehicle (EV) user and the accuracy of their probability distribution models are the key factors affecting the simulation and prediction of EV charging load. Most of the existing works utilized the travel data for all kinds of populations and ignored the influence of people social attributes on their travel pattern, which deteriorates the accuracy of the charging load model. This paper demonstrates that the daily EV charging load profiles vary with different demographic and social attributes by presenting a refined EV charging load simulation method considering people's demographics and social characteristics, e.g., gender, age, and education level. First, to improve the fitting accuracy of people travel pattern, new probabilistic models of many defined spatial-temporal variables are established under refined conditions (i.e., location, day type, etc.). Second, additional factors (i.e., charging preference, power consumption rate, etc.) are included to simulate the daily profile of EV charging load based on the refined probabilistic models and Monte Carlo algorithm. Data from the US National Household Travel Survey are used to validate the proposed method. The results show that the user's demographic and social attributes have a considerable effect on the magnitude and peak time of the EV charging load profile, particularly for workdays and workplace. The proposed probabilistic models can improve the accuracy of the data fitting and the charging load simulation.

Subject Areas: Electric vehicle; EV charging load; Typical daily profile; Demographic; Travel mode; Monte Carlo

Availability: Zhang, J., Yan, J., Liu, Y., Zhang, H., and Lv, G. (2020). "Daily Electric Vehicle Charging Load Profiles Considering Demographics of Vehicle Users." *Applied Energy*, 274, pp. 70–85. <https://doi.org/10.1016/j.apenergy.2020.115063>

2.90. Title: A Methodology to Model Daily Charging Load in the EV Charging Stations Based on Monte Carlo Simulation

Author(s): Ni, X. and Lo, K.L.

Abstract: Electrical vehicle (EV) charging station is an important facility where EV owners can recharge their vehicles. With increasing penetration of EVs, charging loads in EV charging stations are increasing and consequently have dramatic impacts on the distribution systems. Under this condition, load modeling of the charging station is of great importance to relative research work such as evaluation of impacts of the integration of charging stations, planning for charging networks and so on. In this paper, random factors that can affect daily EV charging load are firstly analyzed in detail. Secondly, a Monte-Carlo simulation-based methodology is proposed to model daily charging load in the EV charging station with considerations of random factors. Another contribution is to design a threshold of failed recharge attempts in the Monte Carlo simulation. In the simulation, this parameter can be adjusted according to the amounts of the EVs that are charged in the charging station during a day. Simulation results validate the methodology proposed in this paper.

Subject Areas: Electric vehicle charging; Load modeling; State of charge; Charging stations; Monte Carlo methods; Batteries; Probabilistic logic; Daily charging load; Random factors; Threshold of failed recharge attempts

Availability: Ni, X. and Lo, K.L. (2020). “A Methodology to Model Daily Charging Load in the EV Charging Stations Based on Monte Carlo Simulation.” *2020 International Conference on Smart Grid and Clean Energy Technologies (ICSGCE)*, pp. 125–130, Kuching, Malaysia.
<https://doi.org/10.1109/ICSGCE49177.2020.9275644>

2.91. Title: Effects of Electric Vehicle Adoption for State-Wide Intercity Trips on the Emission Saving and Energy Consumption

Author(s): Kavianipour, M., Mozafari, H., Ghamami, M., Zockaie, A., and Jackson, R.

Abstract: Electric vehicles (EVs) are considered as sustainable alternatives to conventional vehicles, as they reduce emission and fossil fuel dependency. A recent study has proposed a charging infrastructure planning tool to support intercity trips for the estimated EV market share (6 percent) in Michigan for 2030. The main goal of this study is to estimate the emission reduction associated with this electrification rate and infrastructure investment for light duty vehicles. To this end, a state-of-the-art emission estimation framework is proposed to be applied to the state-wide intercity travels. The main contributions of the proposed framework includes: (1) incorporating a micro emission estimation model for simulated vehicle trajectories of the intercity network of Michigan and (2) adjusting the micro emission model results considering impacts of monthly travel demand and temperature variations and heterogeneity of vehicles based on their make, model, and age. The emission estimation framework is then compared with the traditional VMT analysis method as a benchmark. Finally, five different scenarios are explored for EV adoption to assess potential emission savings from the given electrification rate for each scenario. The results suggest an annual CO₂ emission savings of 0.58–0.92 million-ton. The CO₂ social cost savings may justify the investment on the network electrification. Note that only 3.7 to 8.6 percent of the total EV energy requirements must be provided via the DC fast charger network proposed by the charging infrastructure planning tool. This requires annual energy consumption of 22.15 to 51.76 BWh for the estimated EV market share in Michigan for 2030.

Subject Areas: Electric vehicles; Emission; Charging planning; Microscopic simulation; Energy

Availability: Kavianipour, M., Mozafari, H., Ghamami, M., Zockaie, A., and Jackson, R. (2020). *Effects of Electric Vehicle Adoption for State-Wide Intercity Trips on the Emission Saving and Energy Consumption*. arXiv, Cornell University, Ithaca, NY. <https://arxiv.org/abs/2012.04773>

2.92. Title: Energy and Environmental Impact of the Abidjanese Way of Life (Côte D'Ivoire): A Case Study of Energy Efficiency of Transport Modes

Author(s): N'guessan, K.N., N'guessan, Y., Diango, K.A., Perilhon, C., Sako, M.K., and Saraka, K.J.

Abstract: As part of the protection of the environment in general, and in the particular case of Abidjan which is threatened by pollution from exhaust fumes, a survey was conducted on the 7 modes of transport currently used by Abidjanese, estimated at nearly 4.4 million at the last census of Cote d'Ivoire [5], i.e., 19.4% of the Ivorian national population. The survey aims to determine the energy consumption to transport a passenger over one kilometre (p.km), according to the transport mode which are: Communal taxi, Intercommunal taxi, Taxi, Sotra Bus, Sotra Bus Boat, Personal car, and Mini-bus commonly known as "Gbaka." The average consumption of all light vehicles is 11.0 lge/100 km (litres of petrol equivalent per 100 km), well above the limit set by the North American CAFE (Corporate Average Fuel Economy) regulations [9], which is set at 8.6 lge/100 km, and that of the EU, which is set at 5.6 lge/100 km [10]. This is partly due to the ageing of the light vehicle fleet in Cote d'Ivoire. In terms of energy consumption to transport one passenger over 1 kilometer (specific energy consumption), the Sotra Bus and the Gbaka are the most efficient transport modes, with 0.28 MJ/p.km and 0.43 MJ/p.km, respectively. Within Sotra Bus, the Monbus service is the most efficient of all Abidjan's transport modes with 0.20 MJ/p.km. In contrast, the Taxi and the Personal car are the least efficient, with 3.50 MJ/p.km and 2.27 MJ/p.km, respectively. In terms of specific energy consumption, the Collective taxi (1.39 MJ/p.km) is 38.77% and 60.29% more efficient than the Personal car and the Taxi, respectively. Specifically, the Intercommunal taxi (0.84 MJ/p.km) is 63.00% and 76.00% more efficient than the Personal car and the Taxi, respectively. This relative efficiency of the Collective taxi results from its mode of operation which maximizes its occupancy rate.

Subject Areas: Fuel economy; Energy consumption; Old vehicles; Taxi and personal vehicles

Availability: N'guessan, K.N., N'guessan, Y., Diango, K.A., Perilhon, C., Sako, M.K., and Saraka, K.J. (2020). "Energy and Environmental Impact of the Abidjanese Way of Life (Côte D'Ivoire): A Case Study of Energy Efficiency of Transport Modes." *AIP Conference Proceedings*, 2307. <https://doi.org/10.1063/5.0033666>

2.93. Title: Multi-Objective Framework for Optimal Scheduling of Electric Vehicles

Author(s): Kapoor, A., Gangwar, P., Sharma, A., and Mohapatra, A.

Abstract: This paper presents a multi-objective framework for the optimal scheduling of Electric Vehicles (EVs) to satisfy the interests of multiple stakeholders, such as EV owner/aggregator and the Distribution System Operator (DSO). Optimal scheduling refers to smart charging and Vehicle-to-Grid (V2G) discharging operations of EV. The modelling of stochastic nature of arrival, departure, and the distance travelled by the EV is taken into account with appropriate Probability Distribution Functions (PDFs). The proposed formulation considers the perspectives of the aggregator and the DSO, which are minimization of net cost of charging of EVs and the power loss in the system to improve the performance of the system, respectively. A multi-objective function is formulated using normalized linear weighted sum approach to optimize both the objectives simultaneously. The Particle Swarm Optimization (PSO) is implemented to find out the optimal scheduling of charging and discharging of EVs. The competence of the proposed methodology is tested by implementing it on the IEEE 33-bus test feeder. The analysis is carried out for the residential and commercial loads with the consideration of different Time-of-Use (TOU) tariffs. The results show that the scheduling operation of EV, obtained by implementing proposed methodology, leads to significant reduction in the net cost of charging borne by the owner/aggregator and decrement in the network power loss.

Subject Areas: Vehicle-to-grid; Tariffs; Stochastic processes; Optimal scheduling; Probability density function; Probability distribution; Stakeholders

Availability: Kapoor, A., Gangwar, P., Sharma, A., and Mohapatra, A. (2020). "Multi-Objective Framework for Optimal Scheduling of Electric Vehicles." *2020 21st National Power Systems Conference (NPSC)*, pp. 1–6, Gandhinagar, India.
<https://doi.org/10.1109/NPSC49263.2020.9331921>

2.94. Title: Minimizing the Cost of Charging Plug-In Vehicles through Smart Charging

Author(s): Yi, J.H.

Abstract: Plug-in electric vehicles (PEVs) have the potential to significantly reduce the consumption of gasoline and decrease both greenhouse gas and criteria pollutant emissions. The State of California implemented initiatives to increase zero-emission vehicles to 5 million cars by 2030, most of which will be PEVs. However, with an increased density of PEVs entering the transportation sector, a network of PEV charging infrastructure is required which in turn will result in increased electric demand and prematurely degrade the electric grid and the distribution system. The resultant upgrades to the grid infrastructure and the cost of charging present major obstacles in enabling the market. To minimize costs from the deployment of PEVs, this thesis addresses the development, demonstration, and evaluation of an efficient and improved charging method that encompasses (1) charging hubs at parking structures, (2) a unique smart charging algorithm, (3) targeted use of select distributed energy resources (DERs), such as photovoltaic and battery storage, and (4) load forecasting.

In addition to energy costs, demand charges, rate structures, and tariffs will become significant expenses to PEV and charging hub operators with increased PEV penetration. To mitigate these impacts reduce costs by optimizing a charging schedule for each PEV, a smart charging algorithm was enhanced to include demand charges, DERs, and load forecasting using a neural network and other forecasting methods. The DERs were utilized to further reduce and optimize costs, reduce imports from the grid, and thereby reduce impacts on the distribution system and the overall grid.

By demonstrating the approach with ten electric KIA Soul vehicles at the Anteatr Parking Structure Nanogrid on the University of California Irvine Microgrid (UCIMG), smart charging and DERs reduced the instantaneous demand and overall electricity consumption from the grid. The success of the demonstration revealed promise in applying the methodology on a large-scale strategy for parking structures.

Subject Areas: Plug-in electric vehicle; Charging infrastructure; Electric grid; Distribution system; Charging method; Tariffs; Distributed energy resources

Availability: Yi, J.H. (2020). *Minimizing the Cost of Charging Plug-In Vehicles through Smart Charging*. Master's Thesis, University of California, Irvine, CA.
<https://escholarship.org/uc/item/5tk6f0fv>

2.95. Title: Urban Impacts of Mobile Fuel Delivery Service

Author(s): Broaddus, A.

Abstract: Mobile fuel delivery (MFD) uses a fueling truck to fill up personal and commercial fleet vehicles while they are parked overnight. This study used a sample data set provided by a San Francisco Bay Area company to explore the potential impacts on vehicle miles traveled (VMT), carbon dioxide (CO₂) emissions, and traffic congestion. An analysis of vehicle travel associated with gas station trips was conducted to establish a basis for comparison. Future scenarios comparing the potential impacts of scaled-up MFD services in 2030 were also developed. The study concluded that MFD services compared favorably to gas stations in relation to environmental and traffic benefits in the longer term, even though personal fueling trips tended to generate low VMT. Benefits stemmed from efficiencies achieved by fueling multiple vehicles per delivery trip, replacing car share vehicle fueling trips and removing trips from the network during peak hours. This analysis estimated that total annual CO₂ emissions associated with fuel delivery operations in the Bay Area were 76 metric tons, which is less than a typical gas station with 97 metric tons. Under assumptions of declining demand for gasoline and significantly fewer gas stations, and with highly efficient optimized operations, mobile delivery could gain up to 5% market share for gas and not add additional VMT over the business as usual scenario.

Subject Areas: Mobile fuel delivery (MFD); Vehicle miles traveled (VMT); Carbon dioxide emissions; Traffic congestion; Environmental and traffic benefits

Availability: Broaddus, A. (2020). "Urban Impacts of Mobile Fuel Delivery Service." *Transportation Research Record: Journal of the Transportation Research Board*. <https://doi.org/10.1177%2F0361198120975413>

2.96. Title: V2G Scheduling for an EV Aggregator with Rooftop Solar Charging Park

Author(s): Sharma, S., Jangid, S., and Jain, P.

Abstract: Grid integration of Electric Vehicles (EVs) and renewable generation are major operational challenges for System Operators (SOs) due to their respective mobility behavior dynamics and intermittent behavior. To deal with these challenges, an EV Aggregator (EVA) can employ Vehicle-to-Grid (V2G) technology to synergize grid integration of renewable energy resources (RESs) and EVs. EVA provides smart coordination between SO and EV owners providing grid support services through V2G charge/discharge scheduling of EVs. However, energy market price uncertainties involved in market operation would significantly affect profit and behavior of EVA. Proposed work models an integrated DR and risk-averse V2G scheduling of EVA for its expected profit maximization and effective utilization of photovoltaic (PV) generation from rooftop solar charging park incentivizing EV owners and flexibility enhancement to SO. Revenue of EVA is due to regulation and charging services to SO and EV owners respectively. The operational cost of EVA considers procurement cost of charging energy from wholesale electricity market and cost of battery degradation while ensuring EV owners' driving requirements. The conditional value at risk (CVaR) index is utilized for measuring EVA's risk. Results validate efficacy of proposed model and impact analysis of DR integration on electricity market operations of EVA through performance metrics.

Subject Areas: Energy market; Electric vehicles; Photovoltaics; Renewable energy; Batteries

Availability: Sharma, S., Jangid, S., and Jain, P. (2020). "V2G Scheduling for an EV Aggregator with Rooftop Solar Charging Park." *AIP Conference Proceedings*, 2294.
<https://doi.org/10.1063/5.0031455>

2.97. Title: Plug-in Hybrid Electric Vehicle Observed Utility Factor: Why the Observed Electrification Performance Differ from Expectations

Author(s): Raghavan, S.S. and Tal, G.

Abstract: Plug-in hybrid electric vehicles (PHEVs) are an effective vehicle technology to reduce light duty vehicle greenhouse gas emissions and gasoline consumption. They combine all-electric driving capabilities of a battery electric vehicle with the engine downsizing and fuel economy improvements of a hybrid electric vehicle. Their environmental performance is predicated upon the metric utility factor (UF). It is formally defined in the Society of Automotive Engineers J2841 standard and denotes the fraction of vehicle miles traveled (VMT) on electricity (eVMT). Using year-long driving and charging data collected from 153 PHEVs in California with 11–53 miles range, this article systematically evaluates what aspects of driving and charging behavior causes observed UF to deviate from J2841 expectations. Our analyses indicated that charging behavior, distribution of daily VMT, efficiency of electrical energy consumption in the charge depleting (CD) mode, and annual VMT were the major factors contributing to the disparities between observed and expected UF. The direction and magnitude of their individual effect varied with the vehicle type and range. Approximately $\pm 45\%$ of deviations from J2841 UF is attributable to the observed charging behavior. Differences in daily VMT distribution were responsible for -20% to $+3\%$ of deviation. Annual VMT and effective CD range achieved on-road influenced the UF deviation by $\pm 25\%$ and -20% to -4% , respectively.

Subject Areas: Electrification potential; Longitudinal data; Plug-in hybrid electric vehicle; Utility factor

Availability: Raghavan, S.S. and Tal, G. (2020). “Plug-in Hybrid Electric Vehicle Observed Utility Factor: Why the Observed Electrification Performance Differ from Expectations.”

International Journal of Sustainable Transportation.

<https://doi.org/10.1080/15568318.2020.1849469>

2.98. Title: Impact Analysis of EV Preconditioning on the Residential Distribution Network

Author(s): Antoun, J., Kabir, M.E., Atallah, R., Moussa, B., Ghafouri, M., and Assi, C.

Abstract: Electric vehicles (EV) are coming with a stupendous load demand that raises enough concerns for the power sector. The backlash of such increased demand is notable at the distribution side with different aspects of EV usage. During winter, EV users favor preconditioning their vehicles before leaving their houses, such as heating the cabin and battery compartment to make the operation of EVs more comfortable. Consequently, such behavior, along with a higher penetration of level 2 smart chargers, prompt the presence of a new peak in the residential load profile. This new unexpected peak that operators have to face can disturb the performance of the network. To foresee the impact of preconditioning, we simulate multiple scenarios to assess the network's quality metrics (voltage level and power losses). We expose that preconditioning poses risks on the network in its current state. Furthermore, we evaluate the competencies of network reconfiguration to handle the new imposed preconditioning demand. We find out that reconfiguration will be able to aid the performance of the network to an average EV penetration rate.

Subject Areas: Distribution networks; Electric vehicle charging; Smart grids; Pricing; Batteries; Voltage control; Load modeling

Availability: Antoun, J., Kabir, M.E., Atallah, R., Moussa, B., Ghafouri, M., and Assi, C. (2020). "Impact Analysis of EV Preconditioning on the Residential Distribution Network." *2020 IEEE International Conference on Communications, Control, and Computing Technologies for Smart Grids (SmartGridComm)*, pp. 1–6, Tempe, AZ.
<https://doi.org/10.1109/SmartGridComm47815.2020.9302982>

2.99. Title: Revenue Maximizing Scheduling for a Fast Electric Vehicle Charging Station with Solar PV and ESS

Author(s): Fidele, N.H.L. and Yoon, S.

Abstract: The modern transportation and mobility sector is expected to encounter high penetration of Electric Vehicles (EVs) because EVs contribute to reducing the harmful emissions from fossil fuel-powered vehicles. With the prospective growth of EVs, sufficient and convenient facilities for fast charging are crucial toward satisfying the EVs' quick charging demand during their trip. Therefore, the Fast Electric Vehicle Charging Stations (FECS) will be a similar role to gas stations. In this paper, we study a charging scheduling problem for the FECS with solar photovoltaic (PV) and an Energy Storage System (ESS). We formulate an optimization problem that minimizes the operational costs of FECS. There are two cost and one revenue terms that are buying cost from main grid power, ESS degradation cost, and revenue from the charging fee of the EVs. Simulation results show that the proposed scheduling algorithm reduces the daily operational cost by effectively using solar PV and ESS.

Subject Areas: Electric vehicle fast charging station; Solar photovoltaic; Energy storage system; Optimization; Smart grid; Charging schedule

Availability: Fidele, N.H.L. and Yoon, S. (2020). "Revenue Maximizing Scheduling for a Fast Electric Vehicle Charging Station with Solar PV and ESS." *KEPCO Journal on Electric Power and Energy*, 6(3), pp. 315–319. <https://doi.org/10.18770/KEPCO.2020.06.03.315>

2.100. Title: Affordability of Household Transportation Fuel Costs by Region and Socioeconomic Factors

Author(s): Zhou, Y., Aeschliman, S., and Gohlke, D.

Abstract: Transportation energy is an important component of household budgets. Household vehicle fuel, one part of total transportation energy costs is over 3% of total household expenditures nationwide in the U.S. The average annual expenditure of over \$2,000 for vehicle fuel (mostly gasoline) is comparable to the total average household expenditures for electricity and natural gas combined. However, these average values vary geographically, and lower income households can face higher energy cost burdens. The highly resolved data developed in this study reveals the variation of household energy burdens across the country and provides localized data to support local decision making.

In this study, we enable the quantification of household transportation energy affordability in terms of the transportation energy burden, defined as the percentage of annual household income spent on the household vehicle fuel costs.

Subject Areas: Household vehicle fuel; Transportation energy costs; Household energy burden; Affordability

Availability: Zhou, Y., Aeschliman, S., and Gohlke, D. (2020). *Affordability of Household Transportation Fuel Costs by Region and Socioeconomic Factors*. Energy System Division, Argonne National Laboratory, Lemont, IL.

<https://publications.anl.gov/anlpubs/2021/01/165141.pdf>

2.101. Title: Evaluation of a Stochastic Vehicle Travel Pattern Generation Model with Real-World Travel Data

Author(s): Anand, M., Rajapakse, A., Muthukumarana, S., and Bagen, B.

Abstract: Higher electric vehicle penetration and associated grid charging will have significant reliability impacts on electric power systems. Therefore, distribution network planning studies need suitable models to capture spatial and temporal distribution of vehicle charging demand. When making expensive planning decisions, it is important to have high confidence in the models used. This paper proposes a systematic method and metrics to evaluate a stochastic model that generate random vehicle travel patterns in an urban area. The particular model considered consists of a collection of Hidden Markov Models, and its efficacy is evaluated using a database of actual vehicle travel data from Winnipeg, Manitoba, Canada. The probabilities associated with the model were extracted from the actual data. The evaluation approach involves comparison of actual and simulated values of model outputs representing the spatial-temporal distributions and use of Euclidean distances to measure the similarity of probability distributions produced by actual and simulated data.

Subject Areas: Electric vehicles; Hidden Markov Model; Spatial-temporal distribution; Distribution network; Stochastic model

Availability: Anand, M., Rajapakse, A., Muthukumarana, S., and Bagen, B. (2020). "Evaluation of a Stochastic Vehicle Travel Pattern Generation Model with Real-World Travel Data." *2020 IEEE Electric Power and Energy Conference (EPEC)*, pp. 1–6, Edmonton, AB, Canada. <https://doi.org/10.1109/EPEC48502.2020.9320118>

Chapter 3. Environment

3.1. Title: Best Long-Term Environmental Benefit Of COVID-19: Telecommuting?

Author(s): Elkind, E.

Abstract: Blog.

Subject Areas: COVID-19; Telecommuting; Environmental impact

Availability: Elkind, E. (2020). "Best Long-Term Environmental Benefit Of COVID-19: Telecommuting?" *Colorado Boulevard*. <https://www.coloradoboulevard.net/best-long-term-environmental-benefit-of-covid-19-telecommuting/>

3.2. Title: Virus Brings Blue Skies to Big Cities. Will That Last?

Author(s): Storrow, B. and Joselow, M.

Abstract: Blog.

Subject Areas: COVID-19; Stay-at-home order; CO₂ emissions; Air quality; Electric cars; Teleworking; Environment

Availability: Joselow, M. and Storrow, B. (2020). "Virus Brings Blue Skies to Big Cities. Will That Last?" *E&E News*. <https://www.eenews.net/stories/1063006473>

3.3. Title: How Neighborhood Effect Averaging Might Affect Assessment of Individual Exposures to Air Pollution: A Study of Ozone Exposures in Los Angeles

Author(s): Kim, J. and Kwan, M.

Abstract: The neighborhood effect averaging problem (NEAP) can be a serious methodological problem that leads to erroneous assessments when studying mobility-dependent exposures (e.g., air or noise pollution) because people's daily mobility could amplify or attenuate the exposures they experienced in their residential neighborhoods. Specifically, NEAP suggests that individuals' mobility-based exposures tend toward the mean level of the participants or population of a study area when compared to their residence-based exposures. This research provides an indepth examination of NEAP and how NEAP is associated with people's daily mobility through an assessment of individual exposures to ground-level ozone using the activity travel diary data of 2,737 individuals collected in the Los Angeles metropolitan statistical area. The results obtained with exploratory analysis (e.g., a scatterplot and histograms) and spatial regression models indicate that NEAP exists when assessing individual exposures to ozone in the study area. Further, high-income, employed, younger, and male participants (when compared to low-income, nonworking, older, and female participants) are associated with higher levels of neighborhood effect averaging because of their higher levels of daily mobility. Finally, three-dimensional interactive geo-visualizations of the space-time paths and hourly ozone exposures of 71 selected participants who live in the same neighborhood corroborate the findings obtained from the spatial regression analysis.

Subject Areas: Neighborhood effect averaging problem; Mobility; Exploratory analysis; Spatial regression models

Availability: Kim, J. and Kwan, M. (2020). "How Neighborhood Effect Averaging Might Affect Assessment of Individual Exposures to Air Pollution: A Study of Ozone Exposures in Los Angeles." *Annals of the American Association of Geographers*.
<https://doi.org/10.1080/24694452.2020.1756208>

3.4. Title: Environmental Impacts of Extreme Fast Charging

Author(s): Jenn, A., Clark-Sutton, K., Gallaher, M.P., and Petrusa, J.

Abstract: As electric vehicles and their associated charging infrastructure continue to evolve, there is potential to simultaneously alleviate range and recharge concerns with the development of extreme fast chargers (XFC) that can fully charge batteries in PEVs in the span of a few minutes. Recent announcements from EVSE providers and vehicle manufacturers suggest that XFC charging stations, which can recharge a BEV at roughly 20 to 25 miles per minute of charging, and XFC-capable BEVs could be commercially available within the next 5 years. Our study investigates the potential emission impacts of widespread use of extreme fast charging (350 kW) for electric vehicles in 2030. We conduct a novel vehicle charging simulation model by combining empirical charging behavior data across several data sources. These charging demands are then added as exogenous load to the Grid Optimized Operation Dispatch (GOOD) model, which simulates the operation of generators across the United States. We find that XFC can increase both greenhouse gas emissions and local air pollutants, though the results are sensitive to local contexts and grid composition.

Subject Areas: Electric vehicles; Charging; Extreme fast chargers; Emission; Grid Optimized Operation Dispatch model

Availability: Jenn, A., Clark-Sutton, K., Gallaher, M.P., and Petrusa, J. (2020). "Environmental Impacts of Extreme Fast Charging." *Environmental Research Letters*, 15(9).
<https://doi.org/10.1088/1748-9326/ab9870>

3.5. Title: E-commerce and the Potential Effect of Changing Transport Activity on CO₂ Emissions

Author(s): Linderoth, M.

Abstract: This thesis explores to what extent electronic commerce (e-commerce) might present a potential for reduction in passenger-transport related carbon dioxide (CO₂) emissions by use of numerical evaluation of a theoretical model of last mile transit for e-commerce and individual shopping trips for conventional commerce. E-commerce has grown exponentially since the beginning of the 21st century, which consequently has resulted in increased CO₂ emissions due to higher delivery frequency. While several studies have concluded that e-commerce is a more likely sustainable shopping mode than conventional commerce, studies considering changed shopping activity as a result of e-commerce are ambiguous. This thesis therefore aims to diminish knowledge gaps by simulating scenarios on how changed transport activity affects CO₂ emissions due to shifting consumption patterns. This study moves beyond the current literature by including three categories of interactions between e-commerce and personal travel behavior into a theoretical model of last-mile transport informed by previous literature and evaluates the model numerically using a case study of Austria. The categories are substitution (elimination of shopping trips), generation (stimulation of shopping trips that would otherwise not have been made), and modification (when characteristics of a shopping trips changes, which in this study considers transportation mode only). A sensitivity analysis was conducted by stimulating three types of scenarios in urban and rural areas, respectively: best-case scenario (no occurred failed delivery nor customer return), moderate-case scenario (failed delivery by 10%), and worst-case scenario (failed delivery by 20% and occurred customer return). The results emphasize the importance of transportation mode and travel behavior. In order to avoid an increase of CO₂, a minimum of 0 to 10% more substitution than generation and between 20 and 60% of modification (depending on scenario and area) are required.

Subject Areas: Electronic commerce; Last mile; CO₂ emissions; Austria; Sensitivity analysis; Personal shopping trips; Changed travel behavior; Substitution; Generation; Modification

Availability: Linderoth, M. (2020). *E-commerce and the Potential Effect of Changing Transport Activity on CO₂ Emissions*. Master's Thesis, University of Graz, Austria.

https://www.researchgate.net/profile/Marie_Linderoth3/publication/342232038_E-commerce_and_the_potential_effect_of_changing_transport_activity_on_CO2_emissions/links/5ee9c55e458515814a6539a4/E-commerce-and-the-potential-effect-of-changing-transport-activity-on-CO2-emissions.pdf

3.6. Title: A Systematic Review of the Energy and Climate Impacts of Teleworking

Author(s): Hook, A., Court, V., Sovacool, B., and Sorrell, S.

Abstract: Information and communication technologies (ICTs) increasingly enable employees to work from home and other locations (“teleworking”). This study explores the extent to which teleworking reduces the need to travel to work and the consequent impacts on economy-wide energy consumption.

Methods/Design: The paper provides a systematic review of the current state of knowledge of the energy impacts of teleworking. This includes the energy savings from reduced commuter travel and the indirect impacts on energy consumption associated with changes in non-work travel and home energy consumption. The aim is to identify the conditions under which teleworking leads to a net reduction in economy-wide energy consumption, and the circumstances where benefits may be outweighed by unintended impacts. The paper synthesizes the results of 39 empirical studies identified through a comprehensive search of 9,000 published articles.

Review Results/Synthesis: Twenty six of the 39 studies suggest that teleworking reduces energy use, and only 8 studies suggest that teleworking increases or has a neutral impact on energy use. However, differences in the methodology, scope, and assumptions of the different studies make it difficult to estimate “average” energy savings. The main source of savings is the reduced distance travelled for commuting, potentially with an additional contribution from lower office energy consumption. However, the more rigorous studies that include a wider range of impacts (e.g., non-work travel or home energy use) generally find smaller savings.

Discussion: Despite the generally positive verdict on teleworking as an energy-saving practice, there are numerous uncertainties and ambiguities about its actual or potential benefits. These relate to the extent to which teleworking may lead to unpredictable increases in non-work travel and home energy use that may outweigh the gains from reduced work travel. The available evidence suggests that economy-wide energy savings are typically modest and, in many circumstances, could be negative or non-existent.

Subject Areas: Information and communication technologies; Teleworking; Energy consumption reduction; Synthesis

Availability: Hook, A., Court, V., Sovacool, B., and Sorrell, S. (2020). “A Systematic Review of the Energy and Climate Impacts of Teleworking.” *Environmental Research Letters*.
<https://doi.org/10.1088/1748-9326/ab8a84>

3.7. Title: Commuters are Adapting to the Virus. What it Means for CO2

Author(s): Storrow, B. and Joselow, M.

Abstract: Blog.

Subject Areas: COVID-19; Carbon emissions; Oil demand; Travel pattern; Vehicle miles traveled; Transit ridership

Availability: Storrow, B. and Joselow, M. (2020). "Commuters are Adapting to the Virus. What it Means for CO2." *E&E News*. <https://www.eenews.net/stories/1063233545/print>

3.8. Title: Study Shows How e-Bikes Can Dramatically Reduce CO2 Emissions From Transportation

Author(s): Alter, L.

Abstract: Blog.

Subject Areas: E-Bikes; Electric and hybrid cars; CO₂ emissions; Low-carbon travel; Infrastructure

Availability: Alter, L. (2020). "Study Shows How e-Bikes Can Dramatically Reduce CO2 Emissions From Transportation." *Treehugger*. <https://www.treehugger.com/bikes/study-shows-how-e-bikes-can-dramatically-reduce-co2-emissions-transportation.html>

3.9. Title: Comparing the Impacts of Local Land Use and Urban Spatial Structure on Household VMT and GHG Emissions

Author(s): Lee, S. and Lee, B.

Abstract: To highlight the role of sustainable urban spatial structure in reducing household vehicle miles traveled (VMT) and CO₂ emissions, this empirical study of the 121 largest urban areas (UAs) in the United States compares the effects of local land use and UA scale spatial structure in a multilevel analysis framework. The results show that centralized population and mezzo scale jobs-housing balance as well as higher UA population density can significantly reduce VMT and CO₂ emissions. The combined effects of all UA level variables, including population-weighted density (PWD), are found to be on par with the elasticity of VMT with regard to a census tract level compactness index. Further, we find that urban spatial structure moderates local urban form effects on travel behavior. For example, while 10% more compact census tracts are associated with 5% fewer VMT in UAs with the sample average PWD, such as St. Louis and Pittsburgh, this estimated local effect increases to 7.5% and 10% in UAs where PWD is as high as in Chicago and New York, respectively. The findings of this study strongly support policy programs that aim to boost “articulated densities” in the urban region and call for stronger institutional frameworks for regional planning.

Subject Areas: Urban form; Urban spatial structure; Sustainable transportation; Vehicle miles traveled; Greenhouse gas emissions; Multilevel analysis

Availability: Lee, S. and Lee, B. (2020). “Comparing the Impacts of Local Land Use and Urban Spatial Structure on Household VMT and GHG Emissions.” *Journal of Transport Geography*, 84. <https://doi.org/10.1016/j.jtrangeo.2020.102694>

3.10. Title: CHI 2020: Right Here, Right Now?: A Bottom-up Approach to Estimating the Carbon Emissions From More Than Twenty Years of CHI Conference Travel

Author(s): Jacques, J.T.

Abstract: Over the last 20 years, the CHI conference has grown substantially. However, with the reframing of climate change as a climate crisis, environmental concerns have become increasingly pervasive in the community. In 2019, CHI introduced a sustainability role and set a goal to make CHI more sustainable. In 2020, CHI is in Hawaii. This work looks back over the last two decades and estimates what are substantial and growing CO₂ emissions from conference travel. First, it posits how, in the short term, potential environmental damage can be minimized. Second, and longer-term, it invites the community to reflect on research dissemination and how the conference experience may need to change.

Subject Areas: Conference attendance; CO₂ emissions; Sustainability

Availability: Jacques, J.T. (2020). "CHI 2020: Right Here, Right Now?: A Bottom-up Approach to Estimating the Carbon Emissions From More Than Twenty Years of CHI Conference Travel." *CHI EA '20: Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, pp.1–13. <https://doi.org/10.1145/3334480.3381806>

3.11. Title: Towards a Methodology to Estimate Carbon Emissions Savings From Local Mode Shift Initiatives: A Review of Challenges and Emerging Technologies

Author(s): Barber, R.Y.

Abstract: There is international agreement on the need to act to limit carbon emissions. Many nations have set reductions targets with the goal of keeping global warming within 1.5–2 °C by 2050 to avoid disastrous climate change. At its core, this research paper is about exploring ways to measure carbon dioxide equivalent (henceforth, carbon) emissions impacts of local transport schemes, in line with global aspirations.

Subject Areas: Carbon emissions; Climate change; Local transport schemes

Availability: Barber, R.Y. (2019). *Towards a Methodology to Estimate Carbon Emissions Savings From Local Mode Shift Initiatives: A Review of Challenges and Emerging Technologies*. Transport Planning Society Bursary Competition 2019.

<https://tps.org.uk/public/downloads/4AnKY/Mode%20shift%20and%20carbon%20emissions%20-%20R%20Yorke%20Barber.pdf>

3.12. Title: The Climate Change Mitigation Effects of Active Travel

Author(s): Brand, C., Dons, E., Anaya-Boig, E., Avila-Palencia, I., Clark, A., de Nazelle, A., Gascon, M., Gaupp-Berghausen, M., Gerike, R., Gotschi, T., Iacorossi, F., Kahlmeier, S., Laeremans, M., Nieuwenhuijsen, M., Mendoza, J.O., Racioppi, F., Raser, E., Rueda, D.R., Standaert, A., Stigell, E., Sulikova, S., Wegener, S., and Panis, L.I.

Abstract: Active travel (walking or cycling for transport) is considered the most sustainable form of getting from A to B. Yet the net effects of active travel on mobility-related CO₂ emissions are complex and under-researched. Here we collected travel activity data in seven European cities and derived lifecycle CO₂ emissions from daily travel activity. Daily mobility-related lifecycle CO₂ emissions were 3.2 kg CO₂ per person, with car travel contributing 70% and cycling 1%. Cyclists had 84% lower lifecycle CO₂ emissions from all daily travel than non-cyclists. Lifecycle CO₂ emissions decreased by -14% (95%CI -12% to -16%) per additional cycling trip and decreased by -62% (95%CI -61% to -63%) for each avoided car trip. An average person who ‘shifted travel modes’ from car to bike decreased lifecycle CO₂ emissions by 3.2 (95%CI 2.0 to 5.2) kg CO₂/day, and using a bike as the ‘main method of travel’ gave 7.1 (95%CI 4.8 to 10.4) kg CO₂/day lower lifecycle CO₂ emissions than mainly using a car or van. Investing in and promoting active travel should be a cornerstone of strategies to meet net zero carbon targets, particularly in urban areas, while also improving public health and quality of urban life.

Subject Areas: Climate change mitigation; Sustainable transport; Lifecycle CO₂ emissions; Active travel; Walking; Cycling

Availability: Brand, C., Dons, E., Anaya-Boig, E., Avila-Palencia, I., Clark, A., de Nazelle, A., Gascon, M., Gaupp-Berghausen, M., Gerike, R., Gotschi, T., Iacorossi, F., Kahlmeier, S., Laeremans, M., Nieuwenhuijsen, M., Mendoza, J.O., Racioppi, F., Raser, E., Rueda, D.R., Standaert, A., Stigell, E., Sulikova, S., Wegener, S., and Panis, L.I. (2020). “The Climate Change Mitigation Effects of Active Travel.” *Research Square*. <https://doi.org/10.21203/rs.3.rs-39219/v1>

3.13. Title: Save the Planet: Stop Riding Transit

Author(s): O'Toole, R.

Abstract: Blog.

Subject Areas: CO₂ emissions; Transit; Cars

Availability: O'Toole, R. (2020). "Save the Planet: Stop Riding Transit." *New Geography*.
<https://www.newgeography.com/content/006775-save-planet-stop-riding-transit>

3.14. Title: Distributed Effects of Climate Policy: A Machine Learning Approach

Author(s): Green, T. and Knittel, C.R.

Abstract: We employ machine learning techniques to estimate household carbon footprints (HCFs) for the average household in each Census tract—geographic areas that represent roughly 4,000 people. We find that there is significant variation in carbon footprints across income and geography; income effects are driven by higher footprints related to transportation and consumer products and services, while geographic effects are primarily a result of the variable carbon intensity of the electricity grid. Using these footprints, we assess the net effects of various climate policies on households in the United States paying particular attention to the distribution across geography, urbanity, and income groups. Our objective is to improve the understanding of the potential for regressivity, geographic transfers, and rural-urban transfers among climate policy options and test for ways to control for transfers—preserving transfers from high-income households to low-income households, but mitigating transfers from rural areas to urban areas and from the Midwest and South to the Coasts. Our focus is on the net increase or decrease of annual household expenses under 12 different policy scenarios, which included both carbon pricing schemes and regulatory standards. We find regulatory standards tend to be regressive and, on average, are a net cost to low-income households—especially those in rural areas. Carbon pricing, when accompanied with a dividend, is progressive for urban, rural, and suburban households, with the average low-income household receiving a larger dividend check than they spend in carbon taxes. However, there are transfers from the Midwest and Plains to the Coasts when the dividend is evenly divided. We show that this can be mitigated through adjusting the dividend slightly (<8% increase or decrease). Increasing the progressive structure of a policy benefits rural households more on average, but increases the overall heterogeneity of impacts within each income group. Reducing the transfers between geographic regions and urban-rural households increases the average benefit to low-income households and reduces the heterogeneity of impacts within income groups. We encourage policy makers to assess and control for unwanted transfers between households.

Subject Areas: Carbon emissions; Carbon pricing; Climate policy; Machine learning; Regressivity; Geographic transfers; Rural-urban transfers

Availability: Green, T. and Knittel, C.R. (2020). *Distributed Effects of Climate Policy: A Machine Learning Approach*. MIT Center for Energy and Environmental Policy Research, Cambridge, MA. <http://ceepr.mit.edu/publications/reprints/737>

3.15. Title: The Affluence-Technology Connection: Metrics, Analysis, and Implications for Sustainable Technology

Author(s): Mulrow, J.

Abstract: The affluence-technology (A-T) connection is a reference to a popular framing of technology's role in bringing about environmental sustainability, as encapsulated by the IPAT equation (Impact = Population × Affluence × Technology). This thesis explores the A-T connection through the development and application of new metrics that reveal how technological attributes and consumption affluence influence and relate to each other. The work is focused on modern transportation systems in a United States context and includes a detailed examination of this system through three different measurement frameworks. Each of the presented studies points to mechanisms by which the A-T connection diminishes impact reductions from technological efforts typically viewed as “sustainable.” Increasing mode-speed reduces the solution space for the achievement of climate goals; expanding the speed-distance (i.e., sociotechnical) boundaries of personal transportation drives increased transportation activity; emerging transportation technologies succeed by claiming sociotechnical space traditionally occupied by the personal vehicle; and the efficiency benefits of fuel switching are diminished when full material-energy cycles are factored in. The metrics and mechanisms described in this thesis show that the affluence-technology connection can be quantitatively measured using a combination of public survey and technical data. The lesson for sustainable technology development and deployment is that this connection could be factored into the calculation of impact-reduction potential. Furthermore, factoring this connection in may serve to dampen such calculations. The thesis concludes with a discussion of this conundrum and a call for future research to clarify, calculate, and ultimately reframe the prospects for truly sustainable technology. Doing so will require a willingness to consider lower affluence outcomes and slower technological configurations.

Subject Areas: Sustainability; Transportation; Energy; Climate; Sustainable technology; Active transportation

Availability: Mulrow, J. (2020). *The Affluence-Technology Connection: Metrics, Analysis, and Implications for Sustainable Technology*. Doctoral Dissertation, University of Illinois at Chicago, Chicago, IL. <https://doi.org/10.25417/uic.13476384.v1>

3.16. Title: Ex-post Empirical Assessments of Environmental Policies: A Literature Review

Author(s): Lång, E.

Abstract: In this essay, scientific literature that performs ex-post empirical (counterfactual) assessment of environmental policies is reviewed. The main purpose of the literature review is to get an overview of ex-post empirical assessment approaches, i.e., research designs, that aim to capture the causal effects of environmental policies on environmental performance. The literature review is intended to give guidance in the search for a suitable and feasible research design to assess the Swedish tax exemption of pure and high-blended liquid biofuels.

30 articles are reviewed and grouped by research design/estimation model. Considering the small number of studies that apply counterfactual analysis explicitly on liquid biofuel policies, the review will include ex-post empirical assessment studies that focus on the broader concepts of renewable energy, CO₂ taxation, and emission trading systems. Furthermore, since the literature on climate change is dominated by studies employing computational (simulation) models, the literature review also includes a few (ex-ante) computational model studies. Based on research designs applied in the reviewed literature, together with the features of the Swedish tax exemption of pure and high-blended liquid biofuels, suggestions for research designs for ex-post empirical (counterfactual) assessment are given.

Subject Areas: Environmental policies; Ex-post empirical assessment approaches; Liquid biofuels; Sustainable technology; Renewable energy; CO₂ taxation; Emission trading systems

Availability: Lång, E. (2020). "Ex-post Empirical Assessments of Environmental Policies: A Literature Review." *Statens väg- och transportforskningsinstitut*, pg. 37.

<http://urn.kb.se/resolve?urn=urn:nbn:se:vti:diva-15577>

3.17. Title: No Place like Home: Fighting Climate Change (and Saving Money) By Electrifying America’s Households

Author(s): Griffith, S. and Calisch, S.

Abstract: We demonstrate a pathway to total decarbonization of U.S. households on a timeline only limited by our political will and the changeover of household infrastructure. We use historical energy use and pricing data to build a model of the total electrification of the household. We use this model to investigate combinations of finance, regulatory policy, and incremental technology scaling that would save households and the entire economy money. With small and predictable improvements in technology costs over the next five years, and with aggressive interest rates, we could save every household \$1,000-\$2,500 per year. Collectively, the nation would save \$130–320bN per year. This offers the opportunity for a new dialogue about solving climate change that is optimistic and based in real possibility. This analysis also leads to many conclusions and recommendations about policy mixes that can accomplish decarbonization at the fastest possible rate of infrastructure changeover.

Subject Areas: Decarbonization; Household infrastructure changeover; Finance; Regulatory policy; Incremental technology scaling

Availability: Griffith, S. and Calisch, S. (2020). “No Place like Home: Fighting Climate Change (and Saving Money) By Electrifying America’s Households.” *Rewiring America*.
<https://www.rewiringamerica.org/household-savings-report>

Chapter 4. Health

4.1. Title: What Does ‘Discretionary Travel’ Mean?

Author(s): Weisstuch, L.

Abstract: Blog.

Subject Areas: COVID-19; Discretionary travel

Availability: Weisstuch, L. (2020). “What Does ‘Discretionary Travel’ Mean?” *Washington Post*. https://www.washingtonpost.com/lifestyle/travel/what-does-discretionary-travel-mean/2020/03/17/ba9b2c1c-687b-11ea-abef-020f086a3fab_story.html

4.2. Title: Telecommuting Could Curb the Coronavirus Epidemic

Author(s): Prager, F. and Rhoads, M.

Abstract: Blog.

Subject Areas: COVID-19; Telecommuting

Availability: Prager, F. and Rhoads, M. (2020). “Telecommuting Could Curb the Coronavirus Epidemic.” *The Conversation*. <https://theconversation.com/telecommuting-could-curb-the-coronavirus-epidemic-133308>

4.3. Title: Quarantine Fatigue: First-Ever Decrease in Social Distancing Measures After the COVID-19 Outbreak Before Reopening United States

Author(s): Zhao, J., Lee, M., Ghader, S., Younes, H., Darzi, A., Xiong, C., and Zhang, L.

Abstract: By the emergence of the novel coronavirus disease (COVID-19) in Wuhan, China, and its rapid outbreak worldwide, the infectious illness has changed our everyday travel patterns. In this research, our team investigated the changes in the daily mobility pattern of people during the pandemic by utilizing an integrated data panel. To incorporate various aspects of human mobility, the team focused on the Social Distancing Index (SDI) that was calculated based on five basic mobility measures. SDI patterns showed a plateau stage in the beginning of April that lasted for about 2 weeks. This phenomenon then followed by a universal decline of SDI, increased number of trips, and reduction in percentage of people staying at home. We called the latter observation quarantine fatigue. The Rate of Change (ROC) method was employed to trace back the start date of quarantine fatigue, which was indicated to be April 15th. Our analysis showed that despite substantial differences between States, most States' residents started experiencing a quarantine fatigue phenomenon in the same period. This observation became more important by knowing that none of the States had officially announced the reopening until late April, showing that people decide to loosen up their social distancing practices before the official reopening announcement. Moreover, our analysis indicated that official reopening led to a faster decline in SDI, raising the concern of a second wave of outbreak. The synchronized trend among States also emphasizes the importance of a more nationwide decision making attitude for the future as the condition of each State depends on the behavior of other States.

Subject Areas: Social Distancing Index; Social distancing inertia; Quarantine fatigue

Availability: Zhao, J., Lee, M., Ghader, S., Younes, H., Darzi, A., Xiong, C., and Zhang, L. (2020). *Quarantine Fatigue: First-Ever Decrease in Social Distancing Measures After the COVID-19 Outbreak Before Reopening United States*. arXiv, Cornell University, Ithaca, NY. <https://arxiv.org/abs/2006.03716>

4.4. Title: Geographical Influence of Mobile Clinics in the Southern United States

Author(s): Attipoe-Dorcoo, S., Delgado, R., Lai, D., Gupta, A., and Linder, S.

Abstract: To develop a mobile clinic influence index, which could allow mobile clinic managers to prioritize geographic regions and allocate resources systematically. The mobile clinic primary care service index was constructed taking into account miles traveled by the mobile clinic, the speed of the mobile clinic, number of primary care providers available in a primary care service area (PCSA), the total population in a PCSA, and the number of primary care providers per mobile clinic program. To illustrate the application of the mobile clinic influence index, we use the case of selected primary care mobile clinic programs operating in North Carolina and Florida. A survey of selected mobile clinic programs from Texas, Georgia, Florida, and North Carolina in rural and urban zip codes. PCSAs in various counties in North Carolina and Florida experienced varying degrees of additive effects of having mobile clinic providers service these areas. The mobile clinics in these counties were therefore influential in delivering critical primary healthcare services to at-risk populations. The index provides a valuable unit of measure to enable program managers of primary care mobile clinics to allocate resources as needed.

Subject Areas: Mobile clinic influence index; Mobile clinic programs; Primary care service area; At-risk populations

Availability: Attipoe-Dorcoo, S., Delgado, R., Lai, D., Gupta, A., and Linder, S. (2020). "Geographical Influence of Mobile Clinics in the Southern United States." *Applied Spatial Analysis and Policy*, 14, pp. 81–87. <https://doi.org/10.1007/s12061-020-09345-4>

4.5. Title: Does Density Aggravate the COVID-19 Pandemic?

Author(s): Hamidi, S., Sabouri, S., and Ewing, R.

Abstract: Problem, Research Strategy, and Findings: The impact of density on emerging highly contagious infectious diseases has rarely been studied. In theory, dense areas lead to more face-to-face interaction among residents, which makes them potential hotspots for the rapid spread of pandemics. On the other hand, dense areas may have better access to health care facilities and greater implementation of social distancing policies and practices. The current COVID-19 pandemic is a perfect case study to investigate these relationships. Our study uses structural equation modeling to account for both direct and indirect impacts of density on the COVID-19 infection and mortality rates for 913 U.S. metropolitan counties, controlling for key confounding factors. We find metropolitan population to be one of the most significant predictors of infection rates; larger metropolitan areas have higher infection and higher mortality rates. We also find that after controlling for metropolitan population, county density is not significantly related to the infection rate, possibly due to more adherence to social distancing guidelines. However, counties with higher densities have significantly lower virus-related mortality rates than do counties with lower densities, possibly due to superior health care systems.

Takeaway for Practice: These findings suggest that connectivity matters more than density in the spread of the COVID-19 pandemic. Large metropolitan areas with a higher number of counties tightly linked together through economic, social, and commuting relationships are the most vulnerable to the pandemic outbreaks. They are more likely to exchange tourists and businesspeople within themselves and with other parts, thus increasing the risk of cross-border infections. Our study concludes with a key recommendation that planners continue to advocate dense development for a host of reasons, including lower death rates due to infectious diseases like COVID-19.

Subject Areas: COVID-19; Density; Infectious diseases; Pandemic; Urban sprawl

Availability: Hamidi, S., Sabouri, S., and Ewing, R. (2020). "Does Density Aggravate the COVID-19 Pandemic?" *Journal of the American Planning Association*, 86(4), pp. 495–509. <https://doi.org/10.1080/01944363.2020.1777891>

4.6. Title: How the Daily Smartphone is Associated With Daily Travel, Physical Activity, and Self-Perceived Health: Evidence From 2017 National Household Travel Survey

Author(s): Yang, Y., Li, S., Zhang, K., Xiang, X., Li, Z., Ahn, S., and Murphy, J.

Abstract: Knowledge of how smartphone use in daily life, rather than in the context of intervention, may influence people's behaviors and health is limited and mixed. The 2017 National Household Travel Survey data were used to examine the associations between daily smartphone use and several outcomes, including engagement in vigorous physical activity, self-perceived being healthy, and the adjusted mean differences for total trips and active travels among older adults (≥ 65 years) as well as among young and middle-aged groups (18–64 years), respectively. The prevalence of daily smartphone use declined with increasing age. Daily smartphone use was associated with increased total trips and active travel, a higher likelihood of engaging in vigorous physical activity, and in self-perceived being healthy status. The associations were stronger among older adults than young and middle-aged adults. More studies are needed to address the complex pathways among daily smartphone use and other outcomes. Daily smartphone use has the potential to address the unmet daily needs of older adults and bridge health disparities for this disadvantaged group.

Subject Areas: Active travel; Daily travel; Older adults

Availability: Yang, Y., Li, S., Zhang, K., Xiang, X., Li, Z., Ahn, S., and Murphy, J. (2020). "How the Daily Smartphone is Associated with Daily Travel, Physical Activity, and Self-Perceived Health: Evidence From 2017 National Household Travel Survey." *Journal of Aging and Physical Activity*, 28(5), pp. 1–9. <https://doi.org/10.1123/japa.2019-0222>

4.7. Title: Cognitive Disabilities and Fitness Testing Scores in a Title I School

Author(s): De La Paz, C.

Abstract: Statement of Problem: Current research explains how students living in low socio-economic areas are at disadvantage when it comes to physical activity participation. This is primarily due to the lack of available resources to them, which increases their health-related risk. The purpose of this study was to examine fitness testing scores in children with and without clinically diagnosed learning disabilities in a Title I school serving a low socio-economic neighborhood in Northern California to understand the difference in fitness scores between these groups.

Sources of Data: Data were collected from 28 male students (13 with disabilities, 15 without disabilities) attending a public school located in a large Northern California public school district during mandatory fitness testing for 7th grade students. Survey data were collected for demographic purposes from the parents or guardians of the 28 male students participating in the FitnessGram. Northern California Elementary was the location for the FitnessGram, which is a Title I school. The FitnessGram tool measures students' aerobic capacity, body composition, muscular strength, endurance, and flexibility of children ages 5 to 17.

Conclusions Reached: Research analysis indicated that male students without cognitive disabilities only performed better in the FitnessGram 1-mile run ($p = 0.03$) compared to their peers with cognitive disabilities. Students without cognitive disabilities had a better passing rate of students who meet the healthy fitness zone standards for the 1-mile run ($p = 0.04$). Parent survey indicated that fewer students with cognitive disabilities actively commuted to school ($p = 0.002$) compared to students without disabilities. Our hypothesis was inaccurate as male students without cognitive disabilities scored better in one of the six subtests in the FitnessGram. The hypothesis that male students with cognitive disabilities will score lower in the FitnessGram compared to their peers without disabilities was minimally supported.

Subject Areas: Cognitive disabilities; Healthy fitness; Socio-economic areas; Physical activity participation

Availability: De La Paz, C. (2020). *Cognitive Disabilities and Fitness Testing Scores in a Title I School*. Master's Thesis, California State University, Sacramento, CA. <http://csus-dspace.calstate.edu/bitstream/handle/10211.3/216813/COGNITIVE%20DISABILITIES%20AND%20FITNESS%20TESTING%20SCORES%20IN%20A%20TITLE%20I%20SCHOOL.pdf?sequence=5>

4.8. Title: Access to Health Care: Perspectives on Transportation as a Social Determinant of Health

Author(s): Wolfe, M.K.

Abstract: Transportation has a profound impact on a person's ability to access health care and ultimately receive timely medical care. Increasingly, transportation is recognized for its role in fulfilling public health needs. In a time of growing health disparities, research is needed to understand how transportation availability impacts access to care and in what ways innovation in the transportation sector might address these challenges. This dissertation contributes to this gap by examining the role of transportation as a social determinant of health in three related papers.

In the first paper, I use nationally representative data to estimate the prevalence of transportation barriers to health care in the United States. I look at longitudinal trends as well as sociodemographic and health correlates of this barrier. I find that 5.8 million people in the United States delayed medical care because of a lack of transportation in 2017, and this barrier disproportionately affects individuals who are poor and who have chronic conditions. In the second paper, I examine how public transportation connects people with medical care in a rural setting. I determine the scope and nature of health care transportation provided by the sole transit provider in a rural North Carolina county, analyzing spatial patterns of trip demand and differences in trip characteristics by funding source. This study showcases how the health needs of a community ultimately influence the behavior of a rural transit agency. In the third paper, I present findings from a nationwide scan of new mobility strategies for delivering health care transportation in the era of shared mobility. This research documents the ways in which ridesourcing technology is being leveraged to transport people to medical care and proposes a typology of innovative health care transportation services.

These analyses document a significant and persistent problem in access to health care in the United States. Findings suggest that transportation to health facilities should remain an important consideration in health care delivery at the Federal level, at the level of State and local governments in North Carolina, and among new and existing transportation companies during a time of growing health disparities, rapidly changing transportation technology, and evolving health care policy.

Subject Areas: Urban planning; Transportation; Access to health care; Barriers to care; Transportation; Social determinants of health; Public health; Ridesourcing

Availability: Wolfe, M.K. (2020). *Access to Health Care: Perspectives on Transportation as a Social Determinant of Health*. Doctoral Dissertation, University of North Carolina at Chapel Hill, Chapel Hill, NC. <https://doi.org/10.17615/4b6t-cr50>

4.9. Title: Transportation Barriers to Health Care in the United States: Findings From the National Health Interview Survey, 1997–2017

Author(s): Wolfe, M.K., McDonald, N.C., and Holmes, G.M.

Abstract: Objectives: To quantify the number of people in the United States who delay medical care annually because of lack of available transportation and to examine the differential prevalence of this barrier for adults across sociodemographic characteristics and patient populations.

Methods: We used data from the National Health Interview Survey (1997–2017) to examine this barrier over time and across groups. We used joinpoint regression analysis to identify significant changes in trends and multivariate analysis to examine correlates of this barrier for the year 2017.

Results: In 2017, 5.8 million persons in the United States (1.8%) delayed medical care because they did not have transportation. The proportion reporting transportation barriers increased between 2003 and 2009 with no significant trends before or after this window within our study period. We found that Hispanic people, those living below the poverty threshold, Medicaid recipients, and people with a functional limitation had greater odds of reporting a transportation barrier after we controlled for other sociodemographic and health characteristics.

Conclusions: Transportation barriers to health care have a disproportionate impact on individuals who are poor and who have chronic conditions. Our study documents a significant problem in access to health care during a time of rapidly changing transportation technology.

Subject Areas: Medical care; Socio-demography; Joinpoint regression analysis; Accessibility; Transportation barriers

Availability: Wolfe, M.K., McDonald, N.C., and Holmes, G.M. (2020). “Transportation Barriers to Health Care in the United States: Findings From the National Health Interview Survey, 1997–2017.” *American Journal of Public Health*, 110, pp. 815–822.

<https://doi.org/10.2105/AJPH.2020.305579>

4.10. Title: Effects of Walking on Self-assessed Health Status: Links Between Walking, Trip Purposes and Health

Author(s): Pae, G. and Akar, G.

Abstract: Introduction: Positive effects of walking on health has led to a growing number of studies in public health and transportation planning fields. These studies reveal the associations between socio-economic factors, built environment, and health outcomes. However, the effects of walking for various trip purposes on health have often been glossed over. We explore the effects of various trip purposes on individuals' self-assessed health status with a focus on walking trips.

Methods: This study relies on a nationwide dataset from the US, the 2017 National Household Travel Survey (NHTS) data. The sample includes 125,885 adults between the ages of 18 and 64. The analyses are based on an ordered logit model that relates our variables of interest to self-assessed health status. The trip purposes are defined as: home-based work, home-based shopping, home-based recreation, home-based other and non-home-based trips.

Results: First, this study shows that walking for different trip purposes has different effects on adults' self-assessed health scores. For instance, an additional 10-min of walking for home-based work trips increases the odds of being in a higher health outcome category by 6 percent, while this effect is smaller for home-based other trips (3 percent). Second, further examination reveals that walking for different trip purposes has distinct walking speeds and durations. Walking for home-based work trips has the fastest speeds (2.69 miles/hour), followed by walking for home-based recreational trips (2.55 miles/hour). These suggest different trip purposes may have distinct metabolic equivalents (MET) for energy expenditure estimation purposes.

Conclusions: This study shows that the benefits of walking on health mainly come from home-based walking trips. Planners and decision makers should consider diverse interventions to encourage people to walk within, to and from their neighborhoods. This study also provides a basis for using trip purpose variables as proxies for walking speeds and durations.

Subject Areas: Walking; Active transport; Trip purposes; Physical activity; Health

Availability: Pae, G. and Akar, G. (2020). "Effects of Walking on Self-assessed Health Status: Links Between Walking, Trip Purposes and Health." *Journal of Transport & Health*, 18. <https://doi.org/10.1016/j.jth.2020.100901>

4.11. Title: Gender and Education Differences in Sedentary Behavior in Canada: An Analysis of National Cross-sectional Surveys

Author(s): Prince, S.A., Roberts, K.C., Melvin, A., Butler, G.P., and Thompson, W.

Abstract: Background: Canadians spend the majority of their days sedentary. Gender and education are important social determinants of health that impact health behaviors. There is evidence that gender and educational differences in sedentary behavior exist. In Canada, while general trends suggest that leisure sedentary activities have changed; there has been no comprehensive assessment examining whether historical changes in sedentary behavior differ by gender and education level. Our objective was to examine whether gender and educational differences in accelerometer-measured sedentary time and self-reported sedentary behaviors exist among Canadians and if differences are consistent across age groups, over time and across multiple survey sources.

Methods: We summarize amounts of total accelerometer-measured sedentary time and self-reported sedentary activities (e.g., passive travel, television, computer, video games, screen, reading) by age (i.e., children: 6–11 years, youth: 12–17 years, adults: 18–34 years, 45–49 years, 50–64 years, and older adults: ≥ 65 years), gender (girls/women, boys/men) and household education level (< post-secondary vs. \geq post-secondary) over time in the Canadian Community Health Survey, Canadian Health Measures Survey, General Social Survey, and the Health Behavior in School-Aged Children study. Gender and education level differences are examined using independent sample t-tests or chi-square analyses.

Results: While few differences were found for total accelerometer-measured sedentary time, gender and education differences in self-reported, type-specific sedentary behavior were identified. Among youth, data from all surveys consistently identified that boys engaged in more video/computer game play (e.g., boys: 0.35–2.68 vs. girls: 0.09–2.15 h/day), while girls engaged in more leisure reading (e.g., boys: 0.45–0.65 vs. girls: 0.71–0.99 h/day). Those with a higher education or household education often reported more leisure reading and passive travel. Education level differences in screen time were often age dependent, with leisure computer use greater in higher education groups in adults only and leisure television watching generally higher in lower education groups in children and adults, but not youth.

Conclusions: This information is valuable as it helps to identify segments of the population which may be at greater risk for engaging in higher volumes of sedentary behavior. In turn, this information can identify target audiences and behaviors for policies and interventions. Future work is needed to further understand factors contributing to these differences (e.g., preferences, occupation, family structure).

Subject Areas: Sedentary behavior; Surveillance; Gender; Education

Availability: Prince, S.A., Roberts, K.C., Melvin, A., Butler, G.P., and Thompson, W. (2020). "Gender and Education Differences in Sedentary Behavior in Canada: An Analysis of National Cross-sectional Surveys." *BMC Public Health*, 20. <https://doi.org/10.1186/s12889-020-09234-y>

4.12. Title: Human Health and the Transportation Infrastructure

Author(s): Pavlick, D., Faghri, A., DeLucia, S., and Gayen, S.

Abstract: Since the invention of the car, the built transportation environment is becoming increasingly more automobile focused. The creation of auto-oriented roadways and increased automobile usage is in direct contrast with the decrease of more active transportation modes, such as walking, biking, or public transit transportation. Although personal automobiles may save users' time in traveling, there is a growing concern, backed by numerous studies, regarding the health effects directly and indirectly caused by increased automobile dependence and the auto-oriented transportation environment. The present report explores the many health related problems that are correlated with the current transportation environment, including reduced physical activity, obesity, respiratory problems, and mental health issues, particularly in the United States. The findings indicate that the modern built transportation system indeed influences many aforementioned problems, and that there must be engineering and societal responses to both encourage and allow greater opportunities for active transportation. The report further discusses the responses that have already taken place and planning measures to foster more active transportation in the future. Finally, it focuses on the development of a land-use planning health index, which would force land-use planners to identify active transportation needs and create a standard for the accessibility of active transportation within communities.

Subject Areas: Built transportation environment; Health effects; Active transportation; Health index

Availability: Pavlick, D., Faghri, A., DeLucia, S., and Gayen, S. (2020). "Human Health and the Transportation Infrastructure." *Journal of Human Resource and Sustainability Studies*, 8(3), pp. 219–248. <https://doi.org/10.4236/jhrss.2020.83013>

4.13. Title: Active Transportation and Health: Understanding the Impact of Transportation-Related Physical Activity on Health

Author(s): Famili, S.

Abstract: Car-oriented infrastructure in the U.S. leads to physically inactive lifestyles and negative health outcomes. To promote physical activity, public health officials encourage active transportation, namely biking and walking on daily trips. Previous studies proved that both perceived or self-assessed and objective health measures should be used to understand individuals' health status. Therefore, this study uses the National Household Travel Survey (NHTS) data to understand the associations between perceived health and modal trip features including the number of trips; trip distance; and duration for auto, public transit, walk, and bike trips. Regarding the objective health, this dissertation uses one-week walking activities data of a sample population from two universities in the U.S. The walking records include the average resting heart rates and minute-by-minute measures of walking heart rates, burned calories, and the number of steps. The results show that individuals with longer auto trips show lower perceived health; however, the higher frequency and longer active transportation are linked to better perceived health. Also, the cross-analysis results on a sample from one of the universities show that perceived health is not necessarily associated with actual health measures of BMI and physical activity. Regarding the objective physical activity and health, the results show that underweight/normal people, compared with overweight/obese individuals, seem to have lower resting heart rates, longer duration of walking, and a significantly higher number of steps (mean and total). Moreover, the results of modeling the changes in the walking heart rates based on health and activity predictors show that overweight and obese individuals have small changes in walking heart rate due to age and high resting heart rates. On the other hand, greater changes in walking heart rates are observed among the healthier people (with lower resting heart rates), due to their large number of steps, and moderate-to-vigorous minutes of walking.

Subject Areas: Active travel; Perceived health; Objective health; Physical activity; Walking; Obesity; Heart rate

Availability: Famili, S. (2020). *Active Transportation and Health: Understanding the Impact of Transportation-Related Physical Activity on Health*. Doctoral Dissertation, The University of Texas at Arlington, Arlington, TX. <http://hdl.handle.net/10106/29381>

4.14. Title: Open Spaces for Healthy Living

Author(s): Friedman, A.

Abstract: Rates of obesity and lifestyle-related diseases are steadily increasing worldwide despite ongoing efforts to curb them. These alarming trends are due in part to the current built environment which prioritizes vehicle usage over active mobility by segregating land uses. In response to the increasing global prevalence of inactivity, this chapter explores urban design concepts that promote healthy living. To do so, the chapter explores the obesity and inactivity public health challenge, examines the principles of walkability, suggests solutions for retooling cities accordingly, discusses how to locate and design play areas, makes recommendations for planning to include all ages, and concludes with guidelines for future planners to incorporate into health-conscious urban design.

Subject Areas: Obesity; Lifestyle; Play areas; Walkable communities; Mixed-use developments; Public transit; Public open areas; Green spaces; Wheelchair friendly; Physical abilities; Pocket parks; Mixed-use developments

Availability: Friedman, A. (2020). “Open Spaces for Healthy Living.” *Fundamentals of Sustainable Urban Design*, pp. 267–276. https://doi.org/10.1007/978-3-030-60865-1_28

4.15. Title: Healthy Climate, Healthy Bodies: Optimal Fuel Taxation and Physical Activity

Author(s): Sulikavo, S., van den Bijgaart, I., Klenert, D., and Mattauch, L.

Abstract: Transport has significant externalities including carbon emissions and air pollution. Public health research has identified additional social gains from active travel due to health benefits of physical exercise. Per mile, these benefits greatly exceed the external costs from car use. We introduce active travel into an optimal fuel taxation model and analytically characterize the optimal second-best fuel tax. We find that accounting for active travel benefits increases the optimal fuel tax by 49% in the US and 36% in the UK. Fuel taxes should be implemented jointly with other policies aimed at increasing the uptake of active travel.

Subject Areas: Transport externalities; Congestion; Active travel; Fuel; Health behavior; Optimal taxation

Availability: Sulikavo, S., van den Bijgaart, I., Klenert, D., and Mattauch, L. (2020). *Healthy Climate, Healthy Bodies: Optimal Fuel Taxation and Physical Activity*. CESifo Working Paper No. 8762, CESifo Working Papers, Munich, Germany. <https://ssrn.com/abstract=3748963>

4.16. Title: Cost Effectiveness Analysis of Implementing Tuberculosis Screening Among Applicants for Non-immigrant U.S. Work Visas

Author(s): Sayed, B.A., Posey, D.L., Maskery, B., Wingate, L.T., and Cetron, M.S.

Abstract: Background: While persons who receive immigrant and refugee visas are screened for active tuberculosis before admission into the United States, nonimmigrant visa applicants (NIVs) are not routinely screened and may enter the United States with infectious tuberculosis.

Objectives: We evaluated the costs and benefits of expanding pre-departure tuberculosis screening requirements to a subset of NIVs who arrive from a moderate (Mexico) or high (India) incidence tuberculosis country with temporary work visas.

Methods: We developed a decision tree model to evaluate the program costs and estimate the numbers of active tuberculosis cases that may be diagnosed in the United States in two scenarios: (1) “Screening:” screening and treatment for tuberculosis among NIVs in their home country with recommended U.S. follow-up for NIVs at elevated risk of active tuberculosis and (2) “No Screening” in their home country so that cases would be diagnosed passively and treatment occurs after entry into the United States. Costs were assessed from multiple perspectives, including multinational and U.S.-only perspectives.

Results: Under “Screening” versus “No Screening,” an estimated 179 active tuberculosis cases and 119 hospitalizations would be averted in the United States annually via predeparture treatment. From the U.S.-only perspective, this program would result in annual net cost savings of about \$3.75 million. However, from the multinational perspective, the screening program would cost \$151,388 per U.S. case averted for Indian NIVs and \$221,088 per U.S. case averted for Mexican NIVs.

Conclusion: From the U.S.-only perspective, the screening program would result in substantial cost savings in the form of reduced treatment and hospitalization costs. NIVs would incur increased pre-departure screening and treatment costs.

Subject Areas: Patients’ travel costs; Health care trips; Decision tree model; Screening; Treatment costs

Availability: Sayed, B.A., Posey, D.L., Maskery, B., Wingate, L.T., and Cetron, M.S. (2020). “Cost Effectiveness Analysis of Implementing Tuberculosis Screening Among Applicants for Non-immigrant U.S. Work Visas.” *Pneumonia*, 12. <https://doi.org/10.1186/s41479-020-00078-z>

Chapter 5. Policy and Mobility

5.1. Title: E3: Evaluating Equity in Evacuation: A Practical Tool and A Case Study (Collaborative Project)

Author(s): Cirillo, C., Nejad, M., Erdogan, S., and Chavis, C.

Abstract: Natural or man-made hazards that require evacuation put already vulnerable populations in a more precarious situation. When plans and decisions about evacuation are made, access to a private car is typically assumed, and differences in income levels across a community are rarely taken into account. The result is that carless members of a community can find themselves stranded. Low-income carless residents need alternative transportation means to reach shelters in case of an emergency. Thus, evacuation plans, decisions, and models need necessary information that identifies and locates these populations. In this study, data from the American Community Survey, U.S. Census, Internal Revenue Service, and the National Household Travel Survey are used to generate a synthetic population for Anne Arundel County, MD, using the copula concept. Geographic locations of low-income residents are identified within each subarea of the county (census tract), and their car ownership is estimated with a binomial logit model. The developed population synthesis method allows officials to have a more accurate account of populations for emergency planning and identify locations of shelters and triage points as well as planning carless transportation services.

Subject Areas: Synthetic population; Archimedean copulas; Accessibility; Car ownership models; Evacuation planning; Low income; Carless

Availability: Cirillo, C., Nejad, M., Erdogan, S., and Chavis, C. (2020). *E3: Evaluating Equity In Evacuation: A Practical Tool And A Case Study (Collaborative Project)*. Urban Mobility & Equity Center, Morgan State University, Baltimore, MD.
https://www.morgan.edu/school_of_engineering/research_centers/urban_mobility_and_equity_center/research/completed_research/e3_equity_in_evacuation.html

5.2. Title: Does Adoption of Ridehailing Result in More Frequent Sustainable Mobility Choices? An Investigation Based on the National Household Travel Survey (NHTS) 2017 Data

Author(s): Das, V.

Abstract: Among many changes potentially induced by the adoption of ridehailing, one key area of interest in transportation and urban planning research is how these services affect sustainable mobility choices, such as usage of public transit, walking, and biking modes and lower ownership of household vehicles. In this study, by using subsamples of the National Household Travel Survey (NHTS) 2017 data, propensity score matching technique is applied to generate matched samples of ridehailing adopters and non-adopters from ten different core-based statistical areas in the United States. Results from multivariable count data regression models built on the matched samples indicate that, on average, the count of public transit trips is greater for adopters compared against identical non-adopters in all 10 areas. Regarding average counts of walking and biking trips, adopters tend to make more trips in most of the places, although a few exceptions are also found. However, the relationship between ridehailing adoption and count of household vehicles appears to be more complicated as adopters, on average, seem to have a lower or higher number of vehicles than identical non-adopters, depending on the area. One major limitation of this study is that in the statistical analyses, effects of attitudinal and detailed geographic variables are not directly controlled for, which complicates causal interpretations of findings.

Subject Areas: Ridehailing; Public transit; Walking; Biking; Vehicle ownership; Sustainable mobility; Propensity score matching; Count data regression

Availability: Das, V. (2020). “Does Adoption of Ridehailing Result in More Frequent Sustainable Mobility Choices? An Investigation Based on the National Household Travel Survey (NHTS) 2017 Data.” *Smart Cities*, 3(2), pp. 385–400. <https://doi.org/10.3390/smartcities3020020>

5.3. Title: Congress Should Pull the Plug on Electric Vehicle Tax Credits

Author(s): Landrith, G.

Abstract: Blog.

Subject Areas: Electric vehicle tax credits; Subsidy program; Income

Availability: Landrith, G. (2020). "Congress Should Pull the Plug on Electric Vehicle Tax Credits." *Townhall*. <https://townhall.com/columnists/georgelandrith/2020/03/09/congress-should-pull-the-plug-on-electric-vehicle-tax-credits-n2564126>

5.4. Title: What Alternatives Does Maryland Have to Curb Congestion Besides Building More Highways?

Author(s): Reed, D.

Abstract: Blog.

Subject Areas: Congestion; Vehicle miles traveled; Transit; Active travel; Infrastructure; Telecommuting

Availability: Reed, D. (2020). "What Alternatives Does Maryland Have to Curb Congestion Besides Building More Highways?" *Greater Greater Washington*.

<https://ggwash.org/view/76978/transportation-alternatives-to-building-more-highways>

5.5. Title: Flying Cars Will Undermine Democracy and the Environment

Author(s): DeGood, K.

Abstract: Blog.

Subject Areas: Mobility; Flying car; Policy; Democracy; Elitism; Society

Availability: DeGood, K. (2020). "Flying Cars Will Undermine Democracy and the Environment." *Center for American Progress*.

<https://www.americanprogress.org/issues/economy/reports/2020/05/28/481148/flying-cars-will-undermine-democracy-environment/>

5.6. Title: Autonomous Taxis & Public Health: High Cost or High Opportunity Cost?

Author(s): Nunes, A. and Hernandez, K.D.

Abstract: Passenger vehicles are a major source of air pollution, exposure to which increases respiratory disease risk, amplifies life-threatening conditions, and burdens the public purse. The negative externalities associated with these vehicles rise further when road accidents are considered. Almost all such accidents involving fatalities transpire when private users are in single vehicle incidents or collide with each other. Though autonomous vehicle technology can mitigate these effects, widespread adoption and proliferation demands cost competitiveness with the status quo; namely, personally owned and operated conventional vehicles. Here we show that this prospect may—in a commercially owned and operated enterprise—be unlikely. Causal factors of relevance include low capacity utilization rates and impracticable profit expectations. In a single ridership “autonomous taxi” model, we find capacity utilization rates would need to improve from 52 to 100% and profits lowered by 37% (from 27 to 17 cents on a per-mile basis) for autonomous taxis to offer fares that are comparable with personally owned conventional vehicles. In a multiple ridership model, the affordance of these fares requires a 30% increase in vehicle occupancy (from 1.67 to 2.2) and a 75% increase (1.67 to 2.92) were even lower fares offered to incentivize shared, autonomous taxi use over personally owned conventional vehicles. We conclude that consideration of the opportunity costs of driving are integral to the widespread adoption of a technology that may dramatically improve public health outcomes.

Subject Areas: Autonomous taxis; Mobility as a service; Conventional vehicles; Public policy

Availability: Nunes, A. and Hernandez, K.D. (2020). “Autonomous Taxis & Public Health: High Cost or High Opportunity Cost?” *Transportation Research Part A: Policy and Practice*, 138, pp. 28–36. <https://doi.org/10.1016/j.tra.2020.05.011>

5.7. Title: Investigating Bias in SARS-CoV-2 Social Distancing Metrics Using Simulated Human Mobility Data?

Author(s): Vanderklaauw, N., Sansum, H., and Pestre, G.

Abstract: The advent of the information age and access to personal electronic devices has enabled an unparalleled ability to track and understand human locations and mobility. With the outbreak of the recent SARS-CoV-2 pandemic, mobility data have been thrust to the forefront as one of the most critical resources available to governments across the world. This report reviews and highlights some of the common sources of mobility data being used by both the media and U.S. Government to track the movements of people in the context of the SARS-CoV-2 pandemic. We review potential sources of bias along with their implications in policy-making and impact on society as a whole. Given the secrecy and sensitivity of the datasets used by major media outlets, we instead create a synthetic dataset using calibration data from the U.S. Census Bureau, the Federal Highway Administration, and other official sources to obtain baseline measures of phone ownership and travel habits at the county level. This calibration process provides a realistic ground truth with which to compare and contrast various approaches that have been deployed on mobile phone data to proxy the level of human movement and social interaction. By simulating the differences in actual (ground-truth) and observed (mobile-based proxy) social distancing before and after implementation of isolation protocols, we highlight tangible differences that could call into question the sudden and widespread usage of such information. In particular, we find that methods with built-in bias about what kind of movements are measured, for example data from coupon apps that are more likely to pick up shopping-related travel than other kinds are likely to produce biased estimates how behavior changed when stay-at-home orders were issued, thus undermining comparisons between geographic entities.

Subject Areas: Mobility; COVID-19; Synthetic dataset

Availability: Vanderklaauw, N., Sansum, H., and Pestre, G. (2020). *Investigating Bias in SARS-CoV-2 Social Distancing Metrics Using Simulated Human Mobility Data?* AC221: Final Project Report, Harvard John A. Paulson School of Engineering and Applied Sciences, Cambridge, MA. <http://nikhilvdk.me/assets/CovidBiasSimulation.pdf>

5.8. Title: The Energy and Environmental Effects of New and Future Mobility: Econometric and Simulation Analysis of Ridesourcing Services Uber and Lyft

Author(s): Ward, J.W.

Abstract: This thesis provides an initial understanding of the potentially fundamental changes to the way passenger vehicle transportation in the United States is changing given the introduction of ridesourcing via transportation network companies (TNCs) like Uber and Lyft and the effects those changes have on energy and environmental outcomes. First, in a set of two complementary studies, I employ real-world data and econometric modeling to assess the impacts that TNCs have already had on U.S. States and urban areas. In the first study (chapter 2), I focus on the State level, where relevant data are publicly available to estimate TNC market entry effects on vehicle registrations, gasoline use, vehicle miles traveled, and air pollutant emissions. I find an average decrease in vehicle registrations and no significant effect on other outcomes. In the second study (chapter 3), I assess TNC effects on vehicle fleet composition (total registrations and fuel economy) and transit ridership at the urban area level and find evidence that TNC entry causes an average 0.7% increase in vehicle registrations and no average effect on overall fleet efficiency or transit ridership. The difference in State- and urban area-level effects on vehicle registrations is due, in part, to heterogeneity in the effects of TNC entry on different cities. I employ heterogeneous treatment effect, clustering, and regression interaction analysis and find significant heterogeneity across urban areas. TNC entry tends to increase vehicle ownership in urban areas with higher initial vehicle ownership and lower population growth rates, TNC entry tends to increase vehicle ownership, increase overall fleet efficiency more in urban areas with lower childless household rates, and increase transit ridership more in urban areas with lower average incomes and childless household rates. Where the first two studies look at aggregate past changes to the transportation system attributable to TNCs from the top down using observable indicators at the aggregate state and urban area levels, a third study in chapter 4 considers a similar set of outcomes but focused at the vehicle level. I propose and apply a framework to quantify the external costs and benefits of TNC disruption to the transportation energy system by systematically characterizing the avoided cold start emissions and additional non-revenue miles and associated emissions and quantifying the relative size of external benefits and costs from TNC vehicles for several of the largest TNC markets in the United States and find that shifting travel from private vehicles to TNCs offers net external air pollutant benefits in some areas while incurring a net external cost in others; however, including externalities associated with additional vehicular travel yields net external costs everywhere. Taken together, these three studies confirm that TNCs have already affected the number and efficiency of vehicles owned and transit ridership rates in the United States and that they have done so heterogeneously as a function of preexisting socioeconomic and passenger travel characteristics. And, at the individual TNC trip level, targeted sensitivity and policy analyses to illustrate how transportation and urban planning decisions can increase net external benefits and/or reduce negative external costs.

Subject Areas: Mobility; Ridesourcing; Vehicle ownership; Transit ridership; Energy and environmental outcomes

Availability: Ward, J.W. (2020). *The Energy and Environmental Effects of New and Future Mobility: Econometric and Simulation Analysis of Ridesourcing Services Uber and Lyft*. Doctoral

Dissertation, Carnegie Mellon University, Pittsburgh, PA.

<https://search.proquest.com/openview/ecc75a380bb951a36d63cfd2e451b92d/1?pq-origsite=gscholar&cbl=18750&diss=y>

5.9. Title: SNAP Office Accessibility and its Association With Rurality

Author(s): Mu, L., Chen, Y., and Zhen, C.

Abstract: While several studies have explored geographic relationships within the Supplemental Nutrition Assistance Program (SNAP), results have been mixed. Findings have revealed an imbalanced SNAP participation rate among eligible populations in both suburban and rural areas. Studies on SNAP accessibility have often focused on store locations, but few have examined issues of traveling to SNAP offices. In this study, we focused on SNAP office accessibility and its association with rurality. Using Google Map API, we calculated road travel time and distance to the most conveniently located SNAP office for each block group in the conterminous United States. We investigated the degree to which the SNAP office accessibility is linked to rurality, participant demographics, socioeconomic characteristics, and the program's overall participation rate. Results showed that at the block-group level, the SNAP-eligible average driving time to the most convenient SNAP office is 15.28 minutes, while the SNAP-eligible average distance is 8.57 miles. More than 75% of the SNAP-income eligible population live within a 20-minute drive to a SNAP office, and 91.8% live within 30 minutes. Every 10 percentage points of increase in rurality decreases SNAP office accessibility by 1 additional minute of car travel time. We designed a Rurality-Travel Clock (RTC) visualization tool to provide a graphic description of the urban-rural setting and SNAP office accessibility. Other observations include a noticeable cross-relationship between population concentration (e.g., white or black) and SNAP office accessibility. The findings help us to understand the dynamic relationships between SNAP participation rate and SNAP accessibility factors, including eligibility, employment status, population, and rurality at the county and State levels.

Subject Areas: SNAP office; Accessibility; Rurality; Poverty

Availability: Mu, L., Chen, Y., and Zhen, C. (2020). "SNAP Office Accessibility and its Association With Rurality." *Applied Geography*, 120.
<https://doi.org/10.1016/j.apgeog.2020.102209>

5.10. Title: New and Emerging Data Forms in Transportation Planning and Policy: Opportunities and Challenges for “Track and Trace” Data

Author(s): Harrison, G., Grant-Muller, S.M., and Hodgson, F.C.

Abstract: High-quality, reliable data and robust models are central to the development and appraisal of transportation planning and policy. Although conventional data may offer good “content,” it is widely observed that it lacks context (i.e., who and why people are traveling). Transportation modeling has developed within these boundaries, with implications for the planning, design, and management of transportation systems and policymaking. This paper establishes the potential of passively collected GPS-based “Track & Trace” (T&T) datasets of individual mobility profiles towards enhancing transportation modelling and policy-making. T&T is a type of New and Emerging Data Form (NEDF), lying within the broader “Big Data” paradigm and is typically collected using mobile phone sensors and related technologies. These capture highly grained mobility content and can be linked to the phone owner/user behavioral choices and other individual context. Our meta-analysis of existing literature related to spatio-temporal mobile phone data demonstrates that NEDFs, and in particular T&T data, have had little mention to date within an applied transportation planning and policy context. We thus establish there is an opportunity for policymakers, transportation modelers, researchers, and a wide range of stakeholders to collaborate in developing new analytic approaches, revise existing models, and build the skills and related capacity needed to lever greatest value from the data, as well as to adopt new business models that could revolutionize citizen participation in policymaking. This is of particular importance due to the growing awareness in many countries for a need to develop and monitor efficient cross-sectoral policies to deliver sustainable communities.

Subject Areas: Transport policy; Track and trace; Mobile phone data; Mobility profile; Big data

Availability: Harrison, G., Grant-Muller, S.M., and Hodgson, F.C. (2020). “New and Emerging Data Forms in Transportation Planning and Policy: Opportunities and Challenges for ‘Track and Trace’ Data.” *Transportation Research Part C: Emerging Technologies*, 117. <https://doi.org/10.1016/j.trc.2020.102672>

5.11. Title: Transportation Infrastructure in the US

Author(s): Duranton, G., Nagpal, G., and Turner, M.A.

Abstract: Support for massive investments in transportation infrastructure, possibly with a change in the share of spending on transit, seems widespread. Such proposals are often motivated by the belief that our infrastructure is crumbling, that infrastructure causes economic growth, that current funding regimes disadvantage rural drivers at the expense of urban public transit, or that capacity expansions will reduce congestion. In fact, most us transportation infrastructure is not deteriorating, and the existing scientific literature does not show that infrastructure creates growth or reduces congestion. However, current annual expenditure on public transit buses exceeds that on interstate construction and maintenance. A careful examination of how funding is allocated across modes is suggested by the evidence. Massive new expenditures are not.

Subject Areas: Transportation infrastructure; Congestion; Expenditures

Availability: Duranton, G., Nagpal, G., and Turner, M.A. (2020). *Transportation Infrastructure in the US*. National Bureau of Economic Research, Cambridge, MA.

<https://www.nber.org/papers/w27254>

5.12. Title: Investigating Mobility in Rural Areas of China: Features, Equity, and Factors

Author(s): Zhao, P. and Yu, Z.

Abstract: Mobility equity is one of the main issues in sustainable transport in both developed and developing countries. However, the existing literature in the field is dominated by the evidence from cities, while the evidence from rural areas remains scarce. In particular, mobility equity in rural areas in developing countries needs to be paid more attention since a large proportion of people in these countries still live in undeveloped rural areas. This paper contributes to new evidence of mobility and its inequity in rural areas of China. By using questionnaire data from a nationwide survey in 2016, this study investigates the rural residents' mobility characteristics with transport equity concerns and the determinants of mobility inequity. Individual people's trip amount, travel mode, and travel range are used as three main indicators for rural residents' mobility. A number of 12,524 residents from rural townships and 2,952 villagers were analyzed. The results of analysis show those who live in poor areas or areas far from the city have low-level mobility. The socially disadvantaged groups had lower mobility, such as the elderly over the age of 60, women, and people from low-income households. Mobility inequity even exists in rural areas between township residents and villagers. The township residents have a higher level of mobility than rural villagers. Regression results show rural people's mobility is significantly affected by car ownership and public bus services. The policies designed to improve quality and equity of mobility in the rural areas in China should focus on not only the huge rural road constructions but also the improvements in public transport services and car ownership.

Subject Areas: Mobility inequity; Rural disadvantaged; Small towns; Village; China

Availability: Zhao, P. and Yu, Z. (2020). "Investigating Mobility in Rural Areas of China: Features, Equity, and Factors." *Transport Policy*, 94, pp. 66–77.
<https://doi.org/10.1016/j.tranpol.2020.05.008>

5.13. Title: Knowledge Discovery and Data Mining for Shared Mobility and Connected and Automated Vehicle Applications

Author(s): Wang, C.

Abstract: The rapid development of shared mobility and connected and automated vehicles (CAVs) has not only brought new intelligent transportation system (ITS) challenges with the new types of mobility, but also brought a huge opportunity to accelerate the connectivity and informatization of transportation systems, particularly when we consider all the new forms of data that are becoming available. The primary challenge is how to take advantage of the enormous amount of data to discover knowledge, build effective models, and develop impactful applications. With the theoretical and experimental progress being made over the last two decades, data mining and machine-learning technologies have become key approaches for parsing data, understanding information, and making informed decisions, especially as the rise of deep learning algorithms bringing new levels of performance to the analysis of large datasets. The combination of data mining and ITS can greatly benefit research and advances in shared mobility and CAVs.

This dissertation focuses on knowledge discovery and data mining for shared mobility and CAV applications. When considering big data associated with shared mobility via operations and CAV research, data mining techniques can be customized with transportation knowledge to initially parse the data. Then, machine-learning methods can be used to model the parsed data to elicit hidden knowledge. Finally, the discovered knowledge and extracted information can help in the development of effective shared mobility and CAV applications to achieve the goals of safer, faster, and more eco-friendly transportation systems.

In this dissertation, there are four main sections that are addressed. First, new methodologies are introduced for extracting lane-level road features from rough crowdsourced GPS trajectories via data mining, which is subsequently used as the fundamental information for CAV applications. The proposed method results in decimeter level accuracy, which satisfies the positioning needs for many macroscopic and microscopic shared mobility and CAV applications. Second, macroscopic ride-hailing service big data have been analyzed for demand prediction, vehicle operation, and system efficiency monitoring. The proposed deep learning algorithms increase the ride-hailing demand prediction accuracy to 80% and can help the fleet dispatching system reduce 30% of vacant travel distance. Third, microscopic automated vehicle perception data have been analyzed for a real-time computer vision system that can be used for lane change behavior detection. The proposed deep learning design combines the residual neural network image input with time serious control data and reaches 95% of lane change behavior prediction accuracy. Last but not least, new ride sharing and CAV applications have been simulated in a behavior modeling framework to analyze the impact of mobility and energy consumption, which addresses key barriers by quantifying the transportation system-wide mobility, energy and behavior impacts from new mobility technologies using real-world data.

Subject Areas: Knowledge discovery; Data mining; Shared mobility; Connected and automated vehicles

Availability: Wang, C. (2020). *Knowledge Discovery and Data Mining for Shared Mobility and Connected and Automated Vehicle Applications*. Doctoral Dissertation, University of California, Riverside, CA. <https://escholarship.org/uc/item/33c042c2>

5.14. Title: Geographic Mobility in America: Evidence from Cell Phone Data

Author(s): Chen, M.K. and Pope, D.G.

Abstract: Traveling beyond the immediate surroundings of one's residence can lead to greater exposure to new ideas and information, jobs, and greater transmission of disease. In this paper, we document the geographic mobility of individuals in the United States and how this mobility varies across U.S. cities, regions, and income classes. Using geolocation data for ~1.7 million smartphone users over a 10-month period, we compute different measures of mobility, including the total distance traveled, the median daily distance traveled, the maximum distance traveled from one's home, and the number of unique haunts visited. We find large differences across cities and income groups. For example, people in New York travel 38% fewer total kilometers and visit 14% fewer block-sized areas than people in Atlanta. And, individuals in the bottom income quartile travel 12% less overall and visit 13% fewer total locations than the top income quartile.

Subject Areas: Geographic mobility; Cell phone data; Household income; Cities

Availability: Chen, M.K. and Pope, D.G. (2020). *Geographic Mobility in America: Evidence from Cell Phone Data*. National Bureau of Economic Research, Cambridge, MA.
<https://www.nber.org/papers/w27072>

5.15. Title: Data-Driven Modeling Reveals the Impact of Stay-at-Home Orders on Human Mobility during the COVID-19 Pandemic in the U.S.

Author(s): Xiong, C., and Hu, S., Yang, M., Younes, H.N., Luo, W., Ghader, S., and Zhang, L.

Abstract: One approach to delay the spread of the novel coronavirus (COVID-19) is to reduce human travel by imposing travel restriction policies. It is yet unclear how effective those policies are on suppressing the mobility trend due to the lack of the ground truth and large-scale dataset describing human mobility during the pandemic. This study uses real-world location-based service data collected from anonymized mobile devices to uncover mobility changes during COVID-19 and under the “stay-at-home” State orders in the United States. The study measures human mobility with two important metrics: daily average number of trips per person and daily average person-miles traveled. The data-driven analysis and modeling attributes less than 5% of the reduction in number of trips and person-miles traveled to the effect of policy. The models developed in the study exhibit high prediction accuracy and can be applied to inform epidemics modeling with empirically verified mobility trends and to support time-sensitive decisionmaking processes.

Subject Areas: COVID-19; Human mobility; Stay-at-home orders; Generalized additive model

Availability: Xiong, C., and Hu, S., Yang, M., Younes, H.N., Luo, W., Ghader, S., and Zhang, L. (2020). *Data-Driven Modeling Reveals the Impact of Stay-at-Home Orders on Human Mobility during the COVID-19 Pandemic in the U.S.* Maryland Transportation Institute, University of Maryland, College Park, MD. <https://arxiv.org/ftp/arxiv/papers/2005/2005.00667.pdf>

5.16. Title: Human Mobility Trends during the COVID-19 Pandemic in the United States

Author(s): Lee, M., Zhao, J., Sun, Q., Pam, Y., Zhou, W., Xiong, C., and Zhang, L.

Abstract: In March of this year, COVID-19 was declared a pandemic, and it continues to threaten public health. This global health crisis imposes limitations on daily movements, which have deteriorated every sector in our society. Understanding public reactions to the virus and the non-pharmaceutical interventions should be of great help to fight COVID-19 in a strategic way. We aim to provide tangible evidence of the human mobility trends by comparing the day-by-day variations across the United States. Large-scale public mobility at an aggregated level is observed by leveraging mobile device location data and the measures related to social distancing. Our study captures spatial and temporal heterogeneity as well as the sociodemographic variations regarding the pandemic propagation and the non-pharmaceutical interventions. All mobility metrics adapted capture decreased public movements after the national emergency declaration. The population staying home has increased in all States and becomes more stable after the stay-at-home order with a smaller range of fluctuation. There exists overall mobility heterogeneity between the income or population density groups. The public had been taking active responses, voluntarily staying home more, to the in-State confirmed cases while the stay-at-home orders stabilize the variations. The study suggests that the public mobility trends conform with the government message urging to stay home. We anticipate our data-driven analysis offers integrated perspectives and serves as evidence to raise public awareness and, consequently, reinforce the importance of social distancing while assisting policymakers.

Subject Areas: COVID-19; Large-scale public mobility; Heterogeneity; Sociodemographic variations; Stay-at-home orders

Availability: Lee, M., Zhao, J., Sun, Q., Pan, Y., Zhou, W., Xiong, C., and Zhang, L. (2020). *Human Mobility Trends during the COVID-19 Pandemic in the United States*. Maryland Transportation Institute, University of Maryland, College Park, MD.
<https://arxiv.org/ftp/arxiv/papers/2005/2005.01215.pdf>

5.17. Title: Observed Mobility Behavior Data Reveal “Social Distancing Inertia”

Author(s): Ghader, S., Zhao, J., Lee, M., Zhou, W., Zhao, G., and Zhang, L.

Abstract: The research team has utilized an integrated dataset consisting of anonymized location data, COVID-19 case data, and census population information to study the impact of COVID-19 on human mobility. The study revealed that statistics related to social distancing, namely trip rate, miles traveled per person, and percentage of population staying at home have all showed an unexpected trend, which we named “social distancing inertia.” The trends showed that as soon as COVID-19 cases were observed, the statistics started improving, regardless of government actions. This suggests that a portion of population who could and were willing to practice social distancing voluntarily and naturally reacted to the emergence of COVID-19 cases. However, after about 2 weeks, the statistics saturated and stopped improving, despite the continuous rise in COVID-19 cases. The study suggests that there is a natural behavior inertia toward social distancing, which puts a limit on the extent of improvement in the social-distancing-related statistics. The national data showed that the inertia phenomenon is universal, happening in all the U.S. States and for all the studied statistics. The U.S. States showed a synchronized trend, regardless of the timeline of their statewide COVID-19 case spreads or government orders.

Subject Areas: COVID-19; Social distancing inertia

Availability: Ghader, S., Zhao, J., Lee, M., Zhou, W., Zhao, G., and Zhang, L. (2020). *Observed Mobility Behavior Data Reveal ‘Social Distancing Inertia.’* Maryland Transportation Institute, University of Maryland, College Park, MD.
<https://arxiv.org/ftp/arxiv/papers/2004/2004.14748.pdf>

5.18. Title: What Remains? The Influence of Light Rail Transit on Discretionary Income

Author(s): Baker, D.M. and Kim, S.

Abstract: A growing number of studies examine the affordability benefits of living near transit, especially fixed-rail, with the assumption that transportation benefits of transit neighborhoods outweigh increasing housing costs. Yet these studies only compare housing and transportation costs. This study adds to the existing literature by investigating the influence of new light rail on changes in discretionary income in urbanized areas. We examine such changes from 2000 to 2010 at the block group level, comparing light rail neighborhoods (LRNs) and non-LRNs, across 20 U.S. urban areas that opened light rail stations between this time period. Using descriptive statistical measures and OLS regressions, we find that while discretionary income decreased overall, neighborhoods with light rail provide a positive influence on discretionary income. Overall, our findings suggest light rail neighborhoods provide greater affordability benefits than non-light rail neighborhoods.

Subject Areas: Discretionary income; Light rail transit; Affordability; Transportation costs

Availability: Baker, D.M. and Kim, S. (2020). "What Remains? The Influence of Light Rail Transit on Discretionary Income." *Journal of Transport Geography*, 85.
<https://doi.org/10.1016/j.jtrangeo.2020.102709>

5.19. Title: Towards E-mobility: Strengths and Weaknesses of Electric Vehicles

Author(s): Carteni, A., Henke, I., Moliterno, C., and Errico, A.

Abstract: One of the greatest environmental challenges worldwide is mobility. In the future, increasingly sustainable solutions will be proposed and incentivized and new technologies, like electric mobility, could (positive) influence mobility performances/habits. The paper aims at critically analyze weaknesses, strengths, and application fields of the electric mobility in Italy. Specifically, the electric vehicle today has high production costs, low autonomy and not “zero” environmental impacts deriving from the production, motion, and recycling of the vehicle. However, the “local emissions” are null and this pone this technology useful for urban mobility, where high population density often occurs. Furthermore, e-mobility is useful within the new forms of mobility (e.g., mobility as a service) where micro-mobility, shared mobility, urban bus fleet, freight distribution, and an overall higher willingness to pay for users/operators could emphasize the strengths of e-mobility, reducing its weaknesses.

Subject Areas: E-mobility; Electric vehicle; Mobility as a service; Sustainable mobility; New technologies; Local emissions; Environmental impacts

Availability: Carteni A., Henke I., Moliterno C., and Errico A. (2020). “Towards E-mobility: Strengths and Weaknesses of Electric Vehicles.” *Web, Artificial Intelligence and Network Applications. WAINA 2020. Advances in Intelligent Systems and Computing, 1150*, pp. 1383–1393. https://doi.org/10.1007/978-3-030-44038-1_126

5.20. Title: Urban Mobility and Activity Space

Author(s): Cagney, K.A., Cornwell, E.Y., Goldman, A.W., and Cai, L.

Abstract: Recent theoretical and methodological advances in urban sociology, including spatially located data, provide new opportunities to consider the joint influence of mobility and place in urban social life. This review defines the concept of activity space, describes its origins in urban sociology, and examines the extent to which activity space approaches have advanced sociological research in four substantive domains—spatial inequality and segregation, social connectedness and engagement, crime and offending patterns, and health and health-related behavior. It then describes the evolution of methods for location tracking and new approaches that hold promise for maximizing urban mobility and activity space contributions. It then discusses how location data may be augmented to enhance our sociological understanding of the structure, meaning, and implications of the places people visit or traverse in daily life. We close with new directions for activity space research, emphasizing how such work could enable comparative contextual research.

Subject Areas: Activity space; Location tracking; Urban sociology; Joint influence

Availability: Cagney, K.A., Cornwell, E.Y., Goldman, A.W., and Cai, L. (2020). “Urban Mobility and Activity Space.” *Annual Review of Sociology*, 46, pp. 623–648.
<https://doi.org/10.1146/annurev-soc-121919-054848>

5.21. Title: Webinar: New Travel Demand Modeling for our Evolving Mobility Landscape

Author(s): Ewing, R. and Sabouri, S.

Abstract: Conventional four-step travel demand models are used by nearly all metropolitan planning organizations, State departments of transportation, and local planning agencies as the basis for long-range transportation planning in the United States. A flaw of the four-step model is its relative insensitivity to the so-called D variables. The D variables are characteristics of the built environment that are known to affect travel behavior. The Ds are development density, land use diversity, street network design, destination accessibility, and distance to transit. In this seminar, we will explain how we developed a vehicle ownership model (car shedding model), an intrazonal travel model (internal capture model), and mode choice model that consider all of the D variables based on household travel surveys and built environmental data for 32, 31, and 29 regions, respectively, validates the models, and demonstrates that the models have far better predictive accuracy than Wasatch Front Regional Council (WFRC)/Mountainland Association of Governments' (MAG's) current models.

In this webinar, researchers Reid Ewing and Sadegh Sabouri will demonstrate the effectiveness of the new travel demand model and how to implement it by integrating it into the traditional four-step process.

Subject Areas: Travel demand model; Long-range transportation planning; D variables; Vehicle ownership; Intrazonal travel; Mode choice; Built environmental

Availability: Ewing, R. and Sabouri, S. (2020). *Webinar: New Travel Demand Modeling for our Evolving Mobility Landscape*. TREC Webinar Series, Portland State University, Portland, OR. https://pdxscholar.library.pdx.edu/trec_webinar/45

5.22. Title: Investigating Individual Preferences for New Mobility Services: the Case of “Mobility as a Service” Products

Author(s): Matyas, M.B.

Abstract: In just a few years, the Mobility as a Service (MaaS) concept has gone from an idea discussed by very few to being a prominent topic in any transportation related debate. However, within this time, there have only been few rigorous studies that explore the various aspects of MaaS. This thesis aims to contribute to existing knowledge by providing empirical evidence on individual preferences for MaaS plans and their components. In doing so, first, desk research is conducted to summarize existing MaaS schemes and outline the MaaS ecosystem. Next, MaaS surveys that are able to capture individual preferences for MaaS products are designed, and specific challenges in the design process identified. The MaaS surveys, including MaaS plan stated preference experiments, are applied in two case study areas of London and Greater Manchester. Using the novel data collected, individual preferences for MaaS plans are examined using two distinct studies: (1) a mixed methods research conducted in London, which expands the survey by adding a qualitative (indepth interview) element to examine user preferences for MaaS plans and the ways individuals choose between them, and (2) a latent class choice model based on data collected from Manchester to examine whether there is heterogeneity in preferences. Finally, implications for industry and policy stakeholders are discussed as well as interventions that can best support the widespread adoption of MaaS.

The results of this thesis show there is interest in the concept of MaaS among potential users as many see value in a single app that integrates different transport modes into a single service. In general, individuals are hesitant in purchasing pre-paid MaaS plans and would be more comfortable with a pay-as-you-go product option. While many people are reluctant toward MaaS plans, the results indicate that heterogeneity exists in preferences toward them, and there are different user groups based on socio-demographic characteristics and current mobility habits. Smaller, less expensive plans, including modes such as public transport and bike sharing, can be used to target students or middle-income people with high overall mode usage. Larger, more expensive plans that include modes such as taxi and car sharing in addition to public transport will be attractive to individuals who are likely younger, male, well-educated, have higher income, and already use many transport modes. Older population groups, individuals with low income, and those that do not use any transport modes or are uni-modal are least likely to adopt MaaS plans.

The thesis also provides insights into individuals' preferences towards transport modes within MaaS plans. The analysis showed that respondents classify modes within MaaS plans into three categories: “essential” modes that are pivotal to the individual and which they most likely already frequently use; “considered” modes are those that they would be willing to include but may not yet use; and “excluded” modes are those that they definitely do not want in their plans and would eliminate any plan that included these. Public transport consistently proved to be an essential mode, while taxi, car sharing and bike sharing could be “essential,” “considered,” or “excluded” depending on the characteristics of the individual. The main contributions of this thesis are the novel data collected in two case study cities about individuals' preferences for

MaaS plans and the findings gained through the analysis providing insights into possible target audiences and product designs for MaaS plans.

Subject Areas: Mobility as a service plans; Heterogeneity; Individual preferences; Transport modes; Sociodemographic characteristics; Mobility habits

Availability: Matyas, M.B. (2020). *Investigating Individual Preferences for New Mobility Services: the Case of “Mobility as a Service” Products*. Doctoral Dissertation, University College London, London, UK. https://discovery.ucl.ac.uk/id/eprint/10091070/1/Matyas_000_Thesis.pdf

5.23. Title: An Interstate Trips Analysis During COVID-19 in the United States

Author(s): Zhou, W., Lee, M., Sun, Q., Luo, W., Xiong, C., and Zhang, L.

Abstract: The worldwide outbreak of COVID-19 has posed a dire threat to the public. Human mobility has changed in various ways over the course of the pandemic. Despite current studies on common mobility metrics, research specifically on state-to-state mobility is very limited. By leveraging the mobile phone location data from over 100 million anonymous devices, we estimate the population flow between all states in the United States. We first analyze the temporal pattern and spatial differences of between-state flow from January 1, 2020, to May 15, 2020. Then, with repeated measures one-way analysis of variance (ANOVA) and post-hoc analysis, we discern different time-course patterns of between-state population flow by pandemic severity groups. A further analysis shows moderate to high correlation between the flow reduction and the pandemic severity, the strength of which varies with different policies. This paper is promising in predicting imported cases.

Subject Areas: Interstate travel; COVID-19; Mobility; Mobile phone location data; Temporal pattern; One-way analysis of variance; Post-hoc analysis

Availability: Zhou, W., Lee, M., Sun, Q., Luo, W., Xiong, C., and Zhang, L. (2020). *An Interstate Trips Analysis During COVID-19 in the United States*. Maryland Transportation Institute, University of Maryland, College Park, MD.
<https://arxiv.org/ftp/arxiv/papers/2007/2007.02020.pdf>

5.24. Title: Impact of Electric and Hybrid Vehicles on Highway Trust Fund in Alabama

Author(s): Xu, D., Zhou, H., Xue, C., and LaMondia, J.

Abstract: The objective of this paper is to help state agencies better understand the impact of electric and hybrid vehicles on the Highway Trust Fund and to develop a method for estimating proper annual registration fees for electric vehicles (EVs). In this study, a comprehensive literature review was conducted to summarize the background on electric and hybrid vehicles, current national and state policies and incentives, the trend of EV market in the U.S., and registration fees on electric and hybrid vehicles. As electric and hybrid vehicles do not contribute to fuel excise tax revenue, to compensate the lost tax revenues, some states charge additional annual registration fees to EV owners. To help the legislators determine the proper annual fees, a method was developed to assess the additional registration fees for EVs and plug-in hybrid electric vehicles (PHEVs) in Alabama. The collected data include number of registered electric and hybrid vehicles, fuel tax per gallon, and annual average mileage traveled by electric and hybrid vehicles in Alabama. The results of this study served as a key reference in the Rebuild Alabama Act that proposed an annual registration fee of \$200 and \$100 for EVs and PHEVs, respectively, which is effective since January 2020. The method in this study can be applied to other states for developing policies on registration fees for EVs and PHEVs to offset the fuel excise tax revenue loss.

Subject Areas: Highway Trust Fund; Mobility; Policies and incentives; Registration fees

Availability: Xu, D., Zhou, H., Xue, C., and LaMondia, J. (2020). "Impact of Electric and Hybrid Vehicles on Highway Trust Fund in Alabama." *Transportation Research Record*, 2674(9), pp. 913–921. <https://doi.org/10.1177/0361198120932901>

5.25. Title: Literature Review of Mileage-Based Road User Fees

Author(s): Thapa, R., Zeringue, K., and Codjoe, J.

Abstract: A federal tax of 18.4 cents per gallon on gasoline and 24.4 cents on diesel fuel is currently the primary source of revenue for the Federal Highway Trust Fund, and those rates have not been raised since 1993. Gas tax revenue collections are declining each year for a number of reasons, such as the increase in the number of electric vehicles and other vehicles not subject to the gas tax, as well as increases in the vehicle fuel efficiency. Within the state of Louisiana, gas tax revenues are projected to decline by 62% by the end of 2026, with the state having one of the 10 lowest gasoline tax rates in the nation. The inevitable growth in the cost of construction and the construction needs of highway infrastructure are considered as the two major factors behind the state's failure to raise sufficient levels of revenue from gas tax. To address the problem, a new system with a charge based on the mileage driven has been a hot topic for several years.

This study reviewed the relevant available literature and suggests that, despite having some concerns (especially during the implementation), the benefits of using a mileage-based road user fee system outweigh the challenges. Several states within the United States have already successfully conducted pilot tests/programs on the new system. In addition, some other nations have already successfully implemented a mileage-based system for trucks. Based on the available literature, a mileage-based road user fee system may be a viable alternative to the current gas tax system, but implementation of the system has its challenges.

Subject Areas: Mileage-based road user fees; Benefits, Implementation; Pilot studies; Privacy

Availability: Thapa, R., Zeringue, K., and Codjoe, J. (2020). *Literature Review of Mileage-Based Road User Fees*. Technical Assistance Report 20-02TA-SS, Louisiana Transportation Research Center, Baton Rouge, LA. <https://www.ltrc.lsu.edu/pdf/2020/20-02TA-SS.pdf>

5.26. Title: Mobility Design as a Means of Promoting Non-Motorized Travel Behavior? A Literature Review of Concepts and Findings on Design Functions

Author(s): Blitz, A. and Lanzendorf, M.

Abstract: To promote non-motorized travel, many travel behavior studies acknowledge the importance of the built environment to modal choice, for example with its density or mix of uses. From a mobility design theory perspective, however, objects and environments affect human perceptions, assessments and behavior in at least three different ways: by their practical, aesthetic and emblematic functions. This review of existing evidence will argue that travel behavior research has so far mainly focused on the practical function of the built environment. For that purpose, we systematically identified 56 relevant studies on the impacts of the built environment on non-motorized travel behavior in the Web of Science database. The focus of research on the practical design function primary involves land use distribution, street network connectivity and the presence of walking and cycling facilities. Only a small number of papers address the aesthetic and emblematic functions. These show that the perceived attractiveness of an environment and evoked feelings of traffic safety increase the likelihood of walking and cycling. However, from a mobility design perspective, the results of the review indicate a gap regarding comprehensive research on the effects of the aesthetic and emblematic functions of the built environment. Further research involving these functions might contribute to a better understanding of how to promote non-motorized travel more effectively. Moreover, limitations related to survey techniques, regional distribution and the comparability of results were identified.

Subject Areas: Mobility design; Built environment; Design functions; Travel behavior; Non-motorized travel; Literature review

Availability: Blitz, A. and Lanzendorf, M. (2020). "Mobility Design as a Means of Promoting Non-Motorized Travel Behavior? A Literature Review of Concepts and Findings on Design Functions." *Journal of Transport Geography*, 87. <https://doi.org/10.1016/j.jtrangeo.2020.102778>

5.27. Title: Our World Accelerated: How 120 Years of Transportation Progress Affects Our Lives and Communities

Author(s): Litman, T.

Abstract: This report critically examines how 120 years of transportation progress affects our lives and communities. Before 1900, automobile and air travel hardly existed; by 2000, they were dominant forms of travel. Mobility became much faster and cheaper. We can now travel about ten times faster and farther than in 1900. Although this provides benefits, it also imposes significant economic, social and environmental costs, including large increases in household expenses, infrastructure costs, and health problems, plus reduced non-auto transport options. These costs offset a major portion of benefits, and tend to be inequitable; they harm people who cannot drive or have low incomes. This has important lessons for future transport planning.

Subject Areas: Planning and forecasting; Accessibility; Economic impacts; Environmental impacts; Forecasting; History; Mobility; Social impacts; Transportation; Trend (Statistics)

Availability: Litman, T. (2020). *Our World Accelerated: How 120 Years of Transportation Progress Affects Our Lives and Communities*. Victoria Transport Policy Institute, Victoria, British Columbia, Canada. <https://vtpi.org/TIEL.pdf>

5.28. Title: How Different Age Groups Responded to the COVID-19 Pandemic in Terms of Mobility Behaviors: A Case Study of the United States

Author(s): Kabiri, A., Darzi, A., Zhou, W., Sun, Q., and Zhang, L.

Abstract: The rapid spread of COVID-19 has affected thousands of people from different socio-demographic groups all over the country. A decisive step in preventing or slowing the outbreak is the use of mobility interventions, such as government stay-at-home orders. However, different sociodemographic groups might have different responses to these orders and regulations. In this paper, we attempt to fill the current gap in the literature by examining how different communities with different age groups performed social distancing by following orders such as the national emergency declaration on March 13, as well as how fast they started changing their behavior after the regulations were imposed. For this purpose, we calculated the behavior changes of people in different mobility metrics, such as percentage of people staying home during the study period (March, April, and May 2020), in different age groups in comparison to the days before the pandemic (January and February 2020) by utilizing anonymized and privacy-protected mobile device data. Our study indicates that senior communities outperformed younger communities in terms of their behavior change. Senior communities not only had a faster response to the outbreak in comparison to young communities, they also had better performance consistency during the pandemic.

Subject Areas: COVID-19; Mobile device location data; Mobility pattern; Social distancing

Availability: Kabiri, A., Darzi, A., Zhou, W., Sun, Q., and Zhang, L. (2020). *How Different Age Groups Responded to the COVID-19 Pandemic in Terms of Mobility Behaviors: A Case Study of the United States*. arXiv, Cornell University, Ithaca, NY. <https://arxiv.org/abs/2007.10436>

5.29. Title: Creating Built Environments That Expand Active Transportation and Active Living Across the United States: A Policy Statement from the American Heart Association

Author(s): Young, D.R., Cradock, A.L., Eyler, A.A., Fenton, M., Pedroso, M., Sallis, J.F., and Whitsel, L.P.

Abstract: Physical activity is vital for the health and well-being of youth and adults, although the prevalence of physical activity continues to be low. Promoting active transportation or human-powered transportation through policy, systems, and environmental change is one of the leading evidence-based strategies to increase physical activity regardless of age, income, racial/ethnic background, ability, or disability. Initiatives often require coordination across federal, state, and local agencies. To maximize the effectiveness of all types of interventions, it is imperative to establish strong and broad partnerships across professional disciplines, community members, and advocacy groups. Health organizations can play important roles in facilitating these partnerships. This policy statement provides recommendations and resources that can improve transportation systems, enhance land use design, and provide education to support policies and environments to promote active travel. The American Heart Association supports safe, equitable active transportation policies in communities across the country that incorporate consistent implementation evaluation. Ultimately, to promote large increases in active transportation, policies need to be created, enforced, and funded across multiple sectors in a coordinated and equitable fashion. Active transportation policies should operate at 3 levels: the macroscale of land use, the mesoscale of pedestrian and bicycle networks and infrastructure such as Complete Streets policies and Safe Routes to School initiatives, and the microscale of design interventions and placemaking such as building orientation and access, street furnishings, and safety and traffic calming measures. Health professionals and organizations are encouraged to become involved in advocating for active transportation policies at all levels of government.

Subject Areas: Active transportation; American Heart Association; Transportation policies; Transportation infrastructure; Traffic safety

Availability: Young, D.R., Cradock, A.L., Eyler, A.A., Fenton, M., Pedroso, M., Sallis, J.F., and Whitsel, L.P. (2020). "Creating Built Environments That Expand Active Transportation and Active Living Across the United States: A Policy Statement from the American Heart Association." *Circulation*, 142(11), pp. 167–183.

<https://www.ahajournals.org/doi/full/10.1161/CIR.0000000000000878>

5.30. Title: A Customizable Metric to Provide a Comprehensive Picture of the Mobility Potential of a Location

Author(s): Nag, A., Garikapati, V.M., Hou, T., Young, S., and Schroeder, A.

Abstract: Accessibility in a geo-spatial context refers to the ease of reaching a variety of opportunities from a given location. Accessibility theories (and resulting metrics) have traditionally focused on quantifying access to specific opportunities (such as jobs), or focused on specific modes (such as car, bike, etc.). Such approaches often fall short of providing a comprehensive picture of the true accessibility potential of a location as a combination of multiple modes to multiple types of destinations. Addressing this drawback, a novel metric labeled the ‘Mobility Energy Productivity (MEP) Metric’ was developed at the National Renewable Energy Laboratory to quantify the mobility potential of a location to connect people to goods, services, and employment using a variety of modes, while accounting for time, energy, and affordability. The MEP metric has been integrated with advance travel behavior models to compute the changes in mobility potential for various future scenarios, such as introduction of automated vehicles, and/or electric vehicles—but does so at the aggregate, or average-citizen level. The MEP in its initial iteration is not customized to the particular socio-economic contingents, or even to an individual whose modal availability or pattern of trip making may substantially differ from the average. Addressing this gap, this research effort extends the MEP framework from a static state to a more tailored and dynamic state, one in which an individual, or group can customize the metric for their unique characteristics, such as modes, activity patterns, and time-of-day preferences. The extended MEP metric framework can now be integrated to assess the customized mobility energy productivity of an individual.

Subject Areas: Metric systems; Productivity; Computer models; Bicycles; Automobiles; Employment; Travel patterns; Travel modes

Availability: Nag, A., Garikapati, V.M., Hou, T., Young, S., and Schroeder, A. (2020). “A Customizable Metric to Provide a Comprehensive Picture of the Mobility Potential of a Location.” *International Conference on Transportation and Development 2020*.
<https://ascelibrary.org/doi/10.1061/9780784483169.021>

5.31. Title: A Reform Agenda for the U.S. Department of Transportation

Author(s): DeGood, K.

Abstract: Blog.

Subject Areas: Federal infrastructure policy and programs; Climate change; Congestion; Traffic safety; Equal economic opportunity; Facilities maintenance

Availability: DeGood, K. (2020). "A Reform Agenda for the U.S. Department of Transportation." *Center for American Progress*.

<https://www.americanprogress.org/issues/economy/reports/2020/09/09/490158/reform-agenda-u-s-department-transportation/>

5.32. Title: Cross-State Comparison of Income and Vehicle-Ownership Effects on Household Mobility

Author(s): Chung, Y. and Wu, K.

Abstract: The study investigated the effects of income and vehicle ownership on household mobility (measured as trip frequency, miles traveled, and transit use) across states on the basis of the 2017 National Household Travel Survey. Bayesian multilevel (or random-effect) regression models were developed to include state-policy variables and overcome the concern of small sample sizes in some household strata. The analysis results indicated that household income levels were positively associated with vehicle ownership and mobility; however, extremely high-income households were not necessarily more likely than high-income households to own more vehicles. Owning at least one vehicle was the norm for most households, except under two conditions: when the household income was extremely low or when the state transit level of service (LOS) was high. Moreover, states with a high transit LOS exhibited similar household mobility as long as households had similar income levels and vehicle ownership rates; by contrast, household mobility in states with a low transit LOS was relatively varied. Fully equipped (at least one vehicle per driver) and car-light households (having more drivers than vehicles) exhibited a similar trip frequency number; however, the vehicle miles traveled of car-light households were significantly shorter, especially in states with a high transit LOS. These results suggest that the mobility benefits of being fully equipped are more limited than we had anticipated. Transit services can affect household vehicle ownership and mobility only when being provided above a certain LOS.

Subject Areas: Household income; Vehicle ownership; Household mobility; Bayesian multilevel regression; State policy variables; Transit level of service

Availability: Chung, Y. and Wu, K. (2020). "Cross-State Comparison of Income and Vehicle-Ownership Effects on Household Mobility." *Transportation Research Record: Journal of the Transportation Research Board*, 2674(11), pp. 813–826.
<https://doi.org/10.1177%2F0361198120947420>

5.33. Title: Toward Mobility Justice: Linking Transportation and Education Equity in the Context of School Choice

Author(s): Bierbaum, A.H., Karner, A., and Barajas, J.M.

Abstract: Problem, research strategy, and findings: Transportation equity research addresses questions of participation and planning process or the distribution of transportation’s benefits and burdens. This work largely elides issues related to youth and student travel. Existing work on school trip mode choice does not engage deeply with the equity implications of its findings. Education equity researchers identify the abstract notion of choice as equity enhancing but do not engage with the realities of disparate transportation resources and infrastructure. In this review essay, we articulate the contours of transportation equity, youth travel, and school choice research. We use emerging perspectives on “mobility justice” to frame the issues and provide vocabulary that can help bring education and transportation together in planners’ everyday work.

Takeaway for practice: A mobility justice framework encourages critical thought and action to address the root causes of inequities. Our conclusions make three contributions to research and practice: (1) challenging school district leaders to think about choice systems designed for access to schools, not just access to information about available options; (2) clarifying the broader implications of school choice by refusing to look away from the racial implications of forecasts; and (3) elucidating the need for a regional perspective.

Subject Areas: Accessibility; Education equity; Mobility justice; School choice; Transportation equity

Availability: Bierbaum, A.H., Karner, A., and Barajas, J.M. (2020). “Toward Mobility Justice: Linking Transportation and Education Equity in the Context of School Choice.” *Journal of the American Planning Association*. <https://doi.org/10.1080/01944363.2020.1803104>

5.34. Title: Opinion: State Must Subsidize E-Bike Purchases

Author(s): Carroll, R. and Francoeur, M.

Abstract: Blog.

Subject Areas: Bicycling; Democratic Socialists of America; New York State Energy Research and Development Authority (NYSERDA); E-bikes; Biking infrastructure; Rebate; Drive Clean program

Availability: Carroll, R. and Francoeur, M. (2020). "Opinion: State Must Subsidize E-Bike Purchases." *StreetsBlog NYC*. <https://nyc.streetsblog.org/2020/09/23/opinion-state-must-subsidize-e-bike-purchases/>

5.35. Title: A Pileup: Surface Transportation Market Failures and Policy Solutions

Author(s): Butner, M. and Noll, B.A.D.

Abstract: Surface transportation, the movement of people or goods in cars, trucks, trains, buses, and subways, in the United States is in need of reform. The corresponding greenhouse gas (GHG) emissions, local air pollution, traffic congestion, and traffic collisions from cars and trucks generate billions of dollars in economic harm every year. Each on these harms is caused by a market failure, where market forces alone lead to a sub-optimal outcome. Policymakers have an important role to play in such a setting, as well-designed policies can align incentives so as to mitigate the harms of market failures and increase the quality of life for constituents—all at a lower cost to society than the existing paradigm. This report serves as a reference for policymakers and stakeholders interested in reforming the transportation sector with a particular focus on road-way travel—the venue for nearly 99 percent of all miles traveled in 2018. This report begins by describing the major transportation market failures, including their determinates, magnitude, and incidence.

Guided by economic principles, this report summarizes the well-established economically efficient policy solutions and outlines several options for reforming surface transportation that account for technological, institutional, and political realities. Finally, this report highlights the unequal burden of market failures in the transportation sector and policy solutions that can help lead to a more just outcome.

Subject Areas: Climate and energy policy; Environmental justice; Consumer and healthcare protection; Surface transportation

Availability: Butner, M. and Noll, B.A.D. (2020). *A Pileup: Surface Transportation Market Failures and Policy Solutions*. Institute for Policy Integrity, New York University, New York City, NY. <https://policyintegrity.org/publications/detail/a-pileup>

5.36. Title: Pursuing Multiple Goals in Transportation Policy: Lessons from an Integrated Model

Author(s): Domeshek, M., Burtraw, D., and Palmer, K.

Abstract: The existential threat of climate change requires changes in our transportation networks nearly as dramatic as those that occurred a century ago with the advent of the internal combustion engine. These changes will likely include electrification of vehicle fleets, expansion of non-personal-vehicle travel, and changes in land use. This report is motivated by the efforts of 13 jurisdictions in the Northeast and Mid-Atlantic that are developing the Transportation and Climate Initiative (TCI) to pursue this transportation transformation. The initiative involves three essential policy elements: carbon pricing on transportation fuels, investment of carbon revenues to promote cleaner transportation, and coordinated regulations. Although climate change is the main driver of this initiative, these jurisdictions have multiple transportation-related goals they hope to achieve. Importantly, the success of these initiatives will hinge on their ability to address more immediate community-level transportation sector concerns, such as environmental quality, transportation access, and affordability.

This report is not an analysis of TCI, which is being coordinated in an extensive modeling project led by the Georgetown Climate Center. Rather, it is intended to inform the decision process that TCI states will pursue. We exercise a modeling platform representing many of the Northeast and Mid-Atlantic states in the TCI region. We examine a set of transportation policy options, including carbon pricing and the use of carbon revenues, and we look at their performance along metrics relevant to multiple goals—carbon reductions, criteria pollution reductions, vehicle-mile changes, transportation availability, and distribution of costs across households. The model is not intended to identify a single best policy or set of policies but rather to highlight opportunities and trade-offs among multiple transportation goals that can inform a collaborative transportation planning process. We do not address the role of regulations, the third essential element of TCI transportation policy.

Subject Areas: Transportation and Climate Initiative (TCI); Climate change; Environmental quality; Transportation access; Affordability; Transportation policy

Availability: Domeshek, M., Burtraw, D., and Palmer, K. (2020). *Pursuing Multiple Goals in Transportation Policy: Lessons from an Integrated Model*. Resources for the Future, Washington, DC. https://media.rff.org/documents/RFF_Report_20-16_v3.pdf

5.37. Title: Integrated Passenger Transport System in Rural Areas – A Literature Review

Author(s): Maretić, B. and Abramović, B.

Abstract: The planning and organization of public passenger transport in rural areas is a complex process. The transport demand in rural areas is often low, which makes it hard to establish and run a financially sustainable public transport system. A solution is integrated passenger transport that eliminates deficiencies and provides benefits for all participants in the public passenger transport process. This paper describes the impact of integrated passenger transport on mobility in rural areas and critically evaluates different literature sources. Integration of passenger transport in urban areas has been described in the context of rural areas, and the challenges of integration of public passenger transport specific to rural areas have been analyzed. Through the application in urban and rural areas, the planning of integrated and non-integrated passenger transport has been functionally analyzed. The analysis found an increase in the degree of mobility in the areas that use integrated passenger transport compared to the non-integrated one. This research of the literature review has identified the rural areas of mobility as under-researched. The mobility research can set up a more efficient passenger transport planning system in rural areas.

Subject Areas: Transport planning; Rural area; Public passenger transport; Integrated passenger transport; Mobility; Flexible transport service

Availability: Maretić, B. and Abramović, B. (2020). “Integrated Passenger Transport System in Rural Areas – A Literature Review.” *Promet-Traffic & Transportation*, 32(6), pp. 863–873. <https://doi.org/10.7307/ptt.v32i6.3565>

5.38. Title: An Empirical Analysis and Policy Implications of Work Tours Utilizing Public Transit

Author(s): Rafiq, R. and McNally, M.G.

Abstract: We analyze the complex travel behavior of workers who utilize public transit as part of their work tours (“transit commuters”). Here, complex travel behavior is defined in terms of tours, where a tour is defined as a sequence of trips and activities that begins and ends at the same location and a work tour contains at least one non-home, work activity. The objective of this study is to investigate how transit commuters link non-work activities as part of work tours under transit operational constraints. In particular, we identify dominant patterns of work tours made by transit commuters and analyze these tours using a set of activity-travel analytics and data from the 2017 National Household Travel Survey (NHTS). The primary insights are: (1) about 80 percent of work tours consist of 7 dominant patterns whereas the remaining 20 percent of tours demonstrate a total of 106 diverse and more complicated patterns; (2) half of the transit work tours are complex; (3) most simple tours are transit-only tours whereas most complex tours are multi-modal tours; and (4) transit use is more complex than the traditional home to work commute with a diverse set of choices at various stages of activity scheduling. While policies associated with public transit typically focus only on the journey to work, this study considers the complete set of trips starting and ending at home including intermediate non-work activity, which can provide insights for land use and transit-related policies to better accommodate the complex travel behavior of commuters who utilize transit.

Subject Areas: Complex travel behavior; Work tours; Public transit; Commuters; 2017 National Household Travel Survey (NHTS)

Availability: Rafiq, R. and McNally, M.G. (2020). “An Empirical Analysis and Policy Implications of Work Tours Utilizing Public Transit.” *Transportation Research Part A: Policy and Practice*, 142, pp. 237–259. <https://doi.org/10.1016/j.tra.2020.10.018>

5.39. Title: Cash for Clunkers 2.0: Targeting Scrappage Subsidies to Cut Costs

Author(s): Linn, J.

Abstract: Blog.

Subject Areas: Scrapping older vehicles; Scrappage programs; Cash for Clunkers program; Environmental benefits; Vehicle age

Availability: Linn, J. (2020). "Cash for Clunkers 2.0: Targeting Scrappage Subsidies to Cut Costs." *Resources*. <https://www.resourcesmag.org/common-resources/cash-clunkers-20-targeting-scrappage-subsidies-cut-costs/>

5.40. Title: Examining the Effects of King County Metro Carpool Incentive Fund

Author(s): Shen, Q., Wang, Y., and Gifford, C.

Abstract: How should public transit agencies deliver mobility services in the era of shared mobility? Previous literature has recommended that transit agencies actively build partnerships with mobility service companies from the private sector, yet public transit agencies are still in search of a solid empirical basis to help envision the consequences of doing so. This study presents an effort to fill this gap by studying a recent experiment of shared mobility public-private partnership. The carpool incentive fund program launched by King County Metro in the Seattle region. This program offered monetary incentives for participants who commuted using a dynamic app-based carpooling service. Through descriptive analysis and a series of logistic regression models, we found that the monetary incentive to encourage the use of app-based carpooling generated some promising outcomes while having distinct limitations. In particular, it facilitated the growth of carpooling by making carpooling a competitive commuting option for long-distance commuters. Moreover, our evidence suggested that the newly generated carpooling trips mostly substituted for single-occupancy vehicles, thus contributing to a reduction of regional VMT. The empirical results of this research not only will help King County Metro devise its future policies but also highlight an appealing alternative for other transit agencies in designing an integrated urban transportation system in the era of shared mobility.

Subject Areas: Shared mobility; Public-private partnership; App-based carpooling; Incentive fund; Transit agencies

Availability: Shen, Q., Wang, Y., and Gifford, C. (2020). *Examining the Effects of King County Metro Carpool Incentive Fund*. University of Washington, Seattle, WA.

<https://depts.washington.edu/pactrans/research/projects/examining-the-effects-of-king-county-metro-carpool-incentive-fund/>

5.41. Title: The Impact of Shared Mobility Options on Travel Demand

Author(s): Moudon, A.V., Lowry, M., Shen, Q., and Ban, X.

Abstract: Newly available shared mobility options are having a large impact on travel. Car- and bike-sharing and ride-hailing have become increasingly viable and attractive travel modes since they have been app-based and able to link riders and vehicles in real time and space. This project aimed to provide much needed information on how app-based shared mobility options are affecting travel behavior, and specifically how they are changing the parameters leading to mode choice and mode share. We used three available secondary data sets to explore whether shared mobility options substitute for or complement traditional modes. The first set of data came from the 2017 Puget Sound regional Household Travel survey. We found that car-sharing and ride-hailing substituted for household vehicle trips. Yet they induced more travel, which could add to traffic congestion but could also improve access to activities. Substitution effects with transit and biking, and additional walking, differed by day of week and commute status, suggesting that future research focus on the temporal and purpose characteristics of trips by shared mobility. The second set of data came from the Washington State Commute Trip Reduction (CTR) program. We found that in the immediate, CTR instruments used to collect data on commute trips could add questions about shared mobility options. In the long run, CTR employer and employee surveys could be redesigned to facilitate the evaluation of employers' TDM efforts. Also, deploying apps to support the commute trip could yield invaluable and timely information for transportation policy and research. The third set of data addressed "shared micro-mobility," an increasingly popular form of shared mobility that includes bicycles and scooters. Companies that offer this service have dispersed hundreds or even thousands of bicycles and scooters across individual cities for customers to use. A few companies provide real-time location data for their bikes and scooters via the Internet. We created a computer program to continuously "scrape" and archive such data. A technical description of the online database system was provided. A pilot-study served to analyze one year of data and to create trip generation models.

Subject Areas: Shared mobility; Micro-mobility; Car-sharing; Bike-sharing; Ride-hailing; Commute trip reduction; Travel surveys; Transportation demand management

Availability: Moudon, A.V., Lowry, M., Shen, Q., and Ban, X. (2020). *The Impact of Shared Mobility Options on Travel Demand*. University of Washington, Seattle, WA.
<http://hdl.handle.net/1773/46637>

5.42. Title: Mobile Device Location Data Reveal Human Mobility Response to State-Level Stay-at-Home Orders During the COVID-19 Pandemic in the USA

Author(s): Xiong, C., Hu, S., Yang, M., Younes, H., Luo, W., Ghader, S., and Zhang, L.

Abstract: One approach to delaying the spread of the novel coronavirus (COVID-19) is to reduce human travel by imposing travel restriction policies. Understanding the actual human mobility response to such policies remains a challenge owing to the lack of an observed and large-scale dataset describing human mobility during the pandemic. This study uses an integrated dataset, consisting of anonymized and privacy-protected location data from over 150 million monthly active samples in the USA, COVID-19 case data and census population information, to uncover mobility changes during COVID-19 and under the stay-at-home state orders in the USA. The study successfully quantifies human mobility responses with three important metrics: daily average number of trips per person; daily average person-miles travelled; and daily percentage of residents staying at home. The data analytics reveal a spontaneous mobility reduction that occurred regardless of government actions and a “floor” phenomenon, where human mobility reached a lower bound and stopped decreasing soon after each state announced the stay-at-home order. A set of longitudinal models is then developed and confirms that the states’ stay-at-home policies have only led to about a 5% reduction in average daily human mobility. Lessons learned from the data analytics and longitudinal models offer valuable insights for government actions in preparation for another COVID-19 surge or another virus outbreak in the future.

Subject Areas: Human mobility; COVID-19; Mobile device; Location data; Behavioral response

Availability: Xiong, C., Hu, S., Yang, M., Younes, H., Luo, W., Ghader, S., and Zhang, L. (2020). “Mobile Device Location Data Reveal Human Mobility Response to State-Level Stay-at-Home Orders During the COVID-19 Pandemic in the USA.” *Journal of the Royal Society Interface*, 17. <https://doi.org/10.1098/rsif.2020.0344>

5.43. Title: Reducing Vehicle Miles Traveled, Encouraging Walk Trips, and Facilitating Efficient Trip Chains Through Polycentric Development

Author(s): Ewing, R., Park, K., Sabouri, S., Lyons, T., Kim, K., Choi, D., Daly, K., Etmnani Ghasrodashti, R., Kiani, F., Ameli, H, Tian, G., Gaspers, D., and Hersey, J.

Abstract: Compact development can result in many benefits for communities and residents. Areas can connect compact developments through high-quality transportation options, creating a network of centers, or a “polycentric” region. This development pattern is very popular in Europe and is linked to significant benefits. Salt Lake County has organically developed several small centers, and with the right strategies could continue to fuel this kind of growth. The metropolitan planning organization (MPO) for the region, the Wasatch Front Regional Council, has been planning for polycentric development since the Wasatch Choice for 2040 Vision was released in 2010. Our research is aimed at exploring the academic literature and empirical evidence surrounding polycentric development, analyzing more than 120 regional transportation plans (RTP) to see how they promote polycentric development, defining types of centers in a hierarchy of centers, quantifying the transportation benefits of polycentric development, examining a case study of best practices, and, finally, outlining context-specific strategies for Salt Lake County and the Wasatch Front. The resulting report will enable the county and MPO to make informed decisions about its future growth patterns, set realistic—yet visionary—goals, and improve the overall health of its residents and communities.

Subject Areas: Polycentric development; Center; Polycentricity; Compact development; Regional transportation plan; Trip chaining

Availability: Ewing, R., Park, K., Sabouri, S., Lyons, T., Kim, K., Choi, D., Daly, K., Etmnani Ghasrodashti, R., Kiani, F., Ameli, H, Tian, G., Gaspers, D., and Hersey, J. (2020). *Reducing Vehicle Miles Traveled, Encouraging Walk Trips, and Facilitating Efficient Trip Chains Through Polycentric Development*. NITC-RR-1217, Transportation Research Education Center, Portland, OR. <https://dx.doi.org/10.15760/trec.255>

5.44. Title: An Equity Focused Study on the Trip Temporal Distributions of Vulnerable Road Users

Author(s): Wild, S.E.

Abstract: The United States is a megadiverse nation with a transportation system that, for decades, was designed to serve primarily able-bodied, white, male motorists. This legacy creates a situation in which varying socio-demographic groups experience the transportation system differently with contrasting safety, accessibility, and convenience outcomes. This project introduces descriptive statistics and binary logistic models that provide transportation professionals and policy makers with a quantitative understanding on how, why, and when certain socio-demographic groups are more likely to engage in a trip. This project provides tools to measure and understand the equity implications of a wide array of transportation policy decisions.

The binary logistic models presented predict the likelihood of a trip maker engaging on a weekday trip at a given time of day based on their race and ethnicity, gender, income level, preferred mode of transportation, age, and the purpose of their trip. In some instances, the interactions among these parameters were explored too. The models and descriptive statistics are based on the 2017 National Household Travel Survey data which includes over 900,000 datapoints and is weighted to adequately represent every socio-demographic group present in the U.S.

Subject Areas: Transportation system; Socio-demographics; Safety; Accessibility; Descriptive statistics; Binary logistic models; Transportation policy decisions

Availability: Wild, S.E. (2020). *An Equity Focused Study on the Trip Temporal Distributions of Vulnerable Road Users*. Portland State University, Portland, OR.
<https://doi.org/10.15760/CEEMP.53>

5.45. Title: Sustainable Mobility in the United States: Challenges & Opportunities from New Technologies

Author(s): Borade, S., Cohen, K., Davis, C., and Stockman, J.

Abstract: In 2018, the transportation sector accounted for more than 24% of carbon dioxide (CO₂) emissions globally¹ and became the largest contributor of greenhouse gases (GHGs) in the United States, accounting for 29% of emissions.² While this sector is crucial for the development of any economy, it also has a large role to play in any meaningful efforts to transition to a low-carbon future. Therefore, it is necessary to view the transportation sector through the lens of sustainability, which encompasses economically viability, as well as human and environmental health.

In this report, we define sustainable mobility as the application of technologies and management methods to promote better local and global environmental outcomes, while also remaining economically viable and bridging socioeconomic gaps in the transportation network. Our main goal is to examine the current status of sustainable mobility in the United States and the policies that shape its adoption and impacts on the environment and society and develop strategic recommendations to ensure that the adoption of new mobility technologies truly benefit people and the planet. In doing so, we have focused on three key mobility technologies, which have a potential to transform the transportation sector: battery powered electric vehicles (EVs), shared mobility technologies (specifically ride-hailing and micromobility), and autonomous vehicles (AVs).

We examine policies and programs at the federal, state, and local levels that focus on promoting and regulating these three technologies. Specifically, we chose case studies focusing on two states, California and Michigan, and two cities, Washington, DC, and Pittsburgh. We selected contrasting cases that represented differing policy approaches and stages of technology adoption. The state of California is at the forefront of technology innovation, as well as a leader in sustainability and climate efforts. Michigan, on the other hand, is the historic center of the US automotive industry, with a growing autonomous vehicle industry. As the capital of the United States, the city of Washington, DC boasts a robust and expanding transit network, along with a rapid growth in micromobility services. Pittsburgh, on the other hand, is a former industrial city that is becoming an emerging hub for AV technology and has taken a more collaborative approach to the integration of newer technologies.

Subject Areas: Ride-hailing; Micromobility; Sustainability; Adoption; Policy; Case study

Availability: Borade, S., Cohen, K., Davis, C., and Stockman, J. (2020). *Sustainable Mobility in the United States: Challenges & Opportunities from New Technologies*. Heinrich Böll Foundation, Washington, DC. <https://us.boell.org/sites/default/files/2020-12/Sustainable%20Mobility%20and%20Technology%20in%20the%20United%20States.pdf>

5.46. Title: Modernizing Demand-Responsive Transportation for the Age of New Mobility

Author(s): Lynott, J.

Abstract: America's inadequate demand-responsive transportation (DRT) infrastructure imposes a high cost on individuals, communities, the health care sector, and the economy. Demand-responsive services are transportation options that do not follow fixed routes or schedules; examples include dial-a-ride, *Americans with Disabilities Act* (ADA) complementary paratransit, taxis, app-based ridehailing, ride sharing, car sharing, bike sharing, and other technology-enabled transportation. Many public transit systems in small towns and rural areas operate on a demand-responsive basis as do most human services transportation providers. Demand-responsive services are critical for people who cannot drive or access regular public transportation, including people with disabilities; older people who are frail, ill, or have stopped driving; people with low incomes; and residents of rural areas. These services should be modernized to allow them to function as part of the emerging mobility ecosystem commonly called mobility-as-a-service (MaaS), in which users can personalize their trips and access via a smartphone or computer seamless, on-demand transportation. Until recently, the lack of adequate technology has been a major obstacle to this coordination. This paper from AARP Public Policy Institute (AARP PPI) shows how a new data specification called the transactional data specification for demand-responsive transportation (TDS), published in 2019 by the National Academies of Sciences, Engineering, and Medicine's Transportation Research Board, addresses this need.

Subject Areas: Technology-enabled transportation; Demand-responsive services; Public transit systems; Mobility-as-a-service

Availability: Lynott, J. (2020). *Modernizing Demand-Responsive Transportation for the Age of New Mobility*. AARP Public Policy Institute, Washington, DC.

<https://www.aarp.org/content/dam/aarp/ppi/2020/12/modernizing-demand-responsive-transportation.doi.10.26419-2Fppi.00121.001.pdf>

5.47. Title: The Mismeasurement of Mobility for Walkable Neighborhoods

Author(s): Lewis, S., Grande, E., and Robinson, R.

Abstract: The major US household travel surveys do not ask the right questions to understand mobility in Walkable Neighborhoods. Yet few subjects can be more important for sustainability and real economic growth based on all things of value, including sustainability, affordability, and quality of life. Walkable Neighborhoods are a system of land use, transportation, and transportation pricing. They are areas with attractive walking distances of residential and local business land uses of sufficient density to support enough business and transit, with mobility comparable to suburbia and without owning an auto.

Mobility is defined as the travel time typically spent to reach destinations outside the home, not trips among other destinations that are not related to the home base. A home round trip returns home the same day, a way of defining routine trips based on the home location.

Trip times and purposes, taken together, constitute travel time budgets and add up to total travel time in the course of a day. Furthermore, for Walkable Neighborhoods, the analysis focuses on the trips most important for daily mobility.

Mismeasurement consists of including trips that are not real trips to destinations outside the home, totaling 48 percent of trips. It includes purposes that are not short trips functional for walk times and mixing of different trips into single purposes, resulting in even less useful data. The surveys do not separate home round trips from other major trip types such as work round trips and overnight trips.

The major household surveys collect vast amounts of information without insight into the data needed for neighborhood sustainability. The methodology of statistics gets in the way of using statistics for the deeper insights we need. Household travel surveys need to be reframed to provide the information needed to understand and improve Walkable Neighborhoods. This research makes progress on the issue, but mismeasurement prevents a better understanding of the issue.

Subject Areas: Walkability; Walkable neighborhoods; Sustainability; Affordability; Quality of life; Trip times and purposes; Household surveys

Availability: Lewis, S., Grande, E., and Robinson, R. (2020). "The Mismeasurement of Mobility for Walkable Neighborhoods." *Mineta Transportation Institute Publications*.
<https://doi.org/10.31979/mti.2020.2060>

5.48. Title: Assessing the Benefits of Micromobility

Author(s): Martin, A.

Abstract: Advancements to battery technology has had spillover effects on many new modes of transportation in urban travel that extend beyond electric vehicles. In this paper, I examine the emission and congestion benefits attributable to fewer gasoline vehicle use due to the substitution to dockless, micromobility electric scooters. To estimate the potential demand of this new mode, a discrete choice, random utility framework is employed to estimate existing mode demand and its displacement effects. I focus on the importance of local factors in assessing pollution and congestion and the geographic heterogeneity of damages. I find that the full adoption of short distance, electrified scooters in the major 52 U.S. cities can create a positive externality of \$2.86 million in environmental benefits and \$3.37 billion in congestion benefits annually under general equilibrium estimation and I document the local heterogeneity in benefits across all 52 cities. This paper shows that highly dense urban cities with high marginal congestion, large damages from emissions and a clean electric grid, such as Los Angeles, California, imply lots of environmental and congestion benefits from switching to electric scooters as compared to less dense, less congested cities, with lower emission damages, and a less clean electric grid that draws on power from coal powered plants such as Memphis, Tennessee.

Subject Areas: Micromobility; Urban travel; Emission and congestion benefits; Random utility framework; Displacement effects; Geographic heterogeneity

Availability: Martin, A. (2020). *Assessing the Benefits of Micromobility*. Dissertation, University of North Carolina at Chapel Hill, Chapel Hill, NC.

http://www.abemartincv.com/teaching_materials/research_papers/micromobility.pdf

Chapter 6. Special Population Groups

6.1. Title: Using the 2017 National Household Travel Survey Data to Explore the Elderly's Travel Patterns

Author(s): Tawfik, A. and Sadeghvaziri, E.

Abstract: Transportation mobility is a critical element of the elderly's quality of life. The rapid growth of the older population increases the importance of investigating the elderly's travel behavior. The elderly's mobility is often limited due to their physical abilities and financial constraints. By using data from the 2017 National Household Travel Survey (NHTS), the goal of this study is to explore the mobility patterns of the American elderly. The elderly's preference of going out their home is studied among different racial groups. It is hypothesized that the presence of another elderly companion in the household decreases immobility preference significantly. It is also hypothesized that the African American elderly are more likely to be immobile for a week or more than those from the other racial groups. Another hypothesis is that immobility is affected due to medical conditions and physical constraints. Therefore, it is recommended to increase the public transportation quality where there is a huge elderly population who have difficulties in driving their private vehicles. The findings of this study are compared with those from the previous studies that used the 2009 NHTS data. Therefore, this study's findings are valuable for the transportation planner by providing additional information about the elderly's travel patterns.

Subject Areas: Older population; Mobility patterns; Race

Availability: Tawfik, A. and Sadeghvaziri, E. (2020). *Using the 2017 National Household Travel Survey Data to Explore the Elderly's Travel Patterns*. Transportation Research Board 99th Annual Meeting, Washington, DC.

<https://annualmeeting.mytrb.org/OnlineProgramArchive/Details/13617>

6.2. Title: Has the Younger Population's Vehicle Availability Changed Over the Years?: A Comparative Analysis of the Recent National Household Travel Surveys

Author(s): Adanu, E., Liu, J., McNamara, M., Penmetsa, P., Lidbe, A., Li, X., and Hainen, A.

Abstract: The travel patterns of young people (18–25) are diversified from generation to generation. With the development of the built environment, such as land use, and the application of new technologies, such as shared driving and online shopping, young people's travel behaviors have changed dramatically. To better understand how and why those changes happen to the young population in the last few decades, the National Household Travel Survey data (2001, 2009, and 2017) have been utilized to investigate vehicle availability among young people as well as their travel behaviors or patterns. Latent class logistic regression models are employed to explore the correlation of various factors (trip characteristics, regional and household characteristics, and demographics) with vehicle availability. The results show that generally, among the associated factors, longer trip distance, higher income, and larger household size are likely to contribute to higher vehicle availability among young people. However, those correlations are observed to be heterogeneous in three generations, which leads to the construction of three different models for 2001, 2009, and 2017 for detailed comparison. The marginal effects of various factors on vehicle availability also varies across three survey years. The signs of the marginal effects indicate good rational behind each factor. The results offer implications for vehicle manufacturer decision makers to better target the younger generation and for policymakers to develop strategies to create a better transport environment where younger people can take initiatives to reduce vehicle availability and use more sustainable transport mode such as transit, walking, or biking.

Subject Areas: Travel pattern; Young people; Vehicle availability; Latent class logistic regression models; Built environment; New technologies

Availability: Adanu, E., Liu, J., McNamara, M., Penmetsa, P., Lidbe, A., Li, X. and Hainen, A. (2020). *Has the Younger Population's Vehicle Availability Changed Over the Years?: A Comparative Analysis of the Recent National Household Travel Surveys*. Transportation Research Board 99th Annual Meeting, Washington, DC.
<https://annualmeeting.mytrb.org/OnlineProgramArchive/Details/13909>

6.3. Title: Understanding Older Adults' Travel Characteristics and Immobility: Findings from 2017 National Household Travel Survey Data

Author(s): Jang, S. and Lee, G.R.

Abstract: The U.S. Census Bureau (2018) predicts that the number of older adults aged 65 and over will increase significantly by the year 2030. Given this projection, the immobility of older adults is likewise a growing issue, one in need of substantive solutions. In an effort to identify immobility characteristics in U.S. older adults, this study utilized a generalized ordinal logit model (GOLM) to analyze 2017 National Household Travel Survey (NHTS) data. A GOLM was used to explore how several independent variables, which have been tested in previous research, affected older adults' immobility. As expected, relationships were observed between immobility and certain demographic factors, including educational attainment, household size, household income, and vehicle ownership. Also, the study demonstrated a significant relationship between immobility and medical conditions that resulted in complete driving cessation. Notably, frequent use of paratransit was associated with higher short-term mobility. This suggests that the availability of alternative transportation is one of the most important ways to maintain elderly individuals' mobility.

Subject Areas: Mobility; Older population; Demographic factors; Generalized ordinal logit model (GOLM); Paratransit

Availability: Jang, S. and Lee, G.R. (2020). *Understanding Older Adults' Travel Characteristics and Immobility: Findings from 2017 National Household Travel Survey Data*. Transportation Research Board 99th Annual Meeting, Washington, DC.

<https://annualmeeting.mytrb.org/OnlineProgramArchive/Details/14062>

6.4. Title: A Before and After Evaluation of Shared Mobility Projects in the San Joaquin Valley

Author(s): Drake, C., Song, J.W., and Rodier, C.

Abstract: In rural areas, cost-effective transit service is challenging to provide due to greater distances, lower population densities, and longer travel times than in cities. Rural transit agencies often struggle to meet farebox recovery ratios. Per-trip costs, particularly for dial-a-ride services, can range from \$50 to \$100. The people who rely on public transit contend with infrequent and slow service. Access to a personal car is essential to the quality of life for most residents, from work to health care, education, healthy food, and other basic services. However, keeping two (or sometimes even one) car in reliable working order can consume a significant share of the household budget for low-income families. New technology services may offer cost-effective and cleaner mobility options for residents of rural communities.

In spring 2018, California cap and trade revenues and local matching funds supported a set of pilot projects to provide affordable transportation options for residents of rural disadvantaged communities in the San Joaquin Valley:

1. **Electric Vehicle (EV) Carsharing:** The first project is a battery electric vehicle (BEV) carsharing and ridesharing program. This pilot infrastructure for 24 BEVs, initially located in affordable housing complexes and, later in other strategic locations in three disadvantaged rural communities of Tulare and Kern counties. The goal is to provide a financially viable model of a low-cost, carbon-neutral alternative to private auto ownership and auto travel in rural communities.
2. **Volunteer Ride-Hailing:** The second project is a volunteer-ride hailing service that serves people in rural disadvantaged communities around Lathrop, Manteca, Escalon, and Riverbank who cannot get to essential destinations by available transit services or need access to a transit stop. The volunteer ride-hailing service uses a back-office system and a driver-routing application specifically designed to facilitate pooling of customer trips and lower operating costs for volunteer transportation organizations.
3. **MaaS Application:** The third project introduces mobility-as-a-service to San Joaquin and Stanislaus counties. This project creates a smartphone application that aggregates the demand and supply of available services (i.e., transit, dial-a-ride, volunteer ride-hailing) to improve cost-effective mobility choices for all.

In this project, both stated and measured data will be used to evaluate the EV carsharing program, volunteer ride-hailing program and the MaaS application. The data will be collected via before and after surveys, trip surveys, and service use data. An anonymous identifier will link survey responses and service use data. The pilots will launch at the end of March 2019, and project funding for the evaluation will end March 30, 2020. This project, “A Before and After Evaluation of Shared Mobility Projects in the San Joaquin Valley,” will collect data up until the end of the currently funded evaluation periods to conduct a full pilot evaluation that integrates all stated and observed data using statistical methods to understand the following effects of the program on:

- Change vehicle ownership (shed, deferred, and postponed);
- Change in the use of personal vehicles;
- Change in frequency and use of mode; and
- Unmet travel demand (transit, destinations, purpose).

Subject Areas: Automobile ownership; Before and after studies; Electric vehicles; Evaluation and assessment; Mobility; Mode choice; Pollutants; Ridesourcing; Rural areas; Travel demand; Vehicle sharing

Availability: Drake, C., Song, J.W., and Rodier, C. (2020). *A Before and After Evaluation of Shared Mobility Projects in the San Joaquin Valley*. The National Academies of Sciences, Engineering, and Medicine, Washington, DC. <https://trid.trb.org/View/1652814>

6.5. Title: How People Move: Analyzing the Travel of Vulnerable Populations in Los Angeles

Author(s): Brozen, M.

Abstract: People differ fundamentally in their ability to use or access different transportation systems and modes. Because of these fundamental differences, particular groups experience disparities in their mobility and access to opportunities. As planning agencies in Los Angeles County seek to address transportation equity in their decision-making, there is a need to have a better understanding of these disparities. In response, this project seeks to leverage California's investment in quality transportation data from the 2017 National Household Travel Survey California Add-on and the UC Berkeley Transportation Injury Mapping System. Specifically, this project will examine travel patterns (trips and miles traveled per day, mode split, trip purpose, etc.) by different vulnerable groups (women, youth, older adults, people with disabilities, and low-income families), and the interconnections between these characteristics. Given local, regional, and statewide attention on ending traffic fatalities, I will connect these travel patterns to collision and fatality rates by gender, age, and transportation mode. This project will be completed in four tasks and the goal of the project is to discern the travel patterns of vulnerable groups in Los Angeles County and relate these patterns to traffic safety exposure risks.

Subject Areas: Safety and human factors; Security and emergencies; Society; Transportation; Vehicles and equipment; Fatalities; Travel patterns; Vulnerable road users

Availability: Brozen, M. (2020). *How People Move: Analyzing the Travel of Vulnerable Populations in Los Angeles*. The National Academies of Sciences, Engineering, and Medicine, Washington, DC. <https://trid.trb.org/View/1709506>

6.6. Title: Are Young Americans Carless Across the United States? A Spatial Analysis

Author(s): Liu, J., Nambisan, S., Li, X., and Fu, X.

Abstract: This study uses the National Household Travel Survey (NHTS) data to investigate the most recent correlation of vehicle ownership among young Americans. This study performs a spatial analysis to examine the potentially non-stationary relationships between sociodemographic factors and vehicle ownership. Consistent with previous studies, modeling results from this study showed that young Americans are more likely to be carless than older adults. The spatial analysis answers the research question—in which regions(s) young Americans are even less likely to have a car. The results highlighted the Northeast States for the young American's extra-lower vehicle ownership if the influences of all other factors are held constant. The cost of living and availability of transportation alternatives are possible reasons. Further, this study built separate models for young adults (25–34 years old) and three older age groups. The vehicle ownership correlation within the young adults are found to be generally consistent with the correlation among all adults. Among young adults, vehicle ownership is still significantly related to their gender, educational attainment, employment status, household characteristics, and travel demand. However, young adults' vehicle ownership seems to be less sensitive to household income than mid-age adults' (35–44 years old), perhaps because young people may not perceive financial stress such as child support and mortgage. This study contributes by using a spatial analysis approach to reveal the non-stationary correlates of vehicle ownership. This approach is useful for future travel behavior research and transportation policy considering the spatial heterogeneity.

Subject Areas: Vehicle ownership; Young Americans; Spatial analysis

Availability: Liu, J., Nambisan, S., Li, X., and Fu, X. (2020). "Are Young Americans Carless Across the United States? A Spatial Analysis." *Transportation Research Part D: Transport and Environment*, 78. <https://doi.org/10.1016/j.trd.2019.11.026>

6.7. Title: School Buses Pricey to Replace, Maintain

Author(s): Shriver, S.

Abstract: Blog.

Subject Areas: School buses; Cost of operation and maintenance; School bus ridership; Fuel options; Demand for school bus drivers

Availability: Shriver, S. (2020). "School Buses Pricey to Replace, Maintain." *The Lima News*. <https://www.limaohio.com/news/394994/school-buses-pricey-to-replace-maintain>

6.8. Title: America at a Glance: How Do Working-Age Adults With Travel-Limiting Disabilities Get Around?

Author(s): Research and Training Center on Disability in Rural Communities

Abstract: Using data from the 2017 National Household Travel Survey, this research brief explores travel behaviors and characteristics of rural and urban people with disabilities.

Summary Findings: Rural people report a slightly higher rate of travel-related disability and are also more likely to report being a driver. Urban people with disabilities are more likely to use other transportation options, like special transit services, reduced-fare taxi, or public transit. Overall, people with disabilities who are drivers report higher rates of employment and lower rates of poor health.

Subject Areas: Rural and urban; People with disabilities; Public transit; Driver; Employment; Health

Availability: Research and Training Center on Disability in Rural Communities. (2020). *America at a Glance: How Do Working-Age Adults With Travel-Limiting Disabilities Get Around?*

University of Montana Rural Institute, University of Montana, Missoula, MT.

https://scholarworks.umt.edu/cgi/viewcontent.cgi?article=1065&context=ruralinst_independent_living_community_participation

6.9. Title: Material Hardship among Lower-Income Households: The Role of Liquid Assets and Place

Author(s): Despard, M., Taing, V., Weaver, A., Roll, S., and Grinstein-Weiss, M.

Abstract: Lower-income households are at risk for material hardship, particularly amidst the economic fallout of COVID-19. Where one lives (e.g., suburb or small town) may affect this risk due to variable access to resources, yet the evidence is mixed concerning the influence of place. We used a pooled national cross-sectional sample of 66,046 lower-income tax filers to examine differences in material hardship in rural, small town, micropolitan, and urban areas. Controlling only for standard demographic variables, hardship risk appears higher in non-urban areas, yet these differences disappear after controlling for financial characteristics such as liquid assets and home ownership.

Subject Areas: Material hardship; Urbanicity; Housing hardship; Food insecurity; Low- and moderate-income household

Availability: Despard, M., Taing, V., Weaver, A., Roll, S., and Grinstein-Weiss, M. (2020). "Material Hardship among Lower-Income Households: The Role of Liquid Assets and Place." *Social Policy Institute Research*, 33. <https://doi.org/10.7936/sm16-ap78>

6.10. Title: Exploring Motivations and Barriers for Long-Distance Trips of Adult Women Vermonters

Author(s): Ullman, H. and Aultman-Hall, L.

Abstract: Available data on long-distance travel, both quantitative and qualitative, are limited, including measures of relative accessibility to intercity destinations and its role in overall wellbeing. Moreover, existing travel data only include realized travel, not unmet need. Twenty-four original semi-structured interviews were conducted with women aged 25 years or older in Vermont to better understand the motivations and barriers of long-distance travel that cannot be fully explored in quantitative surveys. The relationship between travel, well-being, and social networks is also considered. Those interviewed indicated long-distance travel played a significant role in their lives by facilitating visits to friends and family, leisure, and breaks from routine as well as fulfilling personal obligations. As expected, long-distance travel was limited by cost as well as both household and work obligations. Physical limitations were noted as a barrier, but the number of people raising fears about travel, being away from home, and travel logistics was unexpected. The interviews also revealed intercity travel as a symbol of social status, which, in turn, created negative impacts for some. Latent demand for long-distance travel was common and larger than expected among the interviewees. Finally, results pointed to overlap between work and personal travel as well as a sense of obligation. While long-distance travel is often considered discretionary, this study suggests intercity non-discretionary personal trips as well as unmet demand merit future attention in both surveys and qualitative research.

Subject Areas: Travel barriers; Long-distance travel; Well-being; Interviews; Intercity travel; Social networks

Availability: Ullman, H. and Aultman-Hall, L. (2020). “Exploring Motivations and Barriers for Long-Distance Trips of Adult Women Vermonters.” *Travel Behaviour and Society*, 21, pp. 37–47. <https://doi.org/10.1016/j.tbs.2020.05.007>

6.11. Title: Where Do the Poor Live in Cities? Revisiting the Role of Public Transportation on Income Sorting in US Urban Areas

Author(s): Nelson, E.

Abstract: Glaeser et al. (2008) argue that the relative distribution of poor and rich households (HHs) in American cities is “strongly” explained by the spatial location of the cities’ public transportation (PT) networks. Among their claims: (1) the broad distribution of poor and rich HHs in the typical American city is consistent with a basic monocentric city model that includes commute technology speeds, (2) poor commuters will overwhelmingly transition from commuting by PT to car if they experience a substantial increase in their HH’s income, and (3) areas in American cities that receive new PT infrastructure become poorer over time. Using 2017 data I find empirical evidence that partially or wholly contradicts these three claims. First, as of 2017, the observed concentration of poor HHs in the inner city and rich HHs in the suburbs of U.S. smaller cities cannot be explained by monocentric model that includes commute speeds. Second, as of 2017, significant increases in poor HH incomes were not expected to lead to a “massive shift” towards car commuting in these HHs; most of these poor workers commute by car already. Third, using data from four cities that expanded their light-rail and rapid-bus network in the early 2000s, I find that neighborhoods surrounding new light-rail or rapid-bus stations either saw little change in their income patterns or became slightly richer after station opening. In conclusion, as of 2017, the spatial distribution of HH incomes within American urban areas is not as intricately linked to the location of PT networks as Glaeser et al. (2008) would have us believe. As an addendum to the analysis, I add some thoughts on how the COVID-19 pandemic might affect commuting behavior and income distributions within urban areas over the next decade.

Subject Areas: Monocentric city model; Public transportation; Commuting; Household income distribution; Mode choice; Random utility model; Event study; Light rail

Availability: Nelson, E. (2020). “Where Do the Poor Live in Cities? Revisiting the Role of Public Transportation on Income Sorting in US Urban Areas.” *Economics Department Working Paper Series, 16*. <https://digitalcommons.bowdoin.edu/econpapers/16>

6.12. Title: Socio-economic Factors and Children’s Walking to and from School

Author(s): Shokoohi, R., Hanif, N.R., and Melasutra, M.D.

Abstract: Walking to school is a healthy mode of travel, yet most children do not start their day with this activity. The cross-sectional survey used a sample of parents of children (9–12 years old) from public primary schools in Tehran to examine if socio-economic factors moderate the relationship between parental perception of traffic safety and children travel to school. Results from multinomial logistic models showed that the numbers of cars in a household and household income are the two main moderators. The findings also showed parental perceptions of traffic safety vary across different socio-economic status areas.

Subject Areas: Socio-economic factors; Children’s travel behavior; Walking to school; Income groups

Availability: Shokoohi, R., Hanif, N.R., and Melasutra, M.D. (2018). “Socio-economic Factors and Children’s Walking to and from School.” *Journal of ASIAN Behavioural Studies*, 3(7), pp. 93–100. <https://doi.org/10.21834/jabs.v3i7.262>

6.13. Title: Person-Based Micro-Simulation Demand Model for National Long-Distance Travel in the U.S.A.

Author(s): Zhang, L., Lu, Y., Ghader, S., Carrion, C., Asadabadi, A., and Yang, D.

Abstract: As the Nation and various States engage in funding transportation infrastructure improvements to meet future long-distance passenger travel demand, it is imperative to develop effective and practical modeling methods for analysis of long-distance passenger travel. Evaluating national-level infrastructure improvements requires a reliable analysis tool to model the demand for long-distance travel. The national travel demand model presented in this paper implements a person-level, tour-based, micro-simulation approach for modeling individuals' long-distance or national activities in the United States. This paper reviews the model framework, explains the model calibration, and presents applications of the model for policy evaluation and demand prediction. The model was estimated using the latest long-distance travel survey in the United States, which is the 1995 American Travel Survey. As the estimation data are old, and no new long-distance travel survey with appropriate sample size is available to re-estimate the model, model calibration is the solution used to update the model and make it capable of capturing up-to-date travel patterns. Calibrating such a large-scale model can be challenging because each calibration iteration is very costly. This paper describes the calibration effort conducted on the national long-distance micro-simulation model to showcase how a large-scale travel demand model can be calibrated efficiently. A fuel price scenario is analyzed to show how the national travel demand will change under a national fuel price increase scenario in the future year 2040. Another scenario analysis corresponding to construction of high-speed rail (HSR) is conducted to observe the effects of adding a HSR system to the northeast corridor on travel demand from a national perspective.

Subject Areas: Long-distance passenger travel; Infrastructure; Micro-simulation; Calibration; Travel demand; High-speed rail

Availability: Zhang, L., Lu, Y., Ghader, S., Carrion, C., Asadabadi, A., and Yang, D. (2020). "Person-Based Micro-Simulation Demand Model for National Long-Distance Travel in the U.S.A." *Transportation Research Record: Journal of the Transportation Research Board*, 2,674(6), pp. 297–309. <https://doi.org/10.1177/0361198120919119>

6.14. Title: Resources to Access Health Care for Low Socioeconomic Status Youth Athletes

Author(s): Walsh, S.

Abstract: Background: Approximately 60 million youth participate in organized sports, with 13.5 million receiving care for sports-related injuries each year. Most youth sports organizations do not have readily accessible health care resources, relying on parents and guardians to manage injuries. However, a majority of parents and guardians are untrained in appropriate management of injuries; therefore, there is a need for understanding the availability of health care resources within the community. Resources necessary to access health care include health services, health insurance, transportation, and communication. Barriers to these resources may affect lower socioeconomic status family's accessibility to care.

Purpose: Investigate the resources available to access health care and identify barriers to accessibility across varying levels of socioeconomic status youth athletes.

Methods: A total of 192 parents and guardians were recruited from two parks and recreation departments. Participants completed a 37-item survey measuring the four resources to health care. Questions were individually analyzed using percentages and frequencies, then grouped according to the respective resource. Kruskal-Wallis tests were calculated to examine differences across socioeconomic status (SES).

Results: The sample was comprised of 24% low SES, 35.9% middle SES, and 40.1% high SES. Participants were found to use an array of health care resources including health services, health insurance, transportation, and communication. Statistically significant differences existed between SES groups for health services ($H(2) = 11.00, p = 0.004$) and transportation ($H(2) = 14.39, p = 0.001$), with low SES having fewer resources than middle and high SES. No significant differences were found between SES and health insurance ($H(2) = 4.49, p = 0.11$) or communication ($H(2) = 3.86, p = 0.15$).

Conclusion: Lower SES participants experienced barriers to accessing health care resources, specifically health services and transportation, compared to higher SES participants. Parents and guardians of varying levels of SES did not experience many difficulties with health insurance or communication between themselves and health care providers for their child. Our findings are consistent with previous literature regarding barriers to accessing health care. Future research should examine effective ways to improve resources available within rural communities for youth athletes in order to provide equitable access to health care.

Subject Areas: Medical care; At-risk; Sports; Guardians; Health care resources; Health services; Health insurance; Transportation; Communication; Rural communities

Availability: Walsh, S. (2020). "Resources to Access Health Care for Low Socioeconomic Status Youth Athletes." Master's Thesis, Georgia Southern University, Statesboro, GA.
<https://digitalcommons.georgiasouthern.edu/etd/2079>

6.15. Title: To Drive or Not to Drive: Driving Cessation Amongst Older Adults in Rural and Small Towns in Canada

Author(s): Hansen, S., Newbold, K.B., Scott, D.M., Vrkljan, B., and Grenier, A.

Abstract: Driving cessation, often due to health-related changes, can be a particularly challenging and troublesome transition in older adulthood that can lead to social isolation. While policymakers have long recognized the potential impact of an aging population on Canada's health care and national pension plans, the transportation needs of older adults have received relatively less attention. For older adults residing in small towns and rural areas who rely, more often than not, on the personal automobile, there is usually limited or no access to public transportation. For policymakers to respond effectively to the transportation needs of an aging population, particularly those living in rural areas, the first step is to understand the travel behaviors of older adults living in such areas, particularly as they approach the transition when they will cease to drive. This paper reports on qualitative research exploring the driving-related challenges and needs faced by older adults in small towns and rural areas near Hamilton, Ontario, Canada. Results revealed four major themes: lack of transportation options in rural areas, changes in driving behaviors, the lack of planning for driving cessation, and the social isolation that comes from the loss (or potential loss) of one's driver's license.

Subject Areas: Older adults; Driving cessation; Social isolation; Transportation demand; Rural; Travel behaviors

Availability: Hansen, S., Newbold, K.B., Scott, D.M., Vrkljan, B., and Grenier, A. (2020). "To Drive or Not to Drive: Driving Cessation Amongst Older Adults in Rural and Small Towns in Canada." *Journal of Transport Geography*, 86. <https://doi.org/10.1016/j.jtrangeo.2020.102773>

6.16. Title: What Commute Patterns Can Tell Us About the Supply of Allied Health Workers and Registered Nurses

Author(s): Dahal, A., Skillman, S.M., Patterson, D.G., and Frogner, B.K.

Abstract: Information on the available supply of workers in a local job market is important when determining whether there are qualified workers to fill health care jobs in demand. The American Community Survey (ACS), a publicly available annual survey of over 3.5 million households conducted by the U.S. Census Bureau, has been a regular source of information for mapping the geographic distribution of a wide range of occupations, describing the time, duration, and distance of workers' commutes, and identifying common forms of transportation for commuting. In this study, we explore what the ACS can tell us about commuting patterns among selected allied health occupations and registered nurses (RNs) as well as how these patterns may inform discussions of health workforce supply.

Subject Areas: Occupation; Health care occupations; Registered nurses; Commuting pattern; Health workforce supply

Availability: Dahal, A., Skillman, S.M., Patterson, D.G., and Frogner, B.K. (2020). *What Commute Patterns Can Tell Us About the Supply of Allied Health Workers and Registered Nurses*. Center for Health Workforce Studies, University of Washington, Seattle, WA.

<https://depts.washington.edu/fammed/chws/publications/what-commute-patterns-can-tell-us-about-the-supply-of-allied-health-workers-and-registered-nurses/>

6.17. Title: Assessment of the Travel Behaviour of a University Residential Community: Case Study of the Federal University of Technology Akure, Ondo State, Nigeria

Author(s): Aderinlewo, O.O.

Abstract: A comprehensive transportation survey was carried out in which the number of each mode of transportation was obtained by means of administering questionnaires to students and staff of the Federal University of Technology Akure (FUTA). The travel characteristics were obtained in terms of travel mode, number of times, and duration to commute to/within FUTA campus per week and mode of transportation at different times of the day. It was determined that students mostly walk to school. A total of 100 students and staff participated in the survey. Descriptive analyses of the responses were presented to describe the dataset with numbers and graphs. The analysis shows the frequencies of the demographic factors (age, gender, place of residence, and academic status) in which male respondents were more than female respondents. A total of 60% of the respondents were between 20 and 25 years old. The modes of transportation to school were identified in the survey with walking being the most used mode of transportation (52%) and motorbike being the least used mode (8%). The relationship between mode of transportation and travel times within FUTA campus was also shown; car (25%) is the most used mode of transportation to commute within FUTA campus. A multinomial logistic regression model was developed to determine the travel mode choice of the students and staff to/within FUTA campus. The result shows that travel distance is a major factor in choosing a travel mode and that people prefer to travel by car over longer distances to reduce travel time.

Subject Areas: Transportation; Travel mode; Commute; Demographic factors; Multinomial logistic

Availability: Aderinlewo, O. O. (2020). "Assessment of the Travel Behaviour of a University Residential Community: Case Study of the Federal University of Technology Akure, Ondo State, Nigeria." *International Journal of Advanced Academic Research*, 6(5).
<https://www.ijaar.org/articles/v6n5/ste/ijaar-ste-v6n5-may20-p6.pdf>

6.18. Title: Improving Transportation Impact Analyses for Subsidized Affordable Housing Developments: A Data Collection and Analysis of Motorized Vehicle and Person Trip Generation

Author(s): Currans, K.M., Abou-Zeid, G., Clifton, K.J., Howell, A., and Schneider, R.

Abstract: Transportation impact analyses begin with a trip generation estimation process—estimating motorized vehicle and person trip counts coming and going from the proposed site. Data commonly used is often insensitive to urban contexts (such as employment densities) and socioeconomic conditions. This insensitivity results in sometimes exaggerated estimates, an increase associated transportation impact fees, and a need for additional mitigation of impacts which may further hinder land development. In this study, we collected and analyzed person and motorized vehicle count data from 26 affordable housing developments in Los Angeles and San Francisco. Counts were regressed upon site and built environment characteristics known to influence site-level travel behavior (e.g., parking supply and employment density), and regressions were validated using externally collected data. The findings indicate the average square footage of dwelling units, parking ratios, and nearby retail employment densities to be important predictors. The findings also indicate that increasing the parking supply from one space to two for each dwelling unit will result in a significant predicted increase of approximately 0.26 and 0.18 motorized vehicle trips per dwelling unit for AM and PM peak periods, respectively. These findings reiterate the need for trip generation methodologies sensitive to the built environment and socio-demographics.

Subject Areas: Trip generation; Transportation impact analysis; Motorized vehicle trips; Person trips; Affordable subsidized housing; Parking supply

Availability: Currans, K.M., Abou-Zeid, G., Clifton, K.J., Howell, A., and Schneider, R. (2020). “Improving Transportation Impact Analyses for Subsidized Affordable Housing Developments: A Data Collection and Analysis of Motorized Vehicle and Person Trip Generation.” *Cities*, 103. <https://doi.org/10.1016/j.cities.2020.102774>

6.19. Title: Rural Transportation Conference Participants' Opinions and Concerns Pertaining to Transit for Older Adults

Author(s): Mjelde, J.W., Dudensing, R.M., Battista, G., Brooks, J., Carrillo, M., Counsil, B., Giri, A., Kim, M., and Pyrialakou, V.D.

Abstract: Mobility remains a vital part of the well-being of rural-living older adults and transportation-disadvantaged persons. This study seeks to identify research and policy needs related to rural transit for older people and the transportation disadvantaged. To obtain this goal, the multidisciplinary study team conducted two activities as part of a 2016 rural transportation conference: a survey of conference attendees and open discussion to elicit additional information. Results suggest the attendees felt the need for rural transit for older adults would continue to increase with public and private funding being critical issues. Respondents had similar opinions about challenges and opportunities across socioeconomic characteristics, including age, gender, political leaning, rurality, and organizational function. This suggests an opportunity to mobilize support for public transportation.

Subject Areas: Transportation; Rural areas; Mobility; Older adults; Stakeholders' opinions; Disadvantaged

Availability: Mjelde, J.W., Dudensing, R.M., Battista, G., Brooks, J., Carrillo, M., Counsil, B., Giri, A., Kim, M., and Pyrialakou, V.D. (2020). "Rural Transportation Conference Participants' Opinions and Concerns Pertaining to Transit for Older Adults." *Sage Open*, 10(2).
<https://doi.org/10.1177%2F2158244020924036>

6.20. Title: Neighbourhood Residential Density and Childhood Obesity

Author(s): Zou, Y., Ma, Y., Wu, Z., Liu, Y., Xu, M., Qiu, G., Vos, H., Jia, P., and Wang, L.

Abstract: Residential density is considered an important attribute of the built environment that may be relevant to childhood obesity. However, findings remain inconclusive, and there are no reviews yet on the association between residential density and childhood obesity. This study aimed to systematically review the associations between residential density and weight-related behaviors and outcomes. A comprehensive literature search was conducted using the Cochrane Library, PubMed, and Web of Science for articles published before January 1, 2019. A total of 35 studies conducted in 14 countries were identified, including 33 cross-sectional studies, 1 longitudinal study, and 1 containing both study designs. Residential density was measured by Geographic Information Systems in 28 studies within a varied radius from 0.25 to 2 km around the individual residence. Our study found a general positive association between residential density and physical activity (PA); no significant associations were observed. This study provided evidence for a supportive role of residential density in promoting PA among children. However, it remained difficult to draw a conclusion between residential density and childhood obesity. Future longitudinal studies are warranted to confirm this association.

Subject Areas: Adolescent; Built environment; Child; Obesity; Overweight; Physical activity; Population density; Residential density

Availability: Zou, Y., Ma, Y., Wu, Z., Liu, Y., Xu, M., Qiu, G., Vos, H., Jia, P., and Wang, L. (2020). "Neighbourhood Residential Density and Childhood Obesity." *Obesity Reviews*, pp. 1–8. <https://doi.org/10.1111/obr.13037>

6.21. Title: Accessibility of Elderly Citizens to Basic Facilities in Akure Metropolis in Nigeria

Author(s): Adetunji, M.A.

Abstract: This study examined the accessibility of elderly citizens to some basic services in Akure metropolis. This was carried out with a view to determine the patterns of distribution and accessibility of these services in the city. Primary and secondary data were employed for this study. Geographical Positioning System was used to capture the coordinates of important locations and of some basic facilities such as Public Tertiary Hospital, Primary Health care center, and banks in the city. Nearest Analysis was used to calculate the mean distance travel to some basic services from 13 major localities in Akure metropolis. Descriptive and inferential statistics were employed to analyze the data. Finding reveals that some basic facilities are not evenly distributed across different localities in Akure. The mean distance travel to Public Tertiary Hospital is 3.36 km. The pattern of distribution of Public Tertiary Hospital is dispersed rather than random. More than 60% of the elderly rely on public transport services for their trip to access some basic facilities in the city. Traffic delay was ranked highest (66%) among the problems militating against the effective utilization of urban facilities in Akure metropolis. The study recommends that more basic facilities should be provided in localities where such services are lacking. This would reduce long distance trip to these facilities in the city. The study concludes that better transport services should be made available at reasonable transport fares in order to promote accessibility of the elderly and other segments of the population to urban facilities in Akure and similar other cities in Nigeria.

Subject Areas: Senior citizens; Urban services; Transport; Accessibility; Planning

Availability: Adetunji, M.A. (2020). "Accessibility of Elderly Citizens to Basic Facilities in Akure Metropolis in Nigeria." *Journal of Architectural Design and Urbanism*, 2(2), pp. 38–52. <https://doi.org/10.14710/jadu.v2i2.7641>

6.22. Title: An Evaluation of the Benefits of Mobile Fare Payment Technology From the User and Operator Perspectives

Author(s): Brakewood, C., Ziedan, A., Hendricks, S.J., Barbeau, S.J., and Joslin, A.

Abstract: Recently, public transit systems have seen declining ridership levels in most American cities, and transit agencies are seeking strategies to counteract this negative trend. One emerging strategy uses mobile technologies for fare payment, which could improve the transit user experience and potentially attract or retain riders. However, there has been limited prior research evaluating the benefits of new mobile fare payment technologies after real-world deployment. Therefore, this research aims to evaluate emerging payment technologies from both the transit user and operator perspectives. Surveys of bus riders in Tallahassee, FL, were conducted before and after a 2-month period in which a mobile fare payment application (“app”) was deployed throughout the bus system. Bus operators, who are responsible for fare validation, were also surveyed at the end of the study period. The results reveal that most app users reported spending less time purchasing a transit pass and less time boarding the bus, which could result in travel time savings from the user perspective. Despite these benefits, it was hypothesized that app users would increase the number of trips they made on transit; however, the user surveys provided limited evidence to support this. From the operator perspective, drivers reported spending less time collecting fares and observed that app users spent less time boarding the bus, which could lead to dwell time reductions after adoption levels increase. As transit users increasingly rely on mobile technologies, these findings are critical for transit agencies to justify initial deployment or expansion of mobile fare payment technologies.

Subject Areas: Public transit; Mobile payment technologies; Mobile ticketing; Mobile app; User acceptance; Survey

Availability: Brakewood, C., Ziedan, A., Hendricks, S.J., Barbeau, S.J., and Joslin, A. (2020). “An Evaluation of the Benefits of Mobile Fare Payment Technology From the User and Operator Perspectives.” *Transport Policy*, 93, pp. 54–66. <https://doi.org/10.1016/j.tranpol.2020.04.015>

6.23. Title: Analyzing the Acceptance of Electric Ridesharing by Drivers With and Without Local Registered Permanent Residence

Author(s): Du, M., Cheng, L., Li, X., and Xiong, J.

Abstract: To achieve the sustainable development of ridesharing industry, the relevant policies on the operation of electric ridesharing (ER) vehicles have been introduced by the Chinese government. However, existing knowledge on the driver's acceptance of ER remains scarce, and the institutional difference (whether the driver has registered permanent residence, Hukou) in the acceptance of ER has been little investigated. To fill the knowledge gap, the objective of this study is to explore the factors affecting the acceptance of ER by drivers with and without local registered permanent residence in Hukou. Using 786 valid samples collected in Shenzhen, China, we analyze the basic attributes and travel information of the drivers. The ordered logit models are established to investigate the differences of the factors affecting the acceptance of ER between these two types of drivers. The results show that: (1) the acceptance of tailored car drivers is low, while that of express service drivers is high and significant; (2) insufficient endurance mileage is a significant barrier to the acceptance of ER, and this impact is greater for the drivers without Hukou; (3) these two drivers focus on different aspects of ER; drivers with local Hukou care more about the external facilities, while their counterparts pay more attention to the vehicle performance; and (4) as for policies, purchasing an electric vehicle (EV) without shaking number and allowing the registration and shipping orders in different cities will significantly increase the acceptance of ER for drivers without Hukou. The cancellation of odd-even license plate policy could improve the acceptance of ER for local drivers. By contrast, financial subsidies and the purchase of an EV without license plate fees are not significant factors for both of them. Based on the results, some suggestions are proposed to promote drivers' acceptance of ER.

Subject Areas: Electric ridesharing vehicle; Acceptance; Local registered permanent residence; Influential factors; Policies

Availability: Du, M., Cheng, L., Li, X., and Xiong, J. (2020). "Analyzing the Acceptance of Electric Ridesharing by Drivers With and Without Local Registered Permanent Residence." *Journal of Cleaner Production*, 265. <https://doi.org/10.1016/j.jclepro.2020.121868>

6.24. Title: Travel Patterns to Work of the Indian Population

Author(s): Singh, B.

Abstract: In 2011, for the first time in Indian history, the Indian Census collected household data on travel patterns to work of the population. This included modes of travel and the distance traveled by the population. Despite the availability of these large-scale data, only a handful of studies have provided an analysis on how Indians as a whole commute to work. In this short note, we provide empirical models that provide an answer to how likely is a population group traveling at least X kilometers to work. We qualitatively compare our analysis with similar studies available for different cities of India.

Subject Areas: Census of India 2011; Travel patterns to work; Gender mobility; Rural urban mobility; Developing nations

Availability: Singh, B. (2020). *Travel Patterns to Work of the Indian Population*. Friedrich-Alexander-Universität Erlangen-Nürnberg Erlangen, Germany.

https://www.researchgate.net/publication/340685484_Travel_patterns_to_work_of_the_Indian_population

6.25. Title: Travel Behaviour of the Elderly in Planned and Unplanned Communities of Lagos Metropolis, Nigeria

Author(s): Alade, W. and Olaseni, A.

Abstract: Interests in the study of travel behavior of the elderly have been growing in the last two decades, and many of the works done are concentrated in the global north. Evidence from literature reveals that most of these studies focus more on the impact of individual and household socioeconomic attributes, urban form, travel attributes, and policy factors on the travel behavior of the elderly but less on the influence of neighborhood planning. This paper examined the travel behavior of old people in Festac (planned town) and Ketu (unplanned community) of the Lagos metropolis in southwest Nigeria, with a view to determining the influence of neighborhood planning on travel pattern. The two neighborhoods were carefully and purposively selected for collection of socio-economic and travel data through structured questionnaire that was administered on 155 randomly selected elderly respondents. The study revealed significant differences and some similarities in respondents' socio-economic and travel characteristics. Respondents from the planned community have a higher daily mean trip rate and mean trip time than those in unplanned community. Residents of planned community also undertake higher work and social trips and rely on automobile more than those in unplanned community. Apart from the fact that the majority of respondents travel more during the off-peak period, frequent road congestion was reported as the top mobility challenge among respondents in the two neighborhoods. The study concluded that neighborhood planning affects travel behavior and recommended a walkable neighborhood concept and promotion of elderly friendly public transport system for the study area.

Subject Areas: Travel behavior; Elderly; Aging; Community; Neighborhood planning

Availability: Alade, W. and Olaseni, A. (2020). "Travel Behaviour of the Elderly in Planned and Unplanned Communities of Lagos Metropolis, Nigeria." *Built Environment Journal*, 17(1), pp. 27–40. <http://ir.uitm.edu.my/id/eprint/30044/1/30044.pdf>

6.26. Title: A Panel Data Analysis of Tour-based University Students' Travel Behaviour

Author(s): Tuveri, G., Sottile, E., Piras, F., and Meloni, I.

Abstract: To date, although young adults seem to be less interested in obtaining a driving license and a car, in several countries, private vehicles are still the most widely used means of transport. The growing interest in promoting sustainable modes has motivated Mobility Managers (MM) to start awareness campaigns among workers who commute by private vehicle. University students, who regularly commute to their campuses, represent a major segment of the working population. Nevertheless, few studies have investigated university students' commuting habits.

The aim of this work is to examine in depth the tour-based university students' travel behavior using panel data from a sample of students from Roma Tre University.

The contribution of this paper consists in understanding the processes underlying daily travel behavior choices to help MMs identify the right steps to promote a correct culture and to improve public transport (PT) services.

The data used were collected during a panel survey split into two 2-day phases. Between the two phases, a personalized travel plan was provided in order to promote more sustainable means of transport. Daily travel behavior was monitored by collecting data through a smartphone app which registered trips/activities in real-time. The data were then exhaustively analyzed by classifying the tours into many layers (main purpose, time of day, mode used, and user attributes).

Analysis of the results indicate how the preferred mode of transport is the private mode and that 25% of tours were related to non-study purposes, which could be a barrier to PT mode choice.

Subject Areas: Tour; Travel behavior; University students; Panel data; Personalized travel plan

Availability: Tuveri, G., Sottile, E., Piras, F., and Meloni, I. (2020). "A Panel Data Analysis of Tour-Based University Students' Travel Behaviour." *Case Studies on Transport Policy*, 8(2), pp. 440–452. <https://doi.org/10.1016/j.cstp.2020.03.005>

6.27. Title: Unequal Traveling: How School District and Family Characteristics Shape the Duration of Students' Commute to School

Author(s): Fast, I.

Abstract: This study analyzes differences in the time elementary school students living in metropolitan areas in the United States spend traveling to schools. Building on existing literature on adults' commuting patterns and educational literature on school districts, school segregation, and school choice. I suggest a model of students' commuting that considers the interaction of students' family and school district characteristics in shaping the trip to school. I use a unique multilevel dataset nesting elementary school students' daily trip to school and their family characteristics in their school district to show that nationally, black students and students whose mothers are least educated travel the longest to school. These differences are accounted for by mode of transportation and black students' reliance of public transportation. But comparing students to their peers within their school districts, students whose mother has higher education travel the longest, and this trend increases in school districts with higher proportions of black students. These findings link students' mundane traveling to greater dynamics in the American educational system and expand our understanding of why different students travel different durations to school.

Subject Areas: Travel behavior; Elderly; Aging; Community; Neighborhood planning

Availability: Fast, I. (2020). "Unequal Traveling: How School District and Family Characteristics Shape the Duration of Students' Commute to School." *Travel Behaviour and Society*, 20, pp. 165–173. <https://doi.org/10.1016/j.tbs.2020.03.008>

6.28. Title: An Analysis of the Travel Patterns of Pilgrimage Groups in Lhasa Tibet

Author(s): Cheng G., Zhao S., and Wang Z.

Abstract: Religiously influenced pilgrims are commonly seen in Lhasa, a political and cultural center in Tibet. This study observed the travel modes of pilgrims in Lhasa between 2011 and 2017. Information was gathered using questionnaires and interviews. Travel modes of pilgrims and non-pilgrims were compared to identify each group's regular patterns. The study assessed differences in the characteristics of the pilgrims' travel behavior at different ages and differences in the behavior of pilgrims with different employment statuses. Given the significant differences among pilgrims' backgrounds, surveys were conducted with subjects of different age groups and employment types. The study's conclusions represent the experience of local pilgrims. Transportation management departments can use this information to better understand the travel needs of pilgrims and provide a higher standard of travel services to ensure the smooth conduct of the pilgrimage. The results of this study also provide a reference for research about pilgrims in other areas, particularly in inhabited areas in Tibet. It can also provide quantitative data to support religious study in Tibet.

Subject Areas: Pilgrims; Circumambulation for prayer; Travel behavior; Analysis of behaviors

Availability: Cheng G., Zhao S., and Wang Z. (2020). "An Analysis of the Travel Patterns of Pilgrimage Groups in Lhasa Tibet." *Green, Smart and Connected Transportation Systems*, pp. 811–826. https://doi.org/10.1007/978-981-15-0644-4_63

6.29. Title: Access Denied? Perceptions of New Mobility Services Among Disabled People in San Francisco

Author(s): Ruvolo, M.

Abstract: Thirty years after the passage of the *Americans with Disabilities Act*, people with disabilities still face significant barriers to transportation access. In recent years, new transportation services known as “new mobility” or “emerging mobility” launched entirely without accessible options. These services include transportation network companies (TNCs) such as Lyft and Uber, bike share, scooter share, and car share. Whether cities rush to welcome or grudgingly accept new mobility services, disability access is still too often an afterthought. This report, prepared for the San Francisco Municipal Transportation Agency, examines perceptions of new mobility services among disabled people in San Francisco via a survey of 218 people with disabilities. The study finds that disabled people in San Francisco see promise in some new mobility services but currently face significant barriers to use. Out of all new mobility options, respondents were most interested in on-demand automobility, e.g., accessible TNCs or accessible taxis. Respondents expressed significant concern about scooters and dockless bike share blocking the path of travel, and nearly 75 percent reported that an improperly parked scooter or bike created a mobility barrier for them on at least one occasion. Additionally, with broken sidewalks and missing curb ramps common, people with disabilities still face many barriers to basic mobility. This project offers the following recommendations: continue advocating for more effective TNC Wheelchair Accessible Vehicle (WAV) regulations at the state level, address the problem of scooters and bicycles on sidewalks, and build safer active transportation infrastructure to decrease conflicts between modes and make public space safer for vulnerable pedestrians.

Subject Areas: People with disabilities; New mobility; Bay Area; Social justice; Transportation planning; Equity

Availability: Ruvolo, M. (2020). *Access Denied? Perceptions of New Mobility Services Among Disabled People in San Francisco*. University of California, Los Angeles, CA.
<https://escholarship.org/uc/item/6jv123qg>

6.30. Title: Gender Disparity in Travel Demand Management of University Students and Employees

Author(s): Zhang, S., Li, Y., Frimpong, B.E., and Mog, J.

Abstract: The Earn-a-Bike (EAB) program is a travel demand management (TDM) effort at the University of Louisville. It provides a \$400 bike shop voucher for students and university employees to forgo their parking permits for two years. This research explores this program to answer three questions: Does gender affect people's willingness to participate in a TDM program such as the EAB? Does gender have different impacts on population segments at different life stages? How does a suburbanized spatial structure interact with gender and affect people's willingness to participate in the EAB program? The findings suggest that females are generally less willing to participate in the EAB program. However, when the student and faculty/staff populations are separated, this gender effect became insignificant for the student population, but became stronger for the faculty/staff population. Furthermore, females in suburban areas are less likely than males to participate in the program.

Subject Areas: Earn-a-Bike; Commuting; Travel demand management; Gender difference

Availability: Zhang, S., Li, Y., Frimpong, B.E., and Mog, J. (2020). "Gender Disparity in Travel Demand Management of University Students and Employees." *Journal of Planning Education and Research*. <https://doi.org/10.1177%2F0739456X20934190>

6.31. Title: Influence of Autonomous Vehicles on Travel Behavior of 50+ Years Population

Author(s): Urbina, S. and Sohaee, N.

Abstract: In this paper, we analyze the adoption of autonomous vehicles (AVs) using survey data collected from June 2019–December 2019 on approximately 250 people who are over 50 years old in the USA. The model is explaining the impact of different factors and trust implementation in older adults. The result demonstrates that almost a third of participants are not accepting AVs because of several factors such as lack of trust in the technology, possibility of hacking the system, job replacement by technology, and safety. While 53% of the participants are supporting AVs as a personal vehicle or public transportation, the rest are having a neutral attitude toward AVs. Among all the participants in this research, 20.57% show the interest in owning personal AVs, while 14.92% of participants like to lease it as their need rises, and 30.65% of the respondents like to use AVs in the form of taxis or public transit only.

Subject Areas: Autonomous vehicles; Older adults; Attitude; Trip mode adaption

Availability: Urbina, S. and Sohaee, N. (2020). *Influence of Autonomous Vehicles on Travel Behavior of 50+ Years Population*. Portland State University, Portland, OR.
https://www.westernite.org/annualmeetings/20_Honolulu/Presentations/Influence-of-Autonomous-Vehicles-on-travel-behavior-of-50.pdf

6.32. Title: School Transportation Equity for Vulnerable Student Populations through Ridehailing: An Analysis of HopSkipDrive and Other Trips to School in Los Angeles County

Author(s): Speroni, S.

Abstract: The *Every Student Succeeds Act* (2015) gave foster youth additional legal protections in school, including the right to transportation and the right to remain at their school despite any moves, similar to protections already in place for students experiencing homelessness and students with disabilities. California’s compliance with this mandate was relatively more difficult than other states’, as less than 10 percent of students in California travel by school bus, compared with 35 percent nationally. Thus, California schools could not simply tap into their existing services to provide transportation for foster youth.

Ridehailing offers a solution to this gap. HopSkipDrive, a ridehailing company designed to transport children, engages in contracts with school districts and county governments to provide school transportation for these vulnerable student populations. In 2018–2019, HopSkipDrive provided 32,796 trips to school in Los Angeles County, with massive time savings over the logical alternative: transit. Using Google’s Directions API, I determine that HopSkipDrive offers time savings of nearly 70 percent compared with the same trips simulated on transit. HopSkipDrive’s trips average 28 minutes in duration, yet on transit only 30 percent would have taken less than 45 minutes. This is despite 90 percent of all origins and destinations being located within a half-mile of a transit stop. This service has important social equity implications beyond just time savings offered to vulnerable student populations, as HopSkipDrive contract trips tend to originate in neighborhoods with high percentages of low-income households and people of color.

Subject Areas: New mobility; School transportation; Equity; Mobility as a service

Availability: Speroni, S. (2020). *School Transportation Equity for Vulnerable Student Populations through Ridehailing: An Analysis of HopSkipDrive and Other Trips to School in Los Angeles County*. Institute of Transportation Studies, University of California, Los Angeles, CA. <https://escholarship.org/content/qt077181dh/qt077181dh.pdf>

6.33. Title: Autonomous Vehicles Should Benefit Those With Disabilities, but Progress Remains Slow

Author(s): Wiggers, K.

Abstract: Blog.

Subject Areas: Accessibility; Population with disabilities; Autonomous vehicles; Challenges

Availability: Wiggers, K. (2020). "Autonomous Vehicles Should Benefit Those With Disabilities, but Progress Remains Slow." *The Machine, VentureBeat*.

<https://venturebeat.com/2020/08/21/autonomous-vehicles-disabilities-accessibility-inclusive-design/>

6.34. Title: Decentralized Autonomous Electric Mobility-on-Demand Services for Individuals with Physical and Cognitive Disabilities

Author(s): Sorour, S. and Abdel-Rahim, A.

Abstract: This report discusses the foundation of innovative decentralized mobility services for individuals with physical or cognitive disabilities using disability-friendly autonomous electric mobility on-demand (AEMoD) services. By leveraging both the Internet-of-things (IoT) and its associated fog control capabilities, this framework will enable real-time, localized, autonomous, disability-aware, and battery level-based dispatching and charging decisions for a fleet of AEMoD services distributed in multiple city zones. Through IoT-enabled fog control, computational resources are pushed closer to customers in each city zone, which enables the collection of real-time information about the AEMoD services, tracking of their state-of-charge, and the collection of service requests from customers. Driven by these collected data, these fog controllers will provide decentralized, efficient, and responsive dispatching and charging decisions within each zone to serve customers, prioritizing their needs in a timely manner, while maintaining suitable AEMoD state-of-charge for subsequent trips.

The proposed fog-based architectures for localized AEMoD system operations provide a good solution for the communication/ computation delays that restrict massive AEMoD operations in big cities. These emerging architectures will soon become widely used, allowing all localized operational decisions to be made with very low latency by fog controllers located close to the end applications (e.g., each city zone for AEMoD systems). The proposed architecture also employs an optimized, multi-class charging and dispatching queuing model, with a partial charging option for AEMoD vehicles, to provide the best solution to the AEMoD charging delay challenges for each zone. The stability conditions of this model and the optimal number of classes were derived. The decisions on the proportions of each class of vehicles to partially/fully charge or directly serve customers are optimized to minimize the maximum and average system response times by using convex optimization and Lagrangian analysis. Analysis results showed the merits of our proposed model and optimized decision scheme in comparison to both the always-charge and the equal-split schemes. Furthermore, the comparison between the maximum and average problem solutions exhibited negligible variance, which favored the use of the maximum solution because of its lower complexity.

Subject Areas: Autonomous mobility on-demand; Electric vehicle; Fog-based architecture; Dispatching; Charging; Queuing systems

Availability: Sorour, S. and Abdel-Rahim, A. (2020). *Decentralized Autonomous Electric Mobility-on-Demand Services for Individuals with Physical and Cognitive Disabilities*. Pacific Northwest Transportation Consortium, Seattle, WA. <http://hdl.handle.net/1773/46225>

6.35. Title: Children’s Health and Well Being During the Coronavirus Pandemic

Author(s): Garfield, R. and Chidambaram, P.

Abstract: The debate over school openings has highlighted the implications of the coronavirus pandemic for children and their families. While experts continue to gather data on children’s risk for contracting and transmitting coronavirus, current research suggests that though children are more likely to be asymptomatic and less likely to experience severe disease than adults, they are capable of transmitting to both other children and adults. In addition to the risk of disease and illness, COVID-19 has led to changes in schooling, health services delivery, and other disruptions of normal routines that will likely affect children’s health and well-being, regardless of whether they are infected.

Subject Areas: COVID-19; Medicaid; School opening; Children; Health; Well-being

Availability: Garfield, R. and Chidambaram, P. (2020). “Children’s Health and Well Being During the Coronavirus Pandemic.” *Kaiser Family Foundation*. <https://www.kff.org/coronavirus-covid-19/issue-brief/childrens-health-and-well-being-during-the-coronavirus-pandemic/>

6.36. Title: Reimagining Aging in America: A Blueprint to Create Health and Economic Security for Older Adults

Author(s): Casey, B.

Abstract: US Senator Bob Casey (ranking member, Special Committee on Aging) has released a new report on how COVID-19 has exacerbated the challenges facing older Americans. The report outlines a blueprint for addressing the problems older adults face and highlights the services necessary to ensure Americans can age with dignity. This report contains policy recommendations that address three main areas: health care, economic security, and social supports.

Subject Areas: COVID-19; Aging with dignity; Economic security; Social supports; Health care

Availability: Casey, B. (2020). "Reimagining Aging in America: A Blueprint to Create Health and Economic Security for Older Adults." *ADvancing States*.

<http://www.advancingstates.org/node/72152>

6.37. Title: Self-Determination in Transportation: The Route to Social Inclusion for People with Disabilities

Author(s): Murray, J.

Abstract: People with disabilities encounter many challenges with transportation but are not usually considered in research about travel behavior and well-being. Research on transportation challenges is often disability-specific even though different access needs can complement or conflict with each other. I argue that disability should be centered in the study of travel and well-being because it magnifies problems that may also frustrate people who do not currently consider themselves disabled. The goal of the dissertation was to identify how basic psychological needs for autonomy, relatedness, and competence apply to the context of transportation and identify ways to measure fulfillment and frustration of those needs.

Mixed methods including surveys and travel diaries were used to measure basic psychological needs in transportation and explore the relationships between psychological needs, flourishing, and moods associated with daily travel. Two surveys were conducted among a broad sample of people living in the New York metropolitan area to develop measures of psychological needs in transportation and explore which types of disabilities are associated with transportation difficulties and unfulfilled needs. A novel digital travel diary method using free software applications was also developed to collect GPS location history and daily surveys about best and worst trips, impediments, and moods, which were compared to survey measures.

There was a positive relationship between the fulfillment of basic psychological needs in transportation and well-being. Participants with disabilities had greater difficulty with factors in transportation that thwart basic psychological needs than participants without disabilities. Self-reported difficulty with transportation was correlated with lower well-being. The travel diaries showed that there were no group differences between disabled and nondisabled participants in the average number of obstacles experienced, and nondisabled participants reported more delays on average than disabled participants. However, experiencing obstacles and delays had a greater negative influence on mood and well-being for disabled participants, which may be a result of previous difficult experiences with transportation. Transit agencies and policymakers should consider basic psychological needs fulfillment, including improving accessibility, encouraging disability awareness and etiquette, and ensuring information access, to encourage better transportation experiences for disabled and nondisabled passengers alike.

Subject Areas: Disability; Public transit; Mobility; Daily travel; Psychological needs; Accessibility

Availability: Murray, J. (2020). "Self-Determination in Transportation: The Route to Social Inclusion for People with Disabilities." *CUNY Academic Works*.

https://academicworks.cuny.edu/gc_etds/4086

6.38. Title: National Teen Driver Safety Week: Teen Driving Accidents

Author(s): Tario, M.J.

Abstract: Blog.

Subject Areas: Teen driving accidents risk factors; Car crashes; 2017 National Household Travel Survey

Availability: Tario, M.J. (2020). "National Teen Driver Safety Week: Teen Driving Accidents." *Lawyers.com*. <https://blogs.lawyers.com/attorney/automobile-accidents/national-teen-driver-safety-week-teen-driving-accidents-65332/>

6.39. Title: Will Ride-Hailing Enhance Mobility for Older Adults? A California Survey

Author(s): Agrawal, A.W., Shirgaokar, M., Misra, A., Wachs, M., and Dobbs, B.

Abstract: Ride-hailing services such as Lyft and Uber offer a potential mobility option for the growing numbers of aging Californians who risk social and economic isolation if they cannot drive for health or financial reasons. They could also serve older adults who currently have mobility options but would prefer a ride-hailing alternative for at least some trips.

This study addressed whether and how older Californians use ride-hailing, as well as the potential of this travel mode to meet the needs of older adults now and in the coming decade. An online survey was completed by 2,917 California adults aged 55 and older. This age range was chosen to include both current seniors (age 65 and older) and individuals who will soon be entering that age group (aged 55 to 64).

The survey explored whether older Californians who have access to the internet used ride-hailing, how comfortable they were with ride-hailing service features that might present barriers to usage, whether they would value potential new ride-hailing service features designed to improve safety, accessibility, and payment options, and what reasons (if any) they saw to use ride-hailing. We also collected data on various factors hypothesized to influence ride-hailing use and behaviors, such as use of the internet and online banking.

Key survey findings indicated that 44% of respondents 65 years old and older had experienced ride-hailing and 27% had booked a ride themselves via phone or using the app. Also, the potential new ride-hailing service features that appealed to large numbers of today's and tomorrow's seniors include having a driver trained to help older passengers and the option to pay with a ride-hailing card that is not linked to a bank account or credit card.

Results also indicated that there were fewer large variations by personal characteristics than we anticipated would influence ride-hailing behavior and attitudes, such as gender, age, and regular use of technology. However, there were some clear differences by population subgroups, most noticeably by income, education, community type (e.g., urban vs. rural), and use of public transit.

Subject Areas: Aged drivers; Ride-hailing; Survey; Persons and personal characteristics

Availability: Agrawal, A.W., Shirgaokar, M., Misra, A., Wachs, M., and Dobbs, B. (2020). "Will Ride-Hailing Enhance Mobility for Older Adults? A California Survey." *Mineta Transportation Institute Publications*. <https://doi.org/10.31979/mti.2020.1815>

6.40. Title: Rural America’s Senior Citizens: Considerations for Transportation, Healthcare Access, Connectedness, Nutrition and Economics

Author(s): Brown, T., Temple, K.M., and Rudolphi, J.

Abstract: In 2018, there were 52 million Americans aged 65 years or older. By 2030, the population of Americans aged 65 or older will double to 77 million, or 21 percent of the U.S. population. This unprecedented growth is attributed to longer life spans and the aging baby boomer generation – one of the largest generational groups in the United States. This is especially important to rural America because older adults disproportionately live in rural areas. Approximately 25% of Americans older than 65 live in a small town or rural area. In some states, the percentage is much higher.

Though not specific to the elderly, many characteristics differentiate the rural population from their urban counterparts. The most recent census data suggests rural Americans are more likely to be married, more likely to have served in the military, and more likely to own their home. While some rural residents had lower rates of poverty, rural citizens were less likely to have obtained a bachelor’s degree. A lower median household income is another rural characteristic.

Rural Americans experience significant health disparities when compared to their urban counterparts, starting with rural-urban life expectancy. In 2014, life expectancy in the United States was 77 years of age for rural non-metro males and females, noticeably lower than that of urban non-metro (77.2), small metro (78.3), medium metro (78.9), and large metro (80.0) areas. People in rural areas also report lower health-related quality of life than people in urban areas. As rural residents age, chronic health conditions may contribute to deteriorating quality of life if not managed adequately.

The challenges of providing health care to an isolated and geographically diverse population also impact the health disparities of rural residents. Risk factors include lower socioeconomic status as well as occupational, behavioral, and environmental concerns that contribute to transportation, health care access, and nutrition issues. These challenges contribute to rural residents’ higher prevalence of heart disease, hypertension, high cholesterol, arthritis, and depressive symptoms when compared to their urban counterparts.

Subject Areas: Rural; Senior population; Health-related transportation issues; Health care; Nutrition status

Availability: Brown, T., Temple, K.M., and Rudolphi, J. (2020). *Rural America’s Senior Citizens: Considerations for Transportation, Healthcare Access, Connectedness, Nutrition and Economics*. National Rural Health Association Policy Paper, National Rural Health Association, Washington, DC.

https://www.ruralhealthweb.org/NRHA/media/Emerge_NRHA/Advocacy/Policy%20documents/2020-NRHA-Policy-Document-Rural-America%E2%80%99s-Senior-Citizens.pdf

6.41. Title: Implementing Complete Streets in Small Towns and Rural Communities: Case Study: Millsboro, Delaware

Author(s): Calloway, D.M.

Abstract: There is growing momentum across the United States to implement complete streets in every corner of the country. Federal agencies have promoted the practice for decades and over the last 15 years, the term complete streets has been growing rapidly in popularity. Cities and towns have increasingly been incorporating them into their policies and guidance for new development and redevelopment of existing areas. Examples of successful complete streets can be found around the world and here in the United States, but how does small town America implement complete streets? How does a small town, with limited existing infrastructure and limited economic means make the shift toward economic resurgence within their town limits? This thesis reviews existing international and national complete streets, current guidance and presents a procedure for assessing and implementing complete streets. This study focuses on what generalized approaches can be used in a rural setting and identifies a process by which any small town or rural community can proceed step-by-step to promote complete streets based on principles from successful urban and suburban examples here in the USA and internationally.

Subject Areas: Complete streets; Small towns; Rural; Generalized approach

Availability: Calloway, D.M. (2020). *Implementing Complete Streets in Small Towns and Rural Communities: Case Study: Millsboro, Delaware*. University of Delaware, Newark, DE.
<https://udspace.udel.edu/handle/19716/28348>

6.42. Title: “More Sidewalks, More Bus Stops”: Travel Behaviors and Opinions of Connecticut Teenagers

Author(s): Auguste, M.E., Tucker, A., and Jackson, E.D.

Abstract: An online survey was developed to evaluate the environmental, demographic, and socioeconomic factors that support or discourage the mobility of teenagers. Distributed to adults (18–25 years old) in Connecticut, the survey gathered retrospective data on their travel behaviors as teenagers, as well as associated attitudes and beliefs about different transportation modes. Seventy-one percent of participants indicated that a family car was their predominant source of transportation. Public transportation was the main source for 14% of participants. Fewer than 10% of participants indicated that a personal car, walking, or other means was their primary source of transportation. Participants who lived in less densely populated areas as teenagers were more likely to report barriers to public transportation access. These same participants were also more likely to report neighborhood walkability issues, including the absence of continuous sidewalks and bike paths. These factors are likely associated with teenagers’ reliance on family cars for transportation. Recommendations for improved connectivity and promotion of currently available public transportation options are provided.

Subject Areas: Travel behavior; Mobility barriers; Teenagers; Accessibility; Attitudes

Availability: Auguste, M.E., Tucker, A., and Jackson, E.D. (2020). ““More Sidewalks, More Bus Stops’: Travel Behaviors and Opinions of Connecticut Teenagers.” *Transportation Research Interdisciplinary Perspectives*, 8. <https://doi.org/10.1016/j.trip.2020.100238>

6.43. Title: **Rural Gerontology: Towards Critical Perspectives on Rural Ageing**

Editor(s): Skinner, M., Winterton, R., and Walsh, K.

Abstract: This book provides the first foundation of knowledge about the intellectual traditions, contemporary scope and future prospects for the interdisciplinary field of rural gerontology.

With a focus on rural regions, small towns, and villages, which have the highest rates of population ageing worldwide, *Rural Gerontology* is aimed at understanding what it means for rural people, communities, and institutions to be at the forefront of 21st century demographic change. The book offers important insights from rural ageing studies into today's most pressing gerontological problems. With chapters from more than 65 established and emerging rural ageing researchers, it is the first synthesis of knowledge about rural gerontology, harnessing a burgeoning interdisciplinary scholarship on the rural dimensions of ageing, old age, and older populations. With a view to advancing a critical understanding of rural ageing populations, this book will have an overreaching impact across the social sciences by drawing on advancements in understandings of rural ageing from social, environmental, geographical, and critical gerontology to facilitate a comprehensive exploration of the diversity, complexity, and implications of the ageing process in rural settings.

Bringing together valuable international perspectives, this book makes a timely contribution to gerontology, rural studies, and the social sciences and will appeal to scholars and researchers across USA and Canada; UK and Ireland; Australia and New Zealand; Europe; China; and countries in Africa, South America, and South-East Asia.

Subject Areas: Rural regions; Aging; Older populations; Accessibility

Availability: Skinner, M., Winterton, R., and Walsh, K. (2020). *Rural Gerontology: Towards Critical Perspectives on Rural Ageing*. Routledge, Oxfordshire, England, UK.
<https://books.google.com/books?id=BqsLEAAQBAJ&lr=>

6.44. Title: Impacts of COVID-19 on Access to Transportation for People with Disabilities

Author(s): Cochran, A.L.

Abstract: People with disabilities may be particularly vulnerable to the direct health effects of the COVID-19 pandemic as well as the wider impacts of the pandemic response. People with disabilities experience numerous barriers to using transportation to access essential goods, like fresh food, and services, like medical care, that are necessary for maintaining health. The pandemic and the pandemic response threaten to exacerbate persistent health disparities and add to transportation barriers that disadvantage people with disabilities. To better understand difficulties that individuals with disabilities are facing using transportation and meeting their needs during the pandemic, I conducted in-depth interviews with 21 San Francisco Bay Area residents with disabilities between March 20 and April 6, 2020, immediately following adoption of the first shelter-in-place orders in the region. Analyzing these interviews, I find that the pandemic is aggravating many difficulties accessing transportation and other essentials that people with disabilities regularly encounter. These include challenges accessing reliable and safe transportation as well as up-to-date communications about transportation and public health, and difficulties getting needed assistance using transportation and completing activities of daily living ranging from personal care to getting groceries. I recommend that those involved in the pandemic response make a concerted and intentional effort to address barriers to accessing needed transportation, communications, and assistance that people with disabilities are facing during the pandemic, paving the way for a more inclusive pandemic response.

Subject Areas: COVID-19; Pandemic response; Disability; Travel behavior; Health; Interviews

Availability: Cochran, A.L. (2020). "Impacts of COVID-19 on Access to Transportation for People with Disabilities." *Transportation Research Interdisciplinary Perspectives*, 8. <https://doi.org/10.1016/j.trip.2020.100263>

6.45. Title: Case Studies of Travel Demand Analysis on Transport Disadvantaged Communities

Author(s): Bills, T.

Abstract: Travel Demand Models are the backbone of decision-making for public transportation infrastructure investment. Yet, critiques of these models with respect to their usefulness and performance for transport disadvantage communities are rare in the academic literature. These disadvantage communities may include (but are not limited to) low income travelers, transit dependents, un/underemployed, and the elderly. With the objective of promoting travel demand models that are better equipped for assessing transportation impacts for disadvantaged communities, this presentation highlights lessons learned from two case studies of applying travel demand analysis to understand the transportation accessibility of low income, elderly, and transit dependent communities. The case studies take place in two Michigan cities: Benton Harbor and Detroit.

Subject Areas: Travel demand models; Transportation infrastructure investment; Transport disadvantage communities; Accessibility; Case study

Availability: Bills, T. (2020). *Case Studies of Travel Demand Analysis on Transport Disadvantaged Communities*. Wayne State University, Detroit, MI.
<https://archives.pdx.edu/ds/psu/34660>

6.46. Title: The Social Side of Early Human Capital Formation: Using a Field Experiment to Estimate the Causal Impact of Neighborhoods

Author(s): List, J.A., Momeni, F., and Zenou, Y.

Abstract: The behavioral revolution within economics has been largely driven by psychological insights, with the sister sciences playing a lesser role. This study leverages insights from sociology to explore the role of neighborhoods on human capital formation at an early age. We do so by estimating the spillover effects from a large-scale early childhood intervention on the educational attainment of over 2,000 disadvantaged children in the United States. We document large spillover effects on both treatment and control children who live near treated children. Interestingly, the spillover effects are localized, decreasing with the spatial distance to treated neighbors. Perhaps our most novel insight is the underlying mechanisms at work: the spillover effect on non-cognitive scores operate through the child's social network while parental investment is an important channel through which cognitive spillover effects operate. Overall, our results reveal the importance of public programs and neighborhoods on human capital formation at an early age, highlighting that human capital accumulation is fundamentally a social activity.

Subject Areas: Early education; Social activity; Neighborhood; Field experiment; Spillover effects; Non-cognitive skills

Availability: List, J.A., Momeni, F., and Zenou, Y. (2020). *The Social Side of Early Human Capital Formation: Using a Field Experiment to Estimate the Causal Impact of Neighborhoods*. National Bureau of Economic Research, Cambridge, MA. <http://www.nber.org/papers/w28283>

Chapter 7. Survey, Data Synthesis, and Other Applications

7.1. Title: What Counts as Commute Travel?: Identification and Resolution of Key Issues Around Measuring Complex Commutes in the National Household Travel Survey

Author(s): Kash, G. and Mokhtarian, P.

Abstract: We use travel diary data from the 2017 National Household Travel Survey (NHTS) Georgia subsample to address critical issues associated with analyzing complex work journeys. To define the work journey, we discuss the importance of defining commute anchors by both purpose and location. We then compare two alternate measures for determining what portion of each journey should be counted as commute distance: the last leg of the journey (the NHTS default) and a modeled counterfactual simple commute to estimate the distance that would have been traveled had no stops been made. The average complex commute distance obtained using the counterfactual method is 63% higher than the estimate based on using the last leg alone. Using the last-leg method may understate Georgia's annual commute distance by 2.6 billion miles (10% of the total, including both simple and complex commutes). We argue that the last-leg method is not an accurate gauge of work travel, particularly among populations such as women, who are more likely to trip chain on their commutes.

Subject Areas: Long-distance travel; Intercity travel; Long-range transportation plan; Statewide transportation plan; State-of-practice surveys

Availability: Kash, G. and Mokhtarian, P. (2020). *What Counts as Commute Travel?: Identification and Resolution of Key Issues Around Measuring Complex Commutes in the National Household Travel Survey*. Transportation Research Board 99th Annual Meeting, Washington, DC. <https://annualmeeting.mytrb.org/OnlineProgramArchive/Details/13909>

7.2. Title: Visualization using the National Household Travel Survey

Author(s): Muhammad, T.

Abstract: Visualization that I developed using the National Household Travel Survey. The analysis uses a web-based framework for visualization (D3) and uses a Java-based script to show the results. The analysis shown below is based on 2009 survey, and I am currently undertaking some work to update and do a comparison using the 2017 survey. The analysis summarizes and provides a Nation-wide view on how the vehicle stock and trip patterns vary across the United States, both for urban and rural areas.

Subject Areas: Visualization; Vehicle stock; Trip patterns; Urban and rural

Availability: Muhammad, T. (2020). *Visualization using the National Household Travel Survey*. Transportation Research Board 99th Annual Meeting, Washington, DC.
<https://annualmeeting.mytrb.org/OnlineProgramArchive/Details/13931>

7.3. Title: Predicting Travel Mode Choice Based on 2017 NHTS Trip Data with Multi-Nomial Logit Model and Light Gradient Boosting Machine

Author(s): Dai, Z., Liu, H., and Guensler, R.

Abstract: Discrete choice modeling methods have dominated the prediction of travel mode choice for decades, within which, multinomial logit model (MNL) and its variants have been at the forefront. One of the biggest advantages of the MNL are its elegant mathematical formula that makes it easy-to-implement and easy to interpret prediction outputs. However, MNL is built upon strict statistical assumptions, for example, independence of irrelevant alternatives, which real cases can run the risk of violating. In recent years, the development of machine-learning techniques has allowed the application of multiple data-mining methods to the field of mode choice modeling in transportation. This paper investigates the method of light gradient boosting machine (LightGBM) for travel mode prediction and compares its performance with the results built upon MNL using 2017 National Household Travel Survey data. LightGBM is a relatively new framework in the field of gradient boosting algorithms, with faster training speed, lower memory usage, and better accuracy. Despite promising performance, LightGBM's applications in transportation planning field to date remain quite limited. The analyses reported herein find that the LightGBM model out-performed MLM with respect to both overall accuracy and individual class accuracy, especially when dealing with extremely imbalanced datasets. These promising results indicate that LightGBM should be further explored as a tool for use in choice-based modeling.

Subject Areas: Multinomial logit model; Light gradient boosting machine; Machine learning; Predictive model; Travel mode choice

Availability: Dai, Z., Liu, H., and Guensler, R. (2020). *Predicting Travel Mode Choice Based on 2017 NHTS Trip Data with Multi-Nomial Logit Model and Light Gradient Boosting Machine*. Transportation Research Board 99th Annual Meeting, Washington, DC. <https://annualmeeting.mytrb.org/OnlineProgramArchive/Details/13908>

7.4. Title: Testing Exogeneity in Nonparametric Instrumental Variables Models Identified by Conditional Quantile Restrictions

Author(s): Fu, J.M., Horowitz, J.L., and Parey, M.

Abstract: This paper presents a test for exogeneity of explanatory variables in a nonparametric instrumental variables (IV) model whose structural function is identified through a conditional quantile restriction. Quantile regression models are increasingly important in applied econometrics. As with mean-regression models, an erroneous assumption that the explanatory variables in a quantile regression model are exogenous can lead to highly misleading results. In addition, a test of exogeneity based on an incorrectly specified parametric model can produce misleading results. This paper presents a test of exogeneity that does not assume that the structural function belongs to a known finite-dimensional parametric family and does not require estimation of this function. The latter property is important because nonparametric estimates of the structural function are unavoidably imprecise. The test presented here is consistent whenever the structural function differs from the conditional quantile function on a set of non-zero probability. The test has non-trivial power uniformly over a large class of structural functions that differ from the conditional quantile function by $O(n^{-1/2})$. The results of Monte Carlo experiments and an empirical application illustrate the performance of the test.

Subject Areas: Hypothesis test; Instrumental variables; Quantile estimation; Specification testing

Availability: Fu, J.M., Horowitz, J.L., and Parey, M. (2020). "Testing Exogeneity in Nonparametric Instrumental Variables Models Identified by Conditional Quantile Restrictions." *The Econometrics Journal*. <https://doi.org/10.1093/ectj/utaa007>

7.5. Title: Data Modeling of Cities, a Machine Learning Application

Author(s): Najari, A., Pajarito, D., and Markopoulou, A.

Abstract: Today, cities are the main humankind settlement relying on intricate systems. The technological growth in the context of urban produces a vast amount of data. Analyzing and visualizing these data have provided insights into this complex environment. However, these mere approaches are inert and, due to technical constraints, hard to be integrated into urban planning.

Consequently, we adopt a research hypothesis in which the adaptability and complexity of urban systems can be replicated, or partially replicated, by the machine-learning algorithms. The current study aims to define a process for evaluating the capabilities for analyzing and predicting urban data with machine-learning (ML) algorithms. This process starts with constructing a data structure for inputting into the ML algorithm. Following this, different tests are applied to identify valid combinations of data and models that allow understanding of urban patterns. The bicycle-sharing system is used as a case study. The process ends discussing the options to replicate the experiment in different urban areas as well as to adapt it to different problems.

Different datasets from different cities have been explored and considered for this experiment. Across many cities' open dataset platforms, the NYD platform offered the most reliable data. From the sub-systems of the city, the mobility network was selected as a case study for exploration. More specifically, data on shared-bicycle mobility and use were selected as a result of its exciting raise as travel choices reported by New York City's Department of Transportation. The urban data analysis and prediction process of this research paper identifies the neighborhood as the unit of the model. Additionally, to illustrate and analyze the relationship between the selected mobility sub-system and other urban systems, contextual indicators such as land use indexes were added in the modeling process. Despite the prediction modeling machine for the bikesharing system coming out of this study, the main achievement is the introduction of a collection of analysis and prediction processes for urban data beyond mobility. For further advancement, implementing this approach in a different urban system and context is crucial. By this means, the replicability of the process could be evaluated and tested.

Subject Areas: Predictive urban model; Urban analytics; Big data; Machine learning; Bicycle mobility data

Availability: Najari, A., Pajarito, D., and Markopoulou, A. (2020). *Data Modeling of Cities, a Machine Learning Application*. Symposium on Simulation in Architecture + Urban Design (SimAUD2020). https://www.researchgate.net/profile/Diego_Fabian_Pajarito_Grajales/publication/341645133_Data_Modeling_of_Cities_a_Machine_Learning_Application/links/5ecd081192851c313aea9d23/Data-Modeling-of-Cities-a-Machine-Learning-Application.pdf

7.6. Title: A Data-Driven Travel Mode Share Estimation Framework based on Mobile Device Location Data

Author(s): Yang, M., Pan, Y., Darzi, A., Ghader, S., Xiong, C., and Zhang, L.

Abstract: Mobile device location data (MDLD) contain abundant travel behavior information to support travel demand analysis. Compared to traditional travel surveys, MDLD has larger spatiotemporal coverage of population and its mobility. However, ground truth information, such as trip origins and destinations, travel modes, and trip purposes, are not included by default. Such important attributes must be imputed to maximize the usefulness of the data. This paper tends to study the capability of MDLD on estimating travel mode share at aggregated levels. A data-driven framework is proposed to extract travel behavior information from the MDLD. The proposed framework first identifies trip ends with a modified Spatiotemporal Density-based Spatial Clustering of Applications with Noise (ST-DBSCAN) algorithm. Then three types of features are extracted for each trip to impute travel modes using machine learning models. A labeled MDLD dataset with ground truth information is used to train the proposed models, resulting in 95% accuracy in identifying trip ends and 93% accuracy in imputing five travel modes (drive, rail, bus, bike, and walk) with a Random Forest (RF) classifier. The proposed framework is then applied to two large-scale MDLD datasets, covering the Baltimore–Washington metropolitan area and the United States, respectively. The estimated trip distance, trip time, trip rate distribution, and travel mode share are compared against travel surveys at different geographies. The results suggest that the proposed framework can be readily applied in different states and metropolitan regions with low cost in order to study multimodal travel demand, understand mobility trends, and support decision-making.

Subject Areas: Mobile device location data; Travel demand analysis; Data-driven framework; Trip originations and destinations

Availability: Yang, M., Pan, Y., Darzi, A., Ghader, S., Xiong, C., and Zhang, L. (2020). *A Data-Driven Travel Mode Share Estimation Framework based on Mobile Device Location Data*. arXiv, Cornell University, Cambridge, MA. <https://arxiv.org/abs/2006.10036>

7.7. Title: A Multiple Discrete Extreme Value Choice Model with Grouped Consumption Data and Unobserved Budgets

Author(s): Bhat, C.R., Mondal, A., Asmussen, K., and Bhat, A.C.

Abstract: In this paper, we propose, for the first time, a closed-form multiple discrete-grouped extreme value model that accommodates grouped observations on consumptions rather than continuous consumptions. For example, in a time-use context, respondents tend to report their activity durations in bins of time (for example, 15- or 30-minute intervals, depending on the duration of an activity). Or when reporting annual mileages driven for each vehicle owned by a household, it is unlikely that households will be able to provide an accurate continuous mileage value, and so it is not uncommon to solicit mileages in grouped categories such as 0–4,999 miles, 5000–9,999 miles, 10,000–14,999 miles, and so on. Similarly, when reporting expenditures on different types of commodities/services, individuals may round up or down to a convenient dollar value of multiples of 10 or 100 (depending on the length of time in which expenditures are sought). In some other cases, a product itself may be available only in specific package sizes (such as say, instant coffee, which is typically packaged in fixed sizes). In this paper, we use the so-called linear outside good utility MDCEV structure of Bhat (2018) to show how the model can be used for grouped consumption observations. Of course, this is also possible because the linear outside good utility does not need a continuous budget value and allows for unobserved budgets. We discuss an important identification issue associated with this linear outside good utility model and proceed to demonstrate applications of the proposed model to the case of weekend time-use choices of individuals and vehicle type/use choices of households.

Subject Areas: Multiple discrete-grouped choice models; Multiple discrete outcomes; Linear outside good utility; Grouped consumption; Unobserved budgets; Utility theory; Time use; Consumer theory

Availability: Bhat, C.R., Mondal, A., Asmussen, K., and Bhat, A.C. (2020). *A Multiple Discrete Extreme Value Choice Model with Grouped Consumption Data and Unobserved Budgets*. The University of Texas at Austin, Austin, TX.

https://www.caee.utexas.edu/prof/bhat/ABSTRACTS/MDGEV_Model.pdf

7.8. Title: Computing the Shapley Value for Ride-Sharing and Routing Games

Author(s): Levinger, C., Hazon, N., and Azaria, A.

Abstract: Ride-sharing services are gaining popularity and are crucial for a sustainable environment. A special case, in which such services are most applicable, is the last-mile variant. In this variant, it is assumed that all the passengers are positioned at the same origin location (e.g., an airport), and each have a different destination. One of the major issues in a shared ride is fairly splitting of the ride cost among the passengers.

In this paper, we use the Shapley value, which is one of the most significant solution concepts in cooperative game theory, for fairly splitting the cost of a shared ride. We consider two scenarios. In the first scenario there exists a fixed priority order in which passengers are dropped-off (e.g., elderly, injured etc.), and we show a method for efficient computation of the Shapley value in this setting. Our results are also applicable for efficient computation of the Shapley value in routing games. In the second scenario, there is no predetermined priority order, and we show that the Shapley value cannot be efficiently computed in this setting.

Subject Areas: Ride-sharing; Cost allocation; Shapley value

Availability: Levinger, C., Hazon, N., and Azaria, A. (2020). *Computing the Shapley Value for Ride-Sharing and Routing Games*. 19th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2020), Auckland, New Zealand.
<http://ifaamas.org/Proceedings/aamas2020/pdfs/p1895.pdf>

7.9. Title: User Private Clouds

Author(s): Riasanovsky, N.

Abstract: Applications that collect data from their participants often give users minimal control over their own data, although they sometimes allow users to request that their data be used properly. In contrast, User Private Clouds (UPCs) let users dictate a unique set of services that run in the cloud and are permitted to process their data. In UPC, users have sole ownership of their data, but they can still participate in large scale applications because the UPC trust model enables safe use of global differential privacy. This work demonstrates UPC by providing a sample implementation of the cloud-based layer. We demonstrate writing software for it by adapting the E-Mission research project and constructing a sample use case involving smart thermostats. Modifying E-Mission services to run in our UPC implementation required minimal software changes, one requiring as few as 6 lines of meaningful changes. Additionally, experiments run using a Kubernetes cluster in Google Cloud showed that spawning each user's specific services may introduce a significant overhead, but if services can be effectively predicted, this increased cost is manageable.

Subject Areas: User private clouds; Large-scale application; Privacy; Kubernetes cluster

Availability: Riasanovsky, N. (2020). *User Private Clouds*. University of California, Berkeley, CA. <https://www2.eecs.berkeley.edu/Pubs/TechRpts/2020/EECS-2020-130.html>

7.10. Title: Impact of Economic Crisis on Passenger Transportation – Case of Travelling to the Greek Mainland from Crete

Author(s): Chita, E., Drimili, E., Gareiou, Z., Milioti, C., Vranna, A., Pouloupoulos, S., and Zervas, E.

Abstract: The Greek economic crisis of 2009 onward has affected all aspects of social and economic life of the country, including transportation. The present study focuses on the impact of economic crisis on the long distance transportation between the island of Crete in Greece, the largest Greek island and one of the largest in the Mediterranean Sea, and the Greek mainland. A questionnaire survey was used to investigate the opinions of the Cretans on the way the economic crisis influenced their transportation to the Greek mainland. The results of the survey show that the frequency of the Cretans' travels was significantly limited, owing to the increased direct or indirect associated cost, due to the economic crisis. Especially for those who struggled to make ends meet, the transportation to the mainland dropped to the bare essentials. Furthermore, the respondents deemed that the deregulation of the Greek maritime and airline markets was also to blame for the high fares; thus, they favored a regulated public transport sector and were against privatization. Inevitably, financially vulnerable individuals were the most preoccupied with these issues. A feeling of isolation and exclusion was revealed by the sample on occasions when the scheduled trips were cancelled by the operators due to exogenous parameters.

Subject Areas: Transport; Economic crisis; Greece; Crete; Public opinion; Principal components analysis

Availability: Chita, E., Drimili, E., Gareiou, Z., Milioti, C., Vranna, A., Pouloupoulos, S., and Zervas, E. (2020). "Impact of Economic Crisis on Passenger Transportation – Case of Travelling to the Greek Mainland from Crete." *Promet - Traffic&Transportation*, 32(3), pp. 347–360. <https://doi.org/10.7307/ptt.v32i3.3255>

7.11. Title: How Large is too Large? A Review of the Issues related to Sample Size Requirements of Regional Household Travel Surveys with a Case Study on the Greater Toronto and Hamilton Area (GTHA)

Author(s): Habib, K.N., El-Assi, W., and Lin, T.

Abstract: The paper presents a review of sample size issues related to regional household travel surveys. A review of current practices reveals that different perspectives and, as a result, different practices exist in Canada, the United States, and abroad on sample size. The paper uses data from the Transportation Tomorrow Survey—a household travel survey conducted every 5 years in the Greater Toronto and Hamilton Area—for a set of empirical investigations that assess the adequacy of household travel survey samples. The empirical investigations reveal that even with a 5% sample size, a full representation of the population and its corresponding travel behavior may be difficult (at the 95% confidence level). Therefore, based on the results of the empirical investigations and the literature review, the paper proposes a flexible framework for household travel survey sample size determination, especially for Canadian municipalities. The findings and recommendations of the paper are unique in transportation literature, as they shed light on the statistical adequacy of household travel surveys' sample size—an issue that lacks consensus in today's practice of survey design. Further, the paper contributes to the literature by presenting a systematic review and recommendations on sample size determinants of regional household travel surveys.

Subject Areas: Regional household survey; Framework; Canadian municipalities

Availability: Habib, K.N., El-Assi, W., and Lin, T. (2020). *How Large is too Large? A Review of the Issues related to Sample Size Requirements of Regional Household Travel Surveys with a Case Study on the Greater Toronto and Hamilton Area (GTHA)*. University of Toronto, Toronto, Ontario, Canada. <https://arxiv.org/ftp/arxiv/papers/2005/2005.00563.pdf>

7.12. Title: Highway Traffic Monitoring—Understanding Tomorrow’s Problems to Better Serve the Public

Author(s): Klein, L.A., Tsapakis, I., Regehr, J., Stolz, L., and O’Brien, S.

Abstract: The Transportation Research Board’s (TRB’s) Technical Activities Division standing committees are communities of individuals who share an interest and expertise in transportation. The Technical Activities Council and the Centennial Task Force invited all standing committees to submit a Centennial Paper as part of the celebration. The Centennial Papers showcase TRB’s standing committees’ past accomplishments and contributions to transportation, demonstrate the committee’s current relevancy and activities, and consider the committee’s role in meeting future challenges and opportunities. This paper was submitted by the Standing Committee on Highway Traffic Monitoring (ABJ35).

Subject Areas: Committees; Highway traffic control; Intelligent transportation systems; Traffic surveillance

Availability: Klein, L.A., Tsapakis, I., Regehr, J., Stolz, L., and O’Brien, S. (2020). “Highway Traffic Monitoring—Understanding Tomorrow’s Problems to Better Serve the Public.” *Centennial Papers*. Transportation Research Board, Washington, DC.
<http://onlinepubs.trb.org/onlinepubs/centennial/papers/ABJ35-Final.pdf>

7.13. Title: A Dynamic Taxi Ride Sharing System Using Particle Swarm Optimization

Author(s): Silwal, S., Raychoudhury, V., Saha, S., and Gani, M.O.

Abstract: With the rapid growth of on-demand taxi services, like Uber, Lyft, etc., the urban public transportation scenario is shifting towards a personalized transportation choice for most commuters. While taxi rides are comfortable and time efficient, they often lead to higher cost and road congestion due to lower overall occupancy than bigger vehicles. A possible solution to improve taxi occupancy is to adopt ride sharing. Existing ride sharing solutions are mostly centralized and proprietary. However, given the wide spatio-temporal variation of incoming ride requests, designing a dynamic and distributed shared-ride scheduling system is NP-hard. In this thesis, we have proposed a publisher- (passengers) and subscriber- (taxis) based ride sharing system that provides effective real-time ride scheduling for multiple passengers willing to share rides in part or in full. A particle swarm based route optimization strategy has been applied to determine the most preferable route for passengers. Empirical analysis using large-scale, single-user taxi ride records from the Chicago Transit Authority show that our proposed system ensures a maximum of 91.74% and 63.29% overall success rates during peak and non-peak hours, respectively.

Subject Areas: On-demand taxi service; Uber; Lyft; Commuter; Taxi occupancy; Ride sharing; Real-time ride scheduling; Route optimization

Availability: Silwal, S., Raychoudhury, V., Saha, S., and Gani, M.O. (2020). “A Dynamic Taxi Ride Sharing System Using Particle Swarm Optimization. Miami University.” *2020 IEEE 17th International Conference on Mobile Ad Hoc and Sensor Systems (MASS)*, pp. 112–120, Delhi, India. <https://ieeexplore.ieee.org/document/9356070>

7.14. Title: A Century of Travel Surveys Informing Transportation Investments

Author(s): Ehrlich, J., Hard, E., Komanduri, A., and Anderson, R.S.

Abstract: Transportation expenditures in the United States account for over 5% of the gross domestic product, with 2015 expenditures estimated at \$972 billion.⁽¹⁾ The annual Federal transportation budget has been near \$77 billion since 2017.⁽²⁾ However, even with billions of dollars of funding, the Nation lacks the financial capacity to meet its transportation needs, with every State carefully selecting projects with the highest benefit/cost ratio for funding.

Since the passage of the *Federal-Aid Road Act* in 1916, all levels of government have been using transportation surveys to determine both existing and future transportation needs. HRB Bibliography No. 11 (3, pg. 6) states:

The early transportation surveys were based on two fundamental principles of management. The first is that the mileage and type of improved highways developed must be such as to meet the public demand and adequately serve traffic needs. The second is that the highway program must be financially sound.

These principles still hold true today, and travel surveys are being asked to do much more than they were a century ago. Today, not only do State departments of transportation use travel demand and economic and air quality models based on travel surveys to select infrastructure projects that meet future demand, but the U.S. Department of Transportation requires these analyses for their discretionary programs, such as the Federal Highway Administration's BUILD⁽⁴⁾ and the Federal Transit Administration's FAST.⁽⁵⁾

Travel surveys have been and continue to be the basis for transportation investment decisions. With the advent of Big Data, changing dynamics of travel and time use, and transformational mobility alternatives (e.g., transportation network companies (TNC)), more complex questions are being asked of travel survey data, and the Transportation Research Board has positioned itself to proactively respond.

Subject Areas: Transportation investment; Transportation expenditures; Travel surveys

Availability: Ehrlich, J., Hard, E., Komanduri, A., and Anderson, R.S. (2020). "A Century of Travel Surveys Informing Transportation Investments." *Centennial Papers*. Transportation Research Board, Washington, DC. <http://onlinepubs.trb.org/onlinepubs/centennial/papers/ABJ40-Final.pdf>

7.15. Title: Street Commerce: Creating Vibrant Urban Sidewalks

Author(s): Sevtsuk, A.

Abstract: Street commerce has gained prominence in urban areas, where demographic shifts, such as increasing numbers of single people and childless “empty nesters,” along with technological innovations enabling greater flexibility of work locations and hours, have changed how people shop and dine out. Contemporary city dwellers are demanding smaller-scale stores located in public spaces that are accessible on foot or by public transit. At the same time, the emergence of online retail undermines both the dominance and viability of big-box discount businesses and drives brick and mortar stores to focus as much on the experience of shopping as on the goods and services sold. Meanwhile, in many developing countries, the bulk of urban retail activity continues to take place on the street, even as new car-oriented shopping centers are on the rise. In light of such trends, street commerce will play an important role in 21st century cities, particularly in producing far-reaching benefits for the environment and local communities.

Although street commerce is deeply intertwined with myriad contemporary urban visions and planning goals—walkability, quality of life, inclusion, equity, and economic resilience—it has rarely been the focus of systematic research and informed practice. In *Street Commerce*, Andres Sevtsuk presents a comprehensive analysis of the issues involved in implementing successful street commerce. Drawing on economic theory, urban design principles, regulatory policies, and merchant organization models, he conceptualizes key problems and offers innovative solutions. He provides a range of examples from around the world to detail how different cities and communities have bolstered and reinvigorated their street commerce. According to Sevtsuk, successful street commerce can only be achieved when the private sector, urban policymakers, planners, and the public are equipped with the relevant knowledge and tools to plan and regulate it.

Subject Areas: Street commerce; Work flexibility; City planning; Online retail; Car-oriented shopping centers; Walkability; Equity; Economic resilience

Availability: Sevtsuk, A. (2020). *Street Commerce: Creating Vibrant Urban Sidewalks*. University of Pennsylvania Press, Philadelphia, PA.
https://books.google.com/books?id=eTXfDwAAQBAJ&dq=%22national+household+travel+survey%22++data&lr=lang_en&source=gbs_navlinks_s

7.16. Title: Comparative Assessment of Accessibility Metrics Across the U.S.

Author(s): McCahill, C., Jain, S., and Brenneis, M.

Abstract: Accessibility-related research has advanced considerably since its foundational conception six decades ago. Yet, despite widespread acceptance of the concept, these methods are still rarely used in practical applications among transportation agencies and policymakers. Until recently, the challenges were mainly technical, but now they are more practical. Practitioners are often faced with decisions about appropriate methods and metrics, which are difficult to answer from the current literature. This study attempts to produce a clearer understanding of the effects that those decisions have on practical outcomes based on data spanning many geographies across the United States. We test a variety of metrics—including different modes, destination types, analytical geographies, and metric definitions—in regions spanning seven States. This study points to several potential best practices, including the use of non-work walking accessibility metrics in multimodal analysis and the use of decay functions in accessibility metrics, and provides a strong foundation for future research.

Subject Areas: Accessibility; Metrics; Multimodal analysis; Decay functions

Availability: McCahill, C., Jain, S., and Brenneis, M. (2020). “Comparative Assessment of Accessibility Metrics Across the U.S.” *Transportation Research Part D: Transport and Environment*, 83. <https://doi.org/10.1016/j.trd.2020.102328>

7.17. Title: Improved Travel Demand Modeling with Synthetic Populations

Author(s): Wang, K., Zhang, W., Mortveit, H., and Swarup, S.

Abstract: We compare synthetic population-based travel demand modeling with the state-of-the-art travel demand models used by metropolitan planning offices in the United States. Our comparison of the models for three U.S. cities shows that synthetic population-based models match the state-of-the-art models closely for the temporal trip distributions and the spatial distribution of destinations. The advantages of the synthetic population-based method are that it provides greater spatial resolution, can be generalized to any region, and can be used for studying correlations with demographics and activity types, which are useful for modeling the effects of policy changes.

Subject Areas: Travel demand; Transportation; Synthetic population

Availability: Wang, K., Zhang, W., Mortveit, H., and Swarup, S. (2020). *Improved Travel Demand Modeling with Synthetic Populations*. 19th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2020), Auckland, New Zealand.

<https://underline.io/lecture/100-improved-travel-demand-modeling-with-synthetic-populations>

7.18. Title: Road Importance Using Complex-Networks, Graph Reduction & Interpolation

Author(s): Alfosool, A.M.S., Chen, Y., Fuller, D., and Al-Eidi, S.

Abstract: Most people spend hours on the road on a daily basis making road networks a crucial part of our daily lives. Trips to work, the grocery store, the hospital, or even casual jogs and road trips mainly occur on walkable or drivable roads. With the increase of online communities, professionals, and enthusiasts, road networks are now abundantly available from various sources, making them a great resource for a variety of analyses, such as finding the road importance, road characteristics, city planning, and the association between neighborhoods' walkability and the local obesity rate. However, as data increases, analyzing larger regions requires much more processing power and computational time. We aim to incorporate graph reduction and centrality interpolation while utilizing some already efficient complex networks centrality algorithms to produce ready-to-analyze road scores for the entire given data set while reducing the required computational time when compared to the conventional algorithms that do not use reduction. Furthermore, our produced road scores can be applied to non-network characteristics such as amenities, elevation, road type, road condition, and road structure to produce more accurate walkability scores.

Subject Areas: Complex networks; Graph reduction; Interpolation; Network centrality; Walkability; Road connectivity

Availability: Alfosool, A.M.S., Chen, Y., Fuller, D., and Al-Eidi, S. (2020). "Road Importance Using Complex-Networks, Graph Reduction & Interpolation." *2020 International Conference on Computing, Networking and Communications (ICNC)*, pp. 855–859, Big Island, HI.
<https://doi.org/10.1109/ICNC47757.2020.9049768>

7.19. Title: Incorporating Activity Space and Trip Chaining into Facility Siting for Accessibility Maximization

Author(s): Li, R. and Tong, D.

Abstract: Location models have been widely used to support locational decisions for various service provision. One common objective of location models has been to ensure maximal accessibility of sited facilities to demand populations. Accessibility evaluation in location models often assumes that trips originate from fixed locations (usually home) and are single purpose. These assumptions contradict the empirical evidence that suggests trips also commonly originate from non-home locations and may involve multiple stops. In this study, a new multi-objective location model is developed that extends the classic p -median problem (PMP) to account for a more realistic assessment of accessibility. Based on the individual accessibility assessment, notions of trip chaining and activity space are incorporated into the model development. In addition to fixed home locations, stops along chained trips are allowed for potential service site visits, and activity space is introduced as an additional dimension to evaluate accessibility of alternative opportunities. The effectiveness of the new model is demonstrated using an application in Tucson, AZ.

Subject Areas: Location modeling; Accessibility; Activity space; Geographical information systems

Availability: Li, R. and Tong, D. (2020). "Incorporating Activity Space and Trip Chaining into Facility Siting for Accessibility Maximization." *Socio-Economic Planning Sciences*, 60, pp. 1–14. <https://doi.org/10.1016/j.seps.2017.01.007>

7.20. Title: Robust Bayesian Adjustment for Finite Population Inference: Application to Naturalistic Driving Data in SHRP2

Author(s): Rafei, A.

Abstract: Presentation.

Subject Areas: Survey methodology; Non-probability sampling; Sensor-based big data; Second Strategic Highway Research Program (SHRP2); Naturalistic driving studies

Availability: Rafei, A. (2020). *Robust Bayesian Adjustment for Finite Population Inference: Application to Naturalistic Driving Data in SHRP2*. SAMSI–Program on Games, Decisions, Risk and Reliability (GDRR) Workshop. <https://www.samsi.info/wp-content/uploads/2020/03/rafei.pdf>

7.21. Title: Meeting Travel Needs: Becoming Reacquainted with a Community's Unmet Travel Needs

Author(s): Annaleigh, Y.E.

Abstract: Our current examples of transportation needs assessments focus on existing and established travel behaviors to predict the needs of a community, but there are populations that face additional burdens that are not captured outside of surveys and data collection efforts in academia. The goal of this research is to identify the best practices to collect data on the unmet travel needs of a neighborhood, particularly for disadvantaged populations. This project is a mixed-methods approach involving a literature review, open-ended interviews with academics and professionals with survey experience, and focus groups with community members in Downtown Huntington Park. This study finds that the ideal approach for collecting information on the travel needs of a neighborhood combines the benefits of active and passive data collection using smartphone-based surveys and thorough outreach to ensure that the survey instrument works for underrepresented populations. The current efforts to study the travel needs of disadvantaged populations in studies occur at a smaller scale, but with a focused effort in relationship building and community context. There are quality resources, examples, and guides for community needs assessments that can serve as a template for agencies seeking to explore the needs of their communities, such as the Mobility Equity Framework and the University of Kansas Community Tool Box. Community members in Downtown Huntington Park conveyed a willingness to participate in a smartphone-based travel survey, expressed their car-dependent nature, and provided valuable feedback on how outreach could be conducted in their neighborhood.

Subject Areas: Survey methodology; Disadvantaged populations; Data collection; Mobility Equity Framework; Smartphone-based travel survey; Downtown Huntington Park, CA

Availability: Annaleigh, Y.E. (2020). *Meeting Travel Needs: Becoming Reacquainted with a Community's Unmet Travel Needs*. University of California, Los Angeles, CA.
<https://escholarship.org/uc/item/446367xt>

7.22. Title: Multimodal Travel Mode Imputation based on Passively Collected Mobile Device Location Data

Author(s): Yang, M.

Abstract: Passively collected mobile device location (PCMDL) data contain abundant travel behavior information to support travel demand analysis. Compared to traditional travel surveys, PCMDL data have larger spatial, temporal, and population coverage while lacking ground truth information. This study proposes a framework to identify trip ends and impute travel modes from the PCMDL data. The proposed framework firstly identifies trip ends using the Spatio-temporal Density-based Spatial Clustering of Applications with Noise (ST-DBSCAN) algorithm. Then three types of features are extracted for each trip to impute travel modes using machine learning methods. A PCMDL dataset with ground truth information is used to calibrate and validate the proposed framework, resulting in 95% accuracy in identifying trip ends and 93% accuracy in imputing five travel modes using the Random Forest (RF) classifier. The proposed framework is then applied to two large-scale PCMDL datasets, covering Maryland and the entire U.S. The mode share results are compared against travel surveys at different geographic levels.

Subject Areas: Travel demand analysis; Passively collected mobile device location; Trip ends identification; Spatio-temporal Density-based Spatial Clustering of Applications with Noise; Travel modes imputation; Random forest (RF)

Availability: Yang, M. (2020). *Multimodal Travel Mode Imputation based on Passively Collected Mobile Device Location Data*. Master's Thesis, University of Maryland, College Park, MD. <https://drum.lib.umd.edu/handle/1903/26291>

7.23. Title: Socio-Economic, Built Environment, and Mobility Conditions Associated With Crime: A Study of Multiple Cities

Author(s): Nadai, M., Xu, Y., Letouzé, E., González, M.C., and Lepri, B.

Abstract: Nowadays, 23% of the world population lives in multi-million cities. In these metropolises, criminal activity is much higher and violent than in either small cities or rural areas. Thus, understanding what factors influence urban crime in big cities is a pressing need. Seminal studies analyze crime records through historical panel data or analysis of historical patterns combined with ecological factor and exploratory mapping. More recently, machine learning methods have provided informed crime prediction over time. However, previous studies have focused on a single city at a time, considering only a limited number of factors (such as socio-economical characteristics) and often at large in a single city. Hence, our understanding of the factors influencing crime across cultures and cities is very limited. Here we propose a Bayesian model to explore how violent and property crimes are related not only to socio-economic factors but also to the built environmental (e.g., land use) and mobility characteristics of neighborhoods. To that end, we analyze crime at small areas and integrate multiple open data sources with mobile phone traces to compare how the different factors correlate with crime in diverse cities, namely Boston, Bogotá, Los Angeles and Chicago. We find that the combined use of socio-economic conditions, mobility information and physical characteristics of the neighborhood effectively explain the emergence of crime, and improve the performance of the traditional approaches. However, we show that the socio-ecological factors of neighborhoods relate to crime very differently from one city to another. Thus there is clearly no “one fits all” model.

Subject Areas: Criminal activity; Crime prediction; Bayesian model; Urban

Availability: Nadai, M., Xu, Y., Letouzé, E., González, M.C., and Lepri, B. (2020). “Socio-Economic, Built Environment, and Mobility Conditions Associated With Crime: A Study of Multiple Cities.” *Scientific Reports*, 10. <https://doi.org/10.1038/s41598-020-70808-2>

7.24. Title: Counterfactual and Welfare Analysis with an Approximate Model

Author(s): Allen, R. and Rehbeck, J.

Abstract: We propose a conceptual framework for counterfactual and welfare analysis for approximate models. Our key assumption is that model approximation error is the same magnitude at new choices as the observed data. Applying the framework to quasilinear utility, we obtain bounds on quantities at new prices using an approximate law of demand. We then bound utility differences between bundles and welfare differences between prices. All bounds are computable as linear programs. We provide detailed analytical results describing how the data map to the bounds including shape restrictions that provide a foundation for plug-in estimation. An application to gasoline demand illustrates the methodology.

Subject Areas: Approximate models; Quasilinear utility; Shape restrictions; Plug-in estimation

Availability: Allen, R. and Rehbeck, J. (2020). *Counterfactual and Welfare Analysis with an Approximate Model*. arXiv, Cornell University, Ithaca, NY. <https://arxiv.org/abs/2009.03379>

7.25. Title: Critical Business Decision Making for Technology Startups—A PerceptIn Case Study

Author(s): Liu, S.

Abstract: Most business decisions are made with analysis, but some are judgment calls not susceptible to analysis due to time or information constraints. In this article, we present a real-life case study of critical business decision making of PerceptIn, an autonomous driving technology startup. In early years of PerceptIn, PerceptIn had to make a decision on the design of computing systems for its autonomous vehicle products. By providing details on PerceptIn's decision process and the results of the decision, we hope to provide some insights that can be beneficial to entrepreneurs and engineering managers in technology startups.

Subject Areas: Case study; Technology startups; Business decisions

Availability: Liu, S. (2020). *Critical Business Decision Making for Technology Startups—A PerceptIn Case Study*. arXiv, Cornell University, Ithaca, NY. <https://arxiv.org/abs/2009.03011>

7.26. Title: Synthesizing Neighborhood Preferences for Automated Vehicles

Author(s): Zhang, W., Wang, K., Wang, S., Jiang, Z., Mondschein, A., and Noland, R.B.

Abstract: Automated Vehicles (AVs) have gained substantial attention in recent years as the technology has matured. Researchers and policymakers envision that AV deployment will change transportation, development patterns, and other urban systems. Researchers have examined AVs and their potential impacts with two methods: (1) survey-based studies of AV preferences and (2) simulation-based estimation of secondary impacts of varied AV deployment strategies, such as Shared AVs (SAVs) and Privately-owned AVs (PAVs). While the preference survey literature can inform AV simulation studies, preference study results have so far not been integrated into simulation-based research. This lack of integration stems from the absence of data that measure preferences towards PAVs and SAVs at the neighborhood level. Existing preference studies usually investigate adoption likelihood without collecting appropriate information to link preferences to precise locations or neighborhoods. This study develops a microsimulation approach, incorporating machine learning and population synthesizing, to fill this data gap, leveraging a national AV perception survey (NAVPS) and the latest National Household Travel Survey (NHTS) data. The model is applied to San Francisco, CA, and Austin, TX, to test the concept. We validate the proposed model by comparing the spatial distributions of synthesized ride-hailing users and observed ride-hailing trips. High correlations between our synthesized user density and empirical trip distributions in two study areas, to some extent, verify our proposed modeling approach.

Subject Areas: Preferences; Shared automated vehicles; Private automated vehicles; Machine learning; Population synthesizing

Availability: Zhang, W., Wang, K., Wang, S., Jiang, Z., Mondschein, A., and Noland, R.B. (2020). "Synthesizing Neighborhood Preferences for Automated Vehicles." *Transportation Research Part C: Emerging Technologies*, 120. <https://doi.org/10.1016/j.trc.2020.102774>

7.27. Title: Performance of One-Way Carsharing Systems Under Combined Strategy of Pricing and Relocations

Author(s): Lu, R., Correia, G.H.A., Zhao, X., Liang, X., and Lv, Y.

Abstract: A bilevel nonlinear mathematical programming model is formulated to determine the optimal pricing and operator-based relocations in a one-way station-based carsharing system in competition with private cars. In the upper level, the carsharing operator determines the vehicle fleet, prices, and relocation operations with the objective of maximizing profits, considering the potential reaction of travelers. In the lower level, travelers choose travel modes from a cost-minimization perspective. Travel utilities are calculated through a logit model. The Karush–Kuhn–Tucker conditions are used to transform the bilevel model into a single-level model and then a genetic algorithm is proposed to solve it. Computational tests in four different scenarios show the combined strategy is the best one. The four scenarios are base, relocations, dynamic pricing, and a combination of relocations and pricing separately. The combined strategy can make the best trade-offs between the operator’s profit and the travelers’ cost.

Subject Areas: Carsharing; Relocations; Optimal pricing; Bilevel nonlinear programming model

Availability: Lu, R., Correia, G.H.A., Zhao, X., Liang, X., and Lv, Y. (2020). “Performance of One-Way Carsharing Systems Under Combined Strategy of Pricing and Relocations.”

Transportmetrica B: Transport Dynamics, 9(1), pp. 134–152.

<https://doi.org/10.1080/21680566.2020.1819912>

7.28. Title: Incorporation of Connected and Automated Vehicles (CAV) in Travel Demand Modeling Focusing on Traffic Forecasting

Author(s): Rahman, A.

Abstract: Traffic forecasting is always a challenge, and the intensity of this challenge is higher when the job is to do traffic forecasts considering connected and automated vehicles (CAV). The travel demand model (TDM) is an important and incomparable tool to do traffic forecasts for transportation projects and scenarios for transportation plans. Different agencies not limited to the State Department of Transportations (DOTs), and the Metropolitan Planning Organizations (MPOs) need to develop plans, such as the long-range transportation plan and short-range transportation plan. These plans range from 4–6 years (short) to 20–30 years (long). Various research and studies are going on considering the CAV for traffic operations, policy, and so on. Specific studies have not been conducted to provide guidelines for planning agencies to consider the CAV for transportation planning focusing on the TDM to do traffic forecasts. This research work has proposed strategies to incorporate CAV in the TDM to do traffic forecasts. This study has proposed an improvised TDM methodology considering the consequences of the emergence of CAV in the transportation system from the planning perspective. The proposed method is based on the most traditional four-step trip based TDM and to incorporate adjustments of different supply level independent variables which will guide to develop different scenarios based on the need for planning agencies and stakeholders. This research has proposed formula to estimate trip production and vehicle ownership from the intuitive reaction of CAV emergence in the near future. Multiple scenario results from this research conclude that vehicle miles travel (VMT), vehicle hours travel (VHT), and travel delay due to CAV implementation are directly related to travel behaviors such as auto occupancy and vehicle ownership. VMT, VHT, and travel delay do not always go up with the dedicated lane (DL) for CAV implementation. This research has analyzed different scenarios considering changes in single occupancy (SO) and vehicle ownership (VO) with the DLs for CAV. This research result shows that the DLs implementation for CAV with the current (according to NHTS 2017) SO and VO rate may increase VMT. Notwithstanding, case study results from this research show that “with CAV” considering reduced SO and VO and DL implementation, VMT may decrease up to 40 percent than “without CAV.” The transportation mobility may be challenging and chaotic if only the DLs for CAV is implemented without considering travel behaviors. Results from case studies in this research suggest implementing single DL for CAV at the beginning of implementation. Another recommendation of this research is to consider and analyze SO and VO as travel behaviors with the DLs for CAV implementation to do traffic forecasts in a transportation plan or a specific project.

Subject Areas: Travel demand model; Connected and automated vehicles; Transportation plans; Vehicle miles travel (VMT); Vehicle hours travel (VHT); Travel delay

Availability: Rahman, A. (2020). *Incorporation of Connected and Automated Vehicles (CAV) in Travel Demand Modeling Focusing on Traffic Forecasting*. Doctoral Dissertation, The University of Wisconsin–Madison, Madison, WI. <https://search.proquest.com/openview/e22c2e2079b1559202cb780a7f9caff7/1?pq-origsite=gscholar&cbl=44156>

7.29. Title: A Pervasive Framework Toward Sustainability and Smart-growth: Assessing Multifaceted Transportation Performance Measures for Smart Cities

Author(s): Feizi, A., Joo, S., Kwigizile, V., and Oh, J.

Abstract: Introduction: The concept of a smart city is fast becoming a key instrument in transforming living environments in a better way to enhance the operational efficiency of a transportation system. This paper presents a framework to assess transportation performance measures and smart-growth of cities around the U.S. by including physical activity as one of the main criteria.

Methods: This study employs Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) as a multi-criteria decision analysis (MCDA) method. The proposed assessment framework is comprised of the evaluation of an individual criterion and the assessment of comprehensive results. The criteria are categorized into four groups including network performance, traffic safety, environmental impact, and physical activity. As a case example, the proposed performance measures were examined for 46 cities in the U.S., and the required data was gathered from multiple sources.

Results: The output of the framework contains sustainability and smart-growth rankings of the selected cities as well as uncertainty and sensitivity analysis. The sensitivity analysis was utilized to determine the quantity that each performance measure or weighting factor requires to alter the smart-growth score. It has been illustrated that the dominancy between reversible pairs in the ranking is critically sensitive for almost 15% of cases.

Conclusion: The results of the proposed framework can be an effective decision supporting tool in analyzing traffic management strategies. Results from the score sensitivity calculation indicate that the proposed framework can be adopted in multifaceted transportation system performance in sustainability and smart-growth of cities.

Subject Areas: Smart city; Sustainable transportation; Transportation performance; Physical activity; Public health; Multi-criteria decision analysis

Availability: Feizi, A., Joo, S., Kwigizile, V., and Oh, J. (2020). "A Pervasive Framework Toward Sustainability and Smart-growth: Assessing Multifaceted Transportation Performance Measures for Smart Cities." *Journal of Transport & Health*, 19.
<https://doi.org/10.1016/j.jth.2020.100956>

7.30. Title: Batches, Bursts, and Service Systems

Author(s): Daw, A.M.

Abstract: In a plethora of natural phenomena, events occur in flurries, clusters, or bunches. Modern service systems are no exception to this. This can be by design, such as in batches of jobs being sent to a data center for processing, or simply by circumstance, such as in bursts of newly infected flu patients arriving to a health clinic or in the virality of new interactions with a popular social media post. This thesis is concerned with the modeling, exploration, and analysis of these batch and burst arrival processes through the lens of applied probability. Often, this builds on the idea of self-exciting Hawkes process, in which each arrival increases the likelihood of another arrival occurring soon after, forming quick bursts of several successive arrivals. By comparison, batches are taken to be truly simultaneous, with multiple entities entering the system at precisely the same epoch. In the course of this dissertation, batches are both compared to bursts and used as tools to develop deeper understanding of bursts. These objects are also both applied in a variety of settings, most notably in the problem of staffing teleoperation support systems for autonomous vehicles. This analysis reveals that batches and bursts have a pronounced effect on service systems, and thus must be addressed.

Subject Areas: Modern service systems; Batch and burst arrival processes; Applied probability; Hawkes process

Availability: Daw, A.M. (2020). *Batches, Bursts, and Service Systems*. Doctoral Dissertation, Cornell University, Ithaca, NY.

<https://search.proquest.com/openview/c999c800cdf4813b57b7a69e20e7410f/1?pq-origsite=gscholar&cbl=44156>

7.31. Title: Non-technological Challenges for the Remote Operation of Automated Vehicles

Author(s): Goodall, N.

Abstract: No existing automated vehicle can operate in all conditions and environments. In order to allow unmanned operation of automated vehicles in all conditions, many developers have the capability for human drivers to operate the vehicle from a remote location using wireless communication. This practice, referred to as remote operation or teleoperation, is prevalent among industry, yet has received little attention in the legal and transportation literature. This paper describes the legal environment for remote operation of vehicles, both in terms of existing motor vehicle codes and model legislation. The operational performance of remote operation is explored, and a model is developed to estimate the number of remote operators needed to manage large, automated vehicle fleets using reasonable assumptions.

Subject Areas: Remote operation; Remote control; Teleoperation; Automation; Outsourcing

Availability: Goodall, N. (2020). “Non-technological Challenges for the Remote Operation of Automated Vehicles.” *Transportation Research Part A: Policy and Practice*, 142, pp. 14–26. <https://doi.org/10.1016/j.tr.2020.09.024>

7.32. Title: Trip Chain Simulation of Electric Vehicles based on NHTS Data

Author(s): Fu, Z., Liu, W., Zhu, J., and Yuan, Y.

Abstract: It has great potential that electric vehicles (EVs) participate in the regulation and control of the power grid. However, due to randomness of EV in use, it is necessary to determine their spatial and temporal distribution status. Based on the latest released National Household Travel Survey (NHTS) data, this paper fits the temporal and spatial feature information of the EV trip chain and makes corresponding improvements to the deficiencies in the existing research. The stochastic simulation method is used to simulate the trip chain, and the simulation results are verified and analyzed, which shows that the method can accurately simulate the EV trip chain and can provide strong support for the subsequent EV participation in the analysis of grid control operations.

Subject Areas: Electric vehicles; Trip chain; Information fitting; Stochastic simulation

Availability: Fu, Z., Liu, W., Zhu, J., and Yuan, Y. (2020). "Trip Chain Simulation of Electric Vehicles based on NHTS Data." *2020 12th IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC)*, pp. 1–6, Nanjing, China.
<https://doi.org/10.1109/APPEEC48164.2020.9220726>

7.33. Title: Robust and Efficient Methods of Inference for Non-Probability Samples: Application to Naturalistic Driving Data

Author(s): Rafei, A., Elliott, M.R., and Flannagan, C.A.C.

Abstract: Presentation.

Subject Areas: Naturalistic driving studies; Strategic highway research program

Availability: Rafei, A., Elliott, M.R., and Flannagan, C.A.C. (2020). *Robust and Efficient Methods of Inference for Non-Probability Samples: Application to Naturalistic Driving Data*.

University of Michigan, Ann Arbor, MI.

https://psm.isr.umich.edu/sites/default/files/2020_0930%20Ali%20Rafei%20Seminar%20final%20slides.pdf

7.34. Title: On the Impact of Income, Age, and Travel Distance on the Value of Time

Author(s): Fournier, N. and Christofa, E.

Abstract: The value of time (VOT) is a fundamental component used in transportation modeling, policy analysis, and economic appraisal. Decades of research and practice have empirically estimated the VOT across many factors (e.g., mode, purpose, time, comfort, etc.), yet little is known about its underlying form. Although it is well established that VOT can vary, it is still unclear whether patterns exist in this variation. The objective of this paper is not to merely estimate the VOT, but to model the VOT across multiple continuous and interacting variables. The purpose is to reveal its functional form with respect to mode, age, gender, purpose, income, and time of day to provide a generalizable understanding for future research and practice. Such an understanding can help develop simpler models and reduce the need for bespoke estimations for every conceivable variable perturbation. This research utilized a household travel survey containing 14,159 reported trips with imputed travel time and costs for the alternative mode choices. The average overall estimated VOT is 40.32 \$/h, with results showing VOT varying logarithmically with income and trip distance, but following a Gaussian function (normal curve) with age. Overall, the results show that travel distance dominates VOT variation, which increases exponentially at a rate that is 3.61 times higher per mile of distance than per \$10,000 of income, and that VOT by age peaks at age 54. This basic understanding of how the VOT varies sets the foundation for answering the subsequent question for why it might vary.

Subject Areas: Value of time; Mode; Age; Gender; Purpose; Income; Time of day; Gaussian function

Availability: Fournier, N. and Christofa, E. (2020). "On the Impact of Income, Age, and Travel Distance on the Value of Time." *Transportation Research Record: Journal of the Transportation Research Board*. <https://doi.org/10.1177/0361198120966603>

7.35. Title: Proxy Reporting and Travel Diary Completion Status and their Impacts on Reported Trips in National Household Travel Surveys

Author(s): Badoe, D., Crouch, L.K., and Mohr, B.

Abstract: Household and travel behavior data are critical to the development of transportation plans for states and metropolitan regions. A key use of such data is the development of travel forecasting models, which are used to generate forecasts of travel with the objective of identifying the major transportation infrastructure needs of a region or state. Thus, it is important for data collected from sampled households to be representative of the population. Most household and travel surveys are often undertaken by telephone. At the time of telephone interview, not all households have their members present or of an age to be eligible for direct interview hence, in such households, an adult member responds on behalf of the unavailable or young members. Providing responses to questions on behalf of another household member in surveys is called proxy reporting. It presents the opportunity for the underreporting of trips with the consequence that future travel demand could be underestimated. To address the latter concern, some planning agencies provide members of survey participating households with travel diaries in which to record their trip-details on their assigned travel day. During the survey retrieval interview, the proxy respondent is supposed to consult the travel diary of non-responding household members. However, some participants do not complete the travel diary. For these, proxy respondents tend to report trips usually made by these household members in question and not their actual trips. This again presents the opportunity for bias in reported trips.

This research investigates the impact of travel diary completion and proxy response on reported trips in two National Household Travel Survey (NHTS) conducted in 2009 and 2017 respectively. It also develops a methodology for estimating factors for the adjustment of underreported trips and applies the methodology to estimate adjustment factors for reported trips in the 2009 and 2017 surveys. The results of the descriptive analysis and statistical testing indicated that home-based discretionary trips and non-home-based trips were significantly underreported when a proxy was used and when a travel diary was not completed. Home-based work trips, although underreported as well, had estimated adjustment factors that were smallest in magnitude. This is attributable to trips for the purpose of work being repetitive hence, being easier to recall by a proxy respondent. The results lead to the conclusion that reported trip data have to be adjusted to correct for underreporting prior to their use in the estimation of travel forecasting models.

Subject Areas: Proxy reporting; Travel diary completion; Home-based discretionary trips; Underreporting

Availability: Badoe, D., Crouch, L.K., and Mohr, B. (2020). *Proxy Reporting and Travel Diary Completion Status and their Impacts on Reported Trips in National Household Travel Surveys*. Master's Thesis, Tennessee Tech University, Cookeville, TN.
https://www.tntech.edu/engineering/pdf/grad/ms/2020/AbounassifL_MS.pdf

7.36. Title: Mining Daily Activity Chains from Large-Scale Mobile Phone Location Data

Author(s): Yin, L., Lin, N., and Zhao, Z.

Abstract: Understanding residents' daily activity chains provides critical support for various applications in transportation, public health and many other related fields. Recently, mobile phone location datasets have been suggested for mining activity patterns because of their utility and large sample sizes. Although recently machine learning-based models seem to perform well in activity purpose inference using mobile phone location data, most of these models work as black boxes. To address these challenges, this study proposes a flexible white box method to mine human activity chains from large-scale mobile phone location data by integrating both the spatial and temporal features of daily activities with varying weights. We find that the frequency distribution of major activity chain patterns agrees well with the patterns derived based on a travel survey of Shenzhen and a state-of-the-art method. Moreover, a dataset covering over 16.5% of the city population can yield a reasonable outcome of the major activity patterns. The contributions of this study not only lie in offering an effective approach to mining daily activity chains from mobile phone location data but also involve investigating the impact of different data conditions on the model performance, which make using big trajectory data more practical for domain experts.

Subject Areas: Mobile phone data; Activity chain; Activity purpose; Trajectory analysis; Data size

Availability: Yin, L., Lin, N., and Zhao, Z. (2020). "Mining Daily Activity Chains from Large-Scale Mobile Phone Location Data." *Cities*, 109. <https://doi.org/10.1016/j.cities.2020.103013>

7.37. Title: Identification of Social Aspects by Means of Inertial Sensor Data

Author(s): Bedogni, L. and Cabri, G.

Abstract: Today's applications and providers are very interested in knowing the social aspects of users in order to customize the services they provide and to be more effective. Among the others, the most frequented places and the paths to reach them are information that turns out to be very useful to define users' habits. The most exploited means to acquire positions and paths is the GPS sensor, however it has been shown how leveraging inertial data from installed sensors can lead to path identification. In this work, we present a Computationally Efficient algorithm to Reconstruct Vehicular Traces (CERT), a novel algorithm which computes the path traveled by a vehicle using accelerometer and magnetometer data. We show that by analyzing data obtained through the accelerometer and the magnetometer in vehicular scenarios, CERT achieves almost perfect identification for medium and small sized cities. Moreover, we show that the longer the path, the easier it is to recognize it. We also present results characterizing the privacy risks depending on the area of the world, since, as we show, urban dynamics play a key role in the path detection.

Subject Areas: Vehicular; Traces; Algorithm; Inertial sensors

Availability: Bedogni, L. and Cabri, G. (2020). "Identification of Social Aspects by Means of Inertial Sensor Data." *Information*, 11(11). <https://doi.org/10.3390/info11110534>

7.38. Title: Comparative Study on Solving the Minimum Fleet of Shared Autonomous Vehicles

Author(s): Wang, G.

Abstract: Assuming that all travel demands are met by shared autonomous vehicle (SAV), the paper compares graph theory method and the multiple travelling salesman problem (MTSP) method in solving the minimum fleet size problem. With the trajectory data of 50 new energy private cars in Shanghai for 1 year, travel demands are extracted. A specific method for calculating whether two trips can be served by one SAV is developed. Then, the minimum fleet size problem are transformed into the minimum path cover problem on directed graph (graph theory method) and MTSP shortest path problem (MTSP method). Hopcroft-Karp algorithm is adopted in graph theory method, while genetic algorithm (GA) is adopted in the MTSP method. Results show that graph theory method outperforms the MTSP method both in the quality of solution and the computing time. Results indicate that a SAV can replace 2.5 traditional private cars on average.

Subject Areas: Transportation engineering; Travel demand; Automobiles; Data collection; Comparative studies; Computing in civil engineering; Algorithms

Availability: Wang, G. (2020). "Comparative Study on Solving the Minimum Fleet of Shared Autonomous Vehicles." *20th Chinese Overseas Transportation Association International Conference of Transportation Professionals*, Xi'an, China (Conference Cancelled).
<https://doi.org/10.1061/9780784483053.045>

7.39. Title: Estimating Small Area Demand for Online Package Delivery

Author(s): Fabusuyi, T., Twumasi-Boakye, R., Broaddus, A., Fishelson, J., and Hampshire, R.C.

Abstract: Using publicly available microdata sets, we show how estimates for online delivery purchases can be generated for small geographic areas defined in our study as micro analysis zones (MAZ) and how these estimates vary across the MAZs that featured in our study. With a focus on Miami-Dade County, we use both the national household travel survey (NHTS) data and synthetic data obtained from Southeast Florida Regional Planning Model (SERPM) to generate demand estimates of online delivery purchases for more than 5,300 distinct geographic units in Miami-Dade County. We assess the quality of the estimates using measures of predictive accuracy and by comparing the cumulative values obtained with the population estimates generated from the NHTS survey data for Miami-Dade County. Our approach fills a void in the area of purchases of online delivery items where rich observable data are typically unavailable and it also provides the added potential benefit of being easily replicated nationwide given the emphasis on the use of publicly available data.

Subject Areas: Online delivery; Package delivery; Small area estimation; National Household Travel Survey; Synthetic population; Miami-Dade county

Availability: Fabusuyi, T., Twumasi-Boakye, R., Broaddus, A., Fishelson, J., and Hampshire, R.C. (2020). "Estimating Small Area Demand for Online Package Delivery." *Journal of Transport Geography*, 88. <https://doi.org/10.1016/j.jtrangeo.2020.102864>

7.40. Title: Developing Guidance for a Corridor Level Vehicle Occupancy Rate Data Collection Program

Author(s): Dougald, L.E., Miller, J.S., and Xu, Y.

Abstract: *Moving Ahead for Progress in the 21st Century Act* (MAP-21) and Smart Scale continue to foster congestion management initiatives, many of which emphasize more person movements than vehicle movements; therefore, vehicle occupancy data are becoming increasingly important. Presently there are two data sources for obtaining the number of persons per vehicle: the American Community Survey (ACS) administered by the U.S. Census Bureau and the National Household Travel Survey (NHTS) administered by Federal Highway Administration (FHWA). The former only provides occupancies for one trip purpose (the work trip) and is updated every one to five years depending on the jurisdiction's population; the latter provides occupancies for many trip purposes but is only updated roughly every 7 years. Neither source provides corridor-specific occupancies. In order to calculate MAP-21 PM3 measures, there is a need to have detailed corridor specific occupancy rate data by time of day (am peak, mid-day, pm peak, weekend) and vehicle types (car, bus, and truck). The objective of this research is to establish guidance on how to collect, where to collect, when to collect, why to collect, and what to collect so that the Virginia Department of Transportation (VDOT) Transportation Mobility Planning Division can build an occupancy rate data collection program similar to VDOT's Traffic Engineering Division's short-term traffic count program. The research and resulting guidance will provide VDOT with methodologies to assess carpooling, commuted activity patterns, and impacts of congestion management strategies at the corridor level. Consequently, MAP-21 and Virginia Smart Scale performance measure requirements can be realized.

Subject Areas: Automobiles; Buses; Congestion management systems; Data collection; Guidelines; Methodology; Periods of the day; Transportation corridors; Trucks; Vehicle occupancy

Availability: Dougald, L.E., Miller, J.S., and Xu, Y. (2020). *Developing Guidance for a Corridor Level Vehicle Occupancy Rate Data Collection Program*. The National Academies of Sciences, Engineering, and Medicine, Washington, DC. <https://rip.trb.org/view/1739082>

Chapter 8. Traffic Safety

8.1. Title: Enough is Enough

Author(s): Not available.

Abstract: Blog.

Subject Areas: Road safety; Teen drivers; Seat belt use; Driver licensing system

Availability: (2020). "Enough is Enough." *This Day*.

<https://www.thisdaylive.com/index.php/2020/04/11/enough-is-enough/>

8.2. Title: My Last Thought on “Enough Is Enough”

Author(s): Not available.

Abstract: Blog.

Subject Areas: Road safety; Teen drivers; Seat belt use; Driver licensing system

Availability: (2020). “My Last Thought on ‘Enough Is Enough’.” *This Day*.
<https://www.thisdaylive.com/index.php/2020/04/25/my-last-thought-on-enough-is-enough/>

8.3. Title: Comparing Distance and Time As Driving Exposure Measures to Evaluate Fatal Crash Risk Ratios

Author(s): Shen, S., Benedetti, M.H., Zhao, S., Wei, L., and Zhu, M.

Abstract: Background: The use of an appropriate driving exposure measure is essential to calculate traffic crash rates and risks. Commonly used exposure measures include driving distance and the number of licensed drivers. These measures have some limitations, including the unavailability of disaggregated estimates for consecutive years, low data quality, and the failure to represent the driving population when the crash occurred. However, the length of driving time, available annually from the American Time Use Survey (ATUS), can be disaggregated by age, gender, time of day, and day of week and addresses the temporal discontinuity limitation of driving distance on the U.S. national scale.

Objectives: The objective of this study is to determine if the length of driving time as a driving exposure measure is comparable to driving distance by comparing distance-based and time-based fatal crash risk ratios by driver age category, gender, time of day, and day of week.

Methods: The 2016–2017 National Household Travel Survey (NHTS) provided driving distance, and 2016–2017 Fatality Analysis Reporting System provided the number of drivers in fatal crashes. The distributions of driving distance and length of driving time by driver age category (16–24, 25–44, 45–64, and 65 years or older), gender, time of day, and day of week were compared. Two negative binomial regression models were used to compute the distance-based and time-based fatal crash risk ratios.

Results: The distributions of driving distance were not different from the length of driving time distributions by driver age category, gender, time of day, and day of week. Driving distance and the length of driving time provide similar fatal crash risk ratio estimates.

Conclusions: The length of driving time can be an alternative to driving distance as a measure of driving exposure. The primary advantage of driving time over driving distance is that, starting from 2003, the disaggregated estimates of the length of driving time are available from ATUS over consecutive years, curtailing the discontinuity limitation of driving distance. Furthermore, the length of driving time is related to drivers' perceived risks about their driving conditions and, as a result, may be a better exposure measure than driving distance in comparing crash risks between drivers whose likelihood of traveling in hazardous driving conditions (e.g., nighttime) varies substantially.

Subject Areas: Driving exposure; Age category; Gender; Time of crash; American Time Use Survey

Availability: Shen, S., Benedetti, M.H., Zhao, S., Wei, L., and Zhu, M. (2020). "Comparing Distance and Time As Driving Exposure Measures to Evaluate Fatal Crash Risk Ratios." *Accident Analysis & Prevention*, 142. <https://doi.org/10.1016/j.aap.2020.105576>

8.4. Title: Sexual Violence in Transit Environments: Aims, Scope, and Context

Author(s): Loukaitou-Sideris, A. and Ceccato, V.

Abstract: The chapter defines the scope of the book and structure. The aim of the book is to characterize the dynamics of transit crime, in particular sexual harassment and violence, from the perspective of those who are most targeted by these offenses, namely young people. The book focuses on women but also adopts a more holistic approach by considering the intersectionality of safety of young adults as transit passengers. It presents examples from a variety of cities worldwide, giving voices to young people from several countries in the global north and the global south. The chapter also introduces some of the most common terms used in this edited volume and the chapters synopsis.

Subject Areas: Urban and regional studies; Planning and decision analysis; Risk and safety

Availability: Loukaitou-Sideris, A. and Ceccato, V. (2020). "Sexual Violence in Transit Environments: Aims, Scope, and Context." *Transit Crime and Sexual Violence in Cities International Evidence and Prevention*, First Edition. Routledge, Oxfordshire, UK.
<https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1437785&dswid=-8727>

8.5. Title: Urban Cycling Expansion Is Associated With an Increased Number of Clavicle Fractures

Author(s): Kugelman, D., Paoli, A., Mai, D., Konda, S., and Egol, K.

Abstract: Background: The number of individuals turning to cycling for physical activity and commuting has been expanding across the United States. However, studies have demonstrated that when compared to motor vehicle accidents, cyclists in major cities have a significantly increased risk of injuries requiring hospitalizations. The purpose of this study was to assess if a correlation exists between the growing cyclist volume in a densely populated metropolitan city and prevalence of clavicle fractures requiring inpatient hospital admissions.

Hypothesis: A correlation exists between the increased number of cyclists and the increasing number of clavicle fractures requiring inpatient hospital admissions.

Methods: Patients who sustained a clavicle fracture that required an inpatient admission were identified using the New York Statewide Planning and Research Cooperative System (SPARCS). The location of hospital admission was screened using New York City (NYC) hospital county codes, as only clavicle fractures presenting to NYC hospitals were included in the analysis. This study was exempt from Institutional Review Board (IRB) approval. Public transportation data were available through the Department of Transportation (DOT) and The Decennial Census. These databases are publicly available and are performed to assess if New Yorkers are using cycling as a mode of transportation. The cycling data included the following information in a given year: the number of people in NYC who use a bicycle as their primary mode of commuting to work, the number of daily cycling trips, total bicycle protected bike lane mileage, midtown Manhattan cycling counts, and East River Bridge cycling counts. Spearman's correlation analysis was conducted between the numbers of patients with clavicle fractures per year and the described data for that specific year. Additionally, the number of bicycle-share program miles traveled per month and total number of cycling trips that month were obtained from the public bicycle-sharing program database from June 2013 through June 2015. Spearman's correlation analysis was conducted between the numbers of patients with clavicle fractures per month and total bicycle-sharing miles and trips traveled per month.

Results: The increasing daily cycling trips in NYC has a strong correlation with the increasing number of clavicle fractures in NYC ($r_s = 0.979, p < 0.001$). The increasing use of a bicycle as transportation to work has a strong positive correlation with the increasing number of clavicle fractures in NYC ($r_s = 0.988, p < 0.001$). There was a strong positive correlation between the mileage of bicycle lanes in NYC and the number of clavicle fractures ($r_s = 0.867, p = 0.001$). A strong positive correlation exists between NYC clavicle fracture number and public bicycle-sharing miles ($r_s = 0.819, p < 0.001$) and trips ($r_s = 0.811, p < 0.001$).

Conclusion: There are many physical benefits to cycling. Cycling, as a means of transportation, has been encouraged to decrease CO₂ emissions from vehicular transportation. These benefits do not come without risks, as this study shows a correlation between increased cycling and clavicle fractures.

Clinical relevance: Physicians and public health officials should be aware of the dangers of cycling in major cities in order to create safer routes for this environmentally beneficial route of transportation.

Subject Areas: Cycling; Clavicle fractures; Road safety

Availability: Kugelman, D., Paoli, A., Mai, D., Konda, S., and Egol, K. (2020). “Urban Cycling Expansion Is Associated With an Increased Number of Clavicle Fractures.” *Bulletin of the Hospital for Joint Diseases*, 78(2), pp. 101–107. <https://pubmed.ncbi.nlm.nih.gov/32510295/>

8.6. Title: Evaluation of Displaced Left-Turn Intersections

Author(s): Abdelrahman, A., Abdel-Aty, M., Lee, J., Yue, L., and Al-Omari, M.M.A.

Abstract: Displaced left-turn intersections (DLTs) are designed to enhance the operational performance of conventional intersections that are congested due to heavy left-turn traffic volumes by excluding the left-turn movements at the main intersection. This results in reducing the number of potential conflict points and increasing the intersection capacity. However, since drivers are not familiar with DLTs' operation, there is a need to assess the safety and operational efficiency of this type of intersections. This paper evaluates the safety performance of DLTs using two common methods, which are a before-and-after study with comparison group and cross-sectional analysis. Furthermore, it investigates the operational performance of DLTs using a general linear model describing the relationship between a selected measure of performance and other operational and geometric characteristics based on high-resolution traffic data. The safety analysis indicates that DLTs can increase crash frequency in comparison to conventional intersections. In addition, the operational analysis implies that DLTs have the potential to reduce the delay at intersections. Consequently, evaluation of the different aspects of costs and benefits were conducted to decide if this alternative design is appropriate for implementation. The study concludes that DLTs have negative safety impacts in comparison to conventional intersections for many crash types, but it might be more efficient for operational performance. It is recommended that appropriate safety countermeasures should be developed and implemented to enhance traffic safety at DLTs.

Subject Areas: Displaced left-turn intersections; Safety performance; Operational performance; High-resolution traffic data

Availability: Abdelrahman, A., Abdel-Aty, M., Lee, J., Yue, L., and Al-Omari, M.M.A. (2020). "Evaluation of Displaced Left-Turn Intersections." *Transportation Engineering, 1*. <https://doi.org/10.1016/j.treng.2020.100006>

8.7. Title: Driver State Monitoring for Decreased Fitness to Drive

Author(s): Lenné, M.G., Roady, T., and Kuo, J.

Abstract:

- Governments and the automotive industry have come to recognize the need for Driver State Monitoring (DSM) as a central safety measure in the next wave of advanced driver assistance system (ADAS) technologies.
- There are a number of different underlying measurement approaches, such as vehicle-based measures; however, most research and industry applications now pursue camera-based approaches focusing on eye, head, and facial features.
- Driver drowsiness and distraction are two of the most common studies on driver states, with some algorithms now published in the research literature.
- There are a number of human factors issues to work through, including ensuring insights from the field inform development of future solutions and ensuring that vehicle technologies interface with the driver in ways that support safe performance.

Subject Areas: Driver state monitoring; Advanced driver assistance systems; Camera-based approach; safety

Availability: Lenné, M.G., Roady, T., and Kuo, J. (2020). “Driver State Monitoring for Decreased Fitness to Drive.” *Handbook of Human Factors for Automated, Connected, and Intelligent Vehicles*. CRC Press, Boca Raton, FL.

https://books.google.com/books?hl=en&lr=&id=0n_oDwAAQBAJ&oi=fnd&pg=PT245&ots=tH9MBAJG2&sig=rP_Z-jsp2cnpnCu5pam8WS5GzZo#v=onepage&q&f=false

8.8. Title: Safety of Micro-mobility: Analysis of E-Scooter Crashes by Mining News Reports

Author(s): Yang, H., Ma, Q., Wang, Z., Cai, Q., Xie, K., and Yang, D.

Abstract: Dockless electric scooters (e-scooters) have emerged as a popular micro-mobility mode for urban transportation. This new form of mobility offers riders a flexible option for massive first-/last-mile trips. Despite the popularity, the limited regulations of e-scooters raise numerous safety concerns among the public and agencies. Due to the unavailability of well-archived crash data, it is difficult to understand and characterize current state quo of e-scooter-involved crashes. This paper aims to shorten the gap by analyzing a set of reported crash data to describe the patterns of crashes related to e-scooter use. Specifically, massive media reports were searched and investigated for constructing the crash dataset. Key crash elements such as rider demographics, crash type, and location were organized in an information table for analysis. From 2017 to 2019, there were 169 e-scooter-involved crashes identified from news reports across the country. Through the descriptive analysis and cross tabulation analysis, the distinct characteristics of these reported crashes were highlighted. Overall, there was a growing trend for the reported e-scooter-involved crashes unevenly distributed among the States. The distribution of the crashes across different groups of users, facilities, time periods, and severity levels also showed skewed patterns toward a subset of categories. The quantitative analyses also provide some supportive evidence for warranting the discussion on key issues, including helmet use, riding under the influence (RUI), vulnerable riders, and data deficiency. This study highlights the importance of public awareness and timely developing safety countermeasures to mitigate crashes involving e-scooters.

Subject Areas: Electric scooters; e-scooter crashes; Crash analysis; Micro-mobility; Crash data; Injury severity

Availability: Yang, H., Ma, Q., Wang, Z., Cai, Q., Xie, K., and Yang, D. (2020). "Safety of Micro-mobility: Analysis of E-Scooter Crashes by Mining News Reports." *Accident Analysis & Prevention*, 143. <https://doi.org/10.1016/j.aap.2020.105608>

8.9. Title: Improving Traffic Safety and Efficiency by Adaptive Signal Control Systems Based on Deep Reinforcement Learning

Author(s): Gong, Y.

Abstract: As one of the most important Active Traffic Management strategies, Adaptive Traffic Signal Control (ATSC) helps improve traffic operation of signalized arterials and urban roads by adjusting the signal timing to accommodate real-time traffic conditions. Recently, with the rapid development of artificial intelligence, many researchers have employed deep reinforcement learning (DRL) algorithms to develop ATSCs. However, most of them are not practice-ready. The reasons are two-fold: first, they are not developed based on real-world traffic dynamics and most of them require the complete information of the entire traffic system. Second, their impact on traffic safety is always a concern by researchers and practitioners but remains unclear. Aiming at making the DRL-based ATSC more implementable, existing traffic detection systems on arterials were reviewed and investigated to provide high-quality data feeds to ATSCs. Specifically, machine-learning frameworks were developed to improve the quality of and pedestrian and bicyclist count data. Then, to evaluate the effectiveness of DRL-based ATSC on the real-world traffic dynamics, a decentralized network-level ATSC using multi-agent DRL was developed and evaluated in a simulated real-world network. The evaluation results confirmed that the proposed ATSC outperforms the actuated traffic signals in the field in terms of travel time reduction. To address the potential safety issue of DRL-based ATSC, an ATSC algorithm optimizing simultaneously both traffic efficiency and safety was proposed based on multi-objective DRL. The developed ATSC was tested in a simulated real-world intersection, and it successfully improved traffic safety without deteriorating efficiency. In conclusion, the proposed ATSCs are capable of effectively controlling real-world traffic and benefiting both traffic efficiency and safety.

Subject Areas: Adaptive traffic signal control; Deep reinforcement learning; Traffic safety; Pedestrian and bicyclist

Availability: Gong, Y. (2020). *Improving Traffic Safety and Efficiency by Adaptive Signal Control Systems Based on Deep Reinforcement Learning*. Doctoral Dissertation, University of Central Florida, Orlando, FL. <https://stars.library.ucf.edu/etd2020/51>

8.10. Title: Incorporating Demographic Proportions into Crash Count Models by Quasi-Induced Exposure Method

Author(s): Sharmin, S., Ivan, J.N., Zhao, S., Wang, K., Hossain, M.J., Ravishanker, N., and Jackson, E.

Abstract: Quasi-induced exposure (QIE) is an effective technique for estimating the exposure of a specific driving or vehicle population when real exposure data are not available. Typically crash prediction models are carried out at the site level, that is, segment or intersection. Driving population characteristics are generally not available at this level, however, and thus are omitted from count models. Because of the sparsity of traffic crashes, estimating driving population distributions at the site level using crash data at individual sites is challenging. This study proposes a technique to obtain demographic proportions to incorporate in the count models as an exposure at each site by aggregating similar adjacent sites until significant demographic proportions are obtained. Information on driver gender, age, and vehicle type are obtained by QIE using 5 years (2010–2014) of crash data, and road inventories are obtained for 1,264 urban four-lane divided highway segments in California. Count models including only site-level factors were compared with models including both crash-level and site-level factors. The latter outperformed the former in relation to mean prediction bias and mean absolute deviation statistics on holdout sample predictions. Results indicate that teen drivers are more crash prone in total and in fatal plus injury severity crashes. For senior drivers, crash risk increases with the increase in severity level. The presence of vehicles other than passenger cars and trucks reduces total and property damage only crash counts. Female drivers are associated with higher total and fatal plus injury crash counts.

Subject Areas: Quasi-induced exposure; Traffic crashes; Prediction models; Site level

Availability: Sharmin, S., Ivan, J.N., Zhao, S., Wang, K., Hossain, M.J., Ravishanker, N., and Jackson, E. (2020). “Incorporating Demographic Proportions into Crash Count Models by Quasi-Induced Exposure Method.” *Transportation Research Record: Journal of the Transportation Research Board*, 2674(9), pp. 548–560. <https://doi.org/10.1177/0361198120930230>

8.11. Title: Beyond Safety Drivers: Applying Air Traffic Control Principles to Support the Deployment of Driverless Vehicles

Author(s): Hampshire, R.C., Bao, S., Lasecki, W.S., Daw, A., and Pender, J.

Abstract: By adopting and extending lessons from the air traffic control system, we argue that a nationwide remote monitoring system for driverless vehicles could increase safety dramatically, speed these vehicles' deployment, and provide employment. It is becoming clear that fully driverless vehicles will not be able to handle "edge" cases in the near future, suggesting that new methods are needed to monitor remotely driverless vehicles' safe deployment. While the remote operations concept is not new, a super-human driver is needed to handle sudden, critical events. We envision that the remote operators do not directly drive the vehicles but provide input on high-level tasks such as path-planning, object detection, and classification. This can be achieved via input from multiple individuals coordinated around a task at a moment's notice. Assuming a 10% penetration rate of driverless vehicles, we show that one remote driver can replace 14,840 human drivers. A comprehensive nationwide interoperability standard and procedure should be established for the remote monitoring and operation of driverless vehicles. The resulting system has potential to be an order of magnitude safer than today's ground transportation system. We articulate a research and policy roadmap to launch this nationwide system. Additionally, this hybrid human–AI system introduces a new job category, likely a source of employment nationwide.

Subject Areas: Air traffic control; Remote monitoring system; Driverless vehicles; Safety

Availability: Hampshire, R.C., Bao, S., Lasecki, W.S., Daw, A., and Pender, J. (2020). "Beyond Safety Drivers: Applying Air Traffic Control Principles to Support the Deployment of Driverless Vehicles." *PLoS ONE*, 15(5). <https://doi.org/10.1371/journal.pone.0232837>

8.12. Title: Near Crash Characteristics Among Risky Drivers Using the SHRP2 Naturalistic Driving Study

Author(s): Seacrist, T., Douglas, E.C., Hannan, C., Rogers, R., Belwadi, A., and Loeb, H.

Abstract: Problem: Previous research has focused extensively on crashes; however, near crashes provide additional data on driver errors leading to critical events as well as evasive maneuvers employed to avoid crashes. The Second Strategic Highway Research Program (SHRP2) Naturalistic Driving Study contains extensive data on real-world driving and offers a reliable methodology to study near crashes. The current study utilized the SHRP2 database to compare the rate and characteristics associated with near crashes among risky drivers.

Methods: A subset from the SHRP2 database consisting of 4,818 near crashes for teen (16–19 years old), young adult (20–34 years old), adult (35–54 years old), and older (70+ years old) drivers was used. Near crashes were classified into seven incident types: rear-end, road departure, intersection, head-on, side-swipe, pedestrian/cyclist, and animal. Near crash rates, incident type, secondary tasks, and evasive maneuvers were compared across age groups. For rear-end near crashes, near crash severity, max deceleration, and time-to-collision at braking were compared across age.

Results: Near-crash rates significantly decreased with increasing age ($p < 0.05$). Young drivers exhibited greater rear-end ($p < 0.05$) and road departure ($p < 0.05$) near crashes compared to adult and older drivers. Intersection near crashes were the most common incident type among older drivers. Evasive maneuver type did not significantly vary across age groups. Near crashes exhibited a longer time-to-collision at braking ($p < 0.01$) compared to crashes.

Summary: These data demonstrate increased total near crash rates among young drivers relative to adult and older drivers. Prevalence of specific near crash types also differed across age groups. Timely execution of evasive maneuvers was a distinguishing factor between crashes or near crashes.

Practical Applications: These data can be used to develop more targeted driver training programs and help OEMs optimize ADAS to address the most common errors exhibited by risky drivers.

Subject Areas: Naturalistic driving; Second Strategic Highway Research Program; Risky drivers; Near crashes

Availability: Seacrist, T., Douglas, E.C., Hannan, C., Rogers, R., Belwadi, A., and Loeb, H. (2020). "Near Crash Characteristics Among Risky Drivers Using the SHRP2 Naturalistic Driving Study." *Journal of Safety Research*, 73, pp. 263–269. <https://doi.org/10.1016/j.jsr.2020.03.012>

8.13. Title: A Bayesian Spatial Poisson-Lognormal Model to Examine Pedestrian Crash Severity at Signalized Intersections

Author(s): Munira, S., Sener, I.N., and Dai, B.

Abstract: Reducing non-motorized crashes requires a profound understanding of the causes and consequences of the crashes at the facility level. Generally, existing literature on bicyclists and pedestrian crash models suffers from two distinct problems: lack of exposure/volume data and inadequacy in capturing potential correlations across various crash aspects. To develop a robust framework for pedestrian crash analysis, this research employed a multivariate model across multiple pedestrian crash severities incorporating a crucial piece of information: pedestrian exposure. A multivariate spatial (conditional autoregressive) Poisson-lognormal model in a Bayesian framework was developed to examine the significant factors influencing the fatal, incapacitating injury (or suspected serious injury), and non-incapacitating injury pedestrian crashes at 409 signalized intersections in the Austin area. Various explanatory variables were used to examine the pedestrian crashes, including traffic characteristics, road geometry, built environment features, and pedestrian exposure volume at intersections, which was estimated through a direct demand model as part of the study. Model results revealed valuable insights. The superior performance of the multivariate model over the univariate model emphasized the need to jointly model multiple pedestrian crash severities. The results showed the significant positive influence of speed limit on fatal pedestrian crashes and revealed that both incapacitating and non-incapacitating injury crashes increase with increasing motorized traffic volume. Bus stop presence was found to have a negative influence on incapacitating injury crashes and a positive influence on non-incapacitating injury crashes. Moreover, the pedestrian volume at intersections positively influences non-incapacitating injury crashes. The difference in influence across crash types warrants careful and focused policy design of intersections to reduce pedestrian crashes of all severity types.

Subject Areas: Pedestrian intersection crash; Injury severity; Pedestrian exposure; Bayesian framework; Multivariate spatial model; Walking trips

Availability: Munira, S., Sener, I.N., and Dai, B. (2020). "A Bayesian Spatial Poisson-Lognormal Model to Examine Pedestrian Crash Severity at Signalized Intersections." *Accident Analysis & Prevention*, 144. <https://doi.org/10.1016/j.aap.2020.105679>

8.14. Title: Female vs. Male Relative Fatality Risk in Fatal Crashes

Author(s): Abrams, M.Z. and Bass, C.R.

Abstract: Since 1975, the US has seen a decrease in vehicle crash fatalities, noticeably among recent model vehicles. However, a lack of requirement to test motor vehicles using anthropomorphic test devices representative of both the average male and the average female occupant may be driving a disparity in the risk of fatality in severe crash scenarios. The double pair comparison method, first developed by Evans, was applied to many different cross-sections of the US Fatality Analysis Reporting System to investigate sex-dependent differences in relative fatality risk in crashes. Despite a dramatic decline in fatalities over the reporting period, female vehicle occupants aged 20–30 years are 20–25% more likely to die as a result of a fatal crash than males in the same age range. The risk to females and males becomes similar as age increases to 60. These trends hold when looking at subsets of crashes in either rural or urban areas, when looking at vehicles manufactured since 2010, and when isolating by single, two- or multiple-vehicle crashes. The consistency of this age-dependent relative risk emphasizes a need to further investigate sex differences in crash-related outcomes.

Subject Areas: Crash analysis; Relative fatality risk; Sex differences; Fatality Analysis Reporting System; Vehicle safety trends

Availability: Abrams, M.Z. and Bass, C.R. (2020). “Female vs. Male Relative Fatality Risk in Fatal Crashes.” *International Research Council on Biomechanics of Injury Conference 2002*, Munich, Germany. <http://www.ircobi.org/wordpress/downloads/irc20/pdf-files/13.pdf>

8.15. Title: Pedestrians Under Influence (PUI) Crashes: Patterns from Correspondence Regression Analysis

Author(s): Das, S., Ashraf, S., Dutta, A., and Tran, L.

Abstract: Introduction: Alcohol-related impairment is a key contributing factor in traffic crashes. However, only a few studies have focused on pedestrian impairment as a crash characteristic. In Louisiana, pedestrian fatalities have been increasing. From 2010 to 2016, the number of pedestrian fatalities increased by 62%. A total of 128 pedestrians were killed in traffic crashes in 2016, and 34.4% of those fatalities involved pedestrians under the influence (PUI) of drugs or alcohol. Furthermore, alcohol-PUI fatalities have increased by 120% from 2010 to 2016. There is a vital need to examine the key contributing attributes that are associated with a high number of PUI crashes.

Method: In this study, the research team analyzed Louisiana's traffic crash data from 2010 to 2016 by applying correspondence regression analysis to identify the key contributing attributes and association patterns based on PUI involved injury levels.

Results: The findings identified five risk clusters: intersection crashes at business/industrial locations, mid-block crashes on undivided roadways at residential and business/residential locations, segment related crashes associated with a pedestrian standing in the road, open country crashes with no lighting at night, and pedestrian violation related crashes on divided roadways. The association maps identified several critical attributes that are more associated with fatal and severe PUI crashes. These attributes are dark to no lighting, open country roadways, and non-intersection locations.

Practical Applications: The findings of this study may be used to help design effective mitigation strategies to reduce PUI crashes.

Subject Areas: Pedestrians; Injury levels; Correspondence regression analysis; Risk clusters

Availability: Das, S., Ashraf, S., Dutta, A., and Tran, L. (2020). "Pedestrians Under Influence (PUI) Crashes: Patterns from Correspondence Regression Analysis." *Journal of Safety Research*, 75, pp. 14–23. <https://doi.org/10.1016/j.jsr.2020.07.001>

8.16. Title: United States Pedestrian Fatality Trends, 1977 to 2016

Author(s): Schneider, R.J.

Abstract: After decreasing for three decades, U.S. pedestrian fatalities increased by more than 40% between 2009 and 2016, hindering progress toward a future transportation system that produces zero deaths. While many researchers have investigated changes in the last decade, this study takes a long-term perspective and asks: what are the most common characteristics associated with U.S. pedestrian fatalities, and how have these characteristics shifted over the last 40 years? It analyzes all 231,675 pedestrian fatalities recorded between 1977 and 2016 in the Fatality Analysis Reporting System (FARS) database. Over 40 years, most pedestrian fatalities occurred in darkness (65%) and involved male pedestrians (70%) and male drivers (67%). They were commonly in roadway lanes (90%), away from intersections (80%), and involved vehicles traveling straight (83%). Most occurred on roadways with speed limits of 35 mph (56 km/h) or higher (70%) and four or more lanes (50%). Trends were compared across eight 5-year periods. Between the earliest and latest periods, there were significant decreases in the proportion of pedestrian fatalities among children younger than 15 (from 18% to 5%) and involving drivers who were drinking (from 15% to 8%). There were significant increases in pedestrian fatalities during darkness (from 63% to 73%), involving large vehicles (e.g., pickup trucks, vans, and SUVs) (from 22% to 44%), on roadways with speed limits 35 mph or higher (from 60% to 76%), and on roadways with four or more lanes (from 41% to 58%). These findings underscore the need for fundamental transportation systems changes to ultimately eliminate pedestrian fatalities.

Subject Areas: Pedestrian fatalities; Fatality Analysis Reporting System; Transportation systems

Availability: Schneider, R.J. (2020). "United States Pedestrian Fatality Trends, 1977 to 2016." *Transportation Research Record: Journal of the Transportation Research Board*, 2674(9), pp. 1069–1083. <https://doi.org/10.1177/0361198120933636>

8.17. Title: Safety Evaluation of Innovative Intersection Designs: Diverging Diamond Interchanges and Displaced Left-turn Intersections

Author(s): Abdelrahman, A.

Abstract: Diverging diamond interchanges (DDIs) and displaced left-turn intersections (DLTs) are designed to enhance the operational performance of conventional intersections that are congested due to heavy left-turn traffic volumes. Since drivers are not familiar with these types of intersections, there is a need to evaluate their safety performance to validate their effect, and to estimate reliable and representative Crash Modification Factors (CMFs). The safety evaluation was conducted based on three common safety assessment methods, which are before-and-after study with comparison group, Empirical Bayes before-and-after method, and cross-sectional analysis. Furthermore, since DLTs showed poor safety performance, the study also investigated the operational performance of DLTs using a general linear model describing the relationship between traffic delay and other operational and geometric characteristics based on high-resolution traffic data. The DDI analysis included a sample size of 80 DDIs and 240 conventional diamond interchanges in 24 states, while the DLT analysis included 13 DLTs and 26 conventional intersections in 4 states. The analysis results indicated that converting conventional diamond interchanges to diverging diamond interchanges could significantly decrease the total, fatal-and-injury, rear-end and angle/left-turn crashes by 26%, 49%, 18%, and 68%, respectively. On the other hand, converting conventional intersections to displaced left-turn intersections could significantly increase the total number of crashes as well injury crashes and some other crash types (i.e., single vehicle, angle). However, the operational analysis implied that they have the potential to reduce the delay at intersections by 3.567 sec/veh. Consequently, the study quantified the costs and benefits associated with implementing DLTs. The results showed that this alternative design could provide many benefits in terms of its operational performance. However, its poor safety performance could result in losses much higher than its benefits. The study concludes that DDIs could significantly decrease crash frequency, while DLTs could not provide safety benefits. However, DLTs might be more efficient for operational performance. It is recommended that appropriate safety countermeasures should be developed and implemented to enhance traffic safety at DLTs.

Subject Areas: Diverging diamond interchanges; Displaced left-turn intersections; Safety evaluation; Left-turn traffic; Empirical Bayes before-and-after method; Cross-sectional analysis

Availability: Abdelrahman, A. (2020). *Safety Evaluation of Innovative Intersection Designs: Diverging Diamond Interchanges and Displaced Left-turn Intersections*. Master's Thesis, University of Central Florida, Orlando, FL. <https://stars.library.ucf.edu/etd2020/165>

8.18. Title: Benefit-Cost Analysis of the Iowa Department of Transportation’s Safety Service Patrol Program

Author(s): Khalilzadeh, Z.

Abstract: A methodology was established to quantifying the Incident-Induced Delay (IID). The methodology computes the IID using real-time travel time data taken from the INRIX dataset. Delay is determined by calculating the extra delay of the subject profile from the reference profile. Subject Profile is the real-time travel time data from 1 hour before the event start time until 1 hour after the time when traffic gets back to normal in the date that event occurred. Candidate profiles of each event are the real-time travel time profiles of each event from 1 hour before the event start time until 1 hour after the time when traffic gets back to normal in all dates except the date that event occurred. Reference profile is the most similar travel time profile to the subject profile without incident-affected (from incident start time until time when the incident gets back to normal) part of the profile. To establish a Reference profile, a k-nearest neighbor-based method was used. Reference profile is taken from assigning a rank-based weight to the 10 nearest candidate profiles that have the most similar traffic pattern to the subject profile in the duration without incident affected part of the profile. Then IID was used to compute the benefits of the Iowa Department of Transportation’s (Iowa DOT’s) Safety Service Patrol (SSP) program known as the Highway Helper (HH) program driven from delay reduction, emissions reduction, and fuel consumption reduction. Benefit calculation also includes motorist assistance benefit and secondary crash reduction. The final monetary equivalent benefit of DM area is provided in the following table.

Subject Areas: Incident-induced delay; K-nearest neighbor; Reference profile; Safety Service Patrol (SSP) program

Availability: Khalilzadeh, Z. (2020). “Benefit-Cost Analysis of the Iowa Department of Transportation’s Safety Service Patrol Program.” *Creative Components*, 596.
<https://lib.dr.iastate.edu/creativecomponents/596>

8.19. Title: Older Driver Crash Involvement and Fatalities, by Age and Sex, 2000–2017

Author(s): Ratnapradipa, K.L., Pope, C.N., Nwosu, A., and Zhu, M.

Abstract: Federal reporting of crash fatalities has limited age-by-sex stratification, but both age and sex are associated with driving reduction and cessation. We described older driver fatal crash involvement and fatalities using Fatality Analysis Reporting System data to calculate rates (per 100,000 licensed drivers, per 100,000 population) with age-by-sex stratifications. Nationally from 2000 through 2017, 110,422 drivers 65+ were involved in crashes resulting in at least one death within 30 days, and 67,843 of these older drivers died. Involvement and fatality rates per 100,000 licensed drivers in 2017 were lowest for females 65–69 (7.7 and 3.6, respectively) and highest for males age 85+ (34.3 and 25.5, respectively). Females had lower driver fatal crash involvement and fatality rates throughout the lifespan, even when rates generally decreased over time. Elaborating fatal crash trends and rates by age and sex helps to differentiate the public health burden of older driver crashes and fatalities.

Subject Areas: Motor vehicle fatality; Crash involvement; Driver fatality rates; Trend; Fatality Analysis Reporting System (FARS)

Availability: Ratnapradipa, K.L., Pope, C.N., Nwosu, A., and Zhu, M. (2020). “Older Driver Crash Involvement and Fatalities, by Age and Sex, 2000–2017.” *Journal of Applied Gerontology*. <https://doi.org/10.1177%2F0733464820956507>

8.20. Title: Is Bicycling Getting Safer? Bicycle Fatality Rates (1985–2017) Using Four Exposure Metrics

Author(s): Ferenchak, N.N. and Marshall, W.E.

Abstract: The National Highway Traffic Safety Administration cites decreasing bicyclist fatalities in the United States over the past several decades as evidence of improved bicycling safety. However, with users possessing a diverse range of tolerances, purposes, and socio-demographics, bicycle safety is an important yet complex problem, one that does not have a simple yes/no answer. To gain a better understanding, we need to take a variety of perspectives. Traditional bicycle safety analyses take a transportation engineering perspective by using distance-based exposure metrics or those based on the number of trips. But there are other perspectives—such as public health (using population) and transportation planning (using bicycle participation)—that could provide us with a fuller picture. This paper applies four measures of bicycling exposure to take a broad, interdisciplinary perspective on bicycling safety to answer the question of whether bicycling is actually getting safer and, if so, for whom. We first explore age differences with respect to the direction and magnitude of bicyclist fatality rates in the United States between 1985 and 2017. We then investigate whether any safety benefits are shared equally among commuters and recreational riders.

Using fatality data from the Fatality Analysis Reporting System (FARS) and exposure data from the National Household Travel Survey (NHTS), the American Community Survey (ACS), the U.S. Census, and the National Sporting Goods Association (NSGA)—a relatively novel approach to measuring exposure through a comprehensive national bicycling participation survey—we derived trends of age-specific bicyclist fatality rates and corresponding confidence intervals for children and adults. We also compare exposure to fatality outcomes by deriving Pearson’s correlation coefficients. This is the first research to provide a longitudinal, age-specific statistical analysis of bicycle fatality rates using these four exposure metrics.

Results suggest that overall declines in bicycle fatality rates have been primarily driven by a sharp decline in child bicyclist fatalities while adult bicycle fatality rates have generally trended upwards (especially for the general population) or remained stagnant (for commuters). This work adds to the understanding of bicyclist safety and gives direction to future research regarding the importance of considering age and exposure sources.

Subject Areas: Bicycle; Safety; Fatality rates; Age; Exposure

Availability: Ferenchak, N.N. and Marshall, W.E. (2020). “Is Bicycling Getting Safer? Bicycle Fatality Rates (1985–2017) Using Four Exposure Metrics.” *Transportation Research Interdisciplinary Perspectives*, 8. <https://doi.org/10.1016/j.trip.2020.100219>

8.21. Title: Measuring Success for Safe Routes to School Programs

Author(s): Voulgaris, C.T., Alexander, S., Hosseinzade, R., Jimenez, J., Lee, K., and Pande, A.

Abstract: Safe Routes to School (SRTS) programs aim to increase the share of students who commute to school by active modes (e.g., walking and cycling). The goal of this work was to assess the effectiveness of SRTS programs. Towards that end, we analyzed the California Household Travel Survey (CHTS) data from the four counties in the San Francisco Bay area. We estimated logistic regression model(s) to predict the likelihood that a child commutes to school by active modes based on the presence of an SRTS program and controlling for individual, household, and tract characteristics. Findings indicate that longer trip distance and race (relative to White students) are associated with reduced rates of active travel to school. The presence of SRTS programs mitigates these differences. We conclude that the effect of SRTS programs might best be described as reducing barriers to active school travel, rather than simply increasing the likelihood of using active modes. We also interviewed parents and school administrators about the SRTS programs. The interviewees noted the importance of social connections among students and their families as an advantage of SRTS programs in addition to the health, economic, and environmental benefits. The barriers to more active travel to school cited by the interviewees included the challenge of implementing SRTS programs consistently over a sustained period and the lack of physical infrastructure that feels safe to the students and their parents.

Subject Areas: School safety; Evaluation and assessment; Statistical analysis; Quantitative analysis; Qualitative analysis

Availability: Voulgaris, C.T., Alexander, S., Hosseinzade, R., Jimenez, J., Lee, K., and Pande, A. (2020). "Measuring Success for Safe Routes to School Programs." *Mineta Transportation Institute Publications*. <https://doi.org/10.31979/mti.2020.1821>

8.22. Title: Evaluating the Effectiveness of the Pedestrian Safety Intervention Program: Behavioral and Observational Approach

Author(s): Petal, D.

Abstract: Pedestrians are considered as the most vulnerable road users. On a nationwide scale, according to the National Highway Traffic Safety Administration, there were 6,075 pedestrian fatalities and more than 85,000 pedestrian injuries as a result of traffic crashes in 2017. This study provides national and state pedestrian fatality statistics, a systematic literature review of pedestrian injury severity, observational (video-based) & behavioral (survey-based) evaluation of the Street-Smart NJ pedestrian safety intervention campaign. Street-Smart NJ is a public education, awareness, and behavioral change campaign program that aims to improve pedestrian safety by increasing awareness of pedestrian safety risks and improving compliance with pedestrian and motorist laws. To do so, before and after campaign data was collected, and several statistical analyses were performed accordingly. In terms of the behavioral study, significant improvements in terms of pedestrian behaviors (i.e., crossing against the signal or outside the crosswalk) and driver behaviors (e.g., drivers not stopping for pedestrians in crosswalk) after the Street-Smart NJ campaign was reported. The observational study also showed significant improvements in pedestrian behaviors (i.e., crossing against the signal or outside the crosswalk) and driver behaviors (e.g., drivers not stopping for pedestrians in crosswalk) in most of the study communities following the Street-Smart NJ campaign.

Subject Areas: Pedestrian safety; Prevention; Street-Smart NJ pedestrian safety intervention campaign; Pedestrian behaviors; Driver behaviors

Availability: Petal, D. (2020). *Evaluating the Effectiveness of the Pedestrian Safety Intervention Program: Behavioral and Observational Approach*. Master's Thesis, Rowan University, Glassboro, NJ. <https://rdw.rowan.edu/etd/2847>

8.23. Title: Investigation of Safety-in-Numbers for Pedestrians and Bicyclists at a Macroscopic Level with Various Exposure Variables

Author(s): Lee, J., Abdel-Aty, M., and Cai, Q.

Abstract: Safety-in-numbers is a phenomenon whereby the crash risks of road users decrease when their numbers increase. Although several previous studies have confirmed safety-in-numbers at a microscopic level (e.g., intersection), few studies have investigated safety-in-numbers at a macroscopic level (or zonal level). In this study, safety-in-numbers is investigated at a larger scale unit, the metropolitan statistical area (MSA), which is usually composed of multiple counties in the U.S.A. Various pedestrian and bicyclist exposure data were obtained from the U.S. National Household Travel Survey (i.e., trips, miles, and hours). A series of Bayesian Poisson lognormal models confirm safety-in-numbers with the different exposure variables at a large-scale geographic level (i.e., MSA). The findings imply that regional travel behavior and cultures of respect for vulnerable road users play a key role in determining the level of pedestrian and bicyclist safety. In addition, the results reveal other factors important to vulnerable road user involved crashes, including but not limited to the climate, demographic, socioeconomic, and travel characteristics of the study regions.

Subject Areas: Cyclists; Pedestrian safety; Risk assessment; Traffic safety; Vulnerable road users

Availability: Lee, J., Abdel-Aty, M., and Cai, Q. (2020). "Investigation of Safety-in-Numbers for Pedestrians and Bicyclists at a Macroscopic Level with Various Exposure Variables." *Transportation Research Record: Journal of the Transportation Research Board*, 2674(12), pp. 568–580. <https://doi.org/10.1177/0361198120953795>

8.24. Title: Injuries Related to Electric Scooter and Bicycle Use in A Washington, DC, Emergency Department

Author(s): Cicchino, J.B. Kulie, P.E., and McCarthy, M.L.

Abstract: This report compares injuries sustained by riders involved in e-scooter crashes and bicycle crashes and the characteristics of those crashes. Analysis is based on interviews with 103 adult e-scooter riders during 2019 and 377 adult bicycle riders from 2015–2017 seeking treatment for injuries at the George Washington University Hospital (Washington, DC) emergency department (ED). Overall, injury severity was similar for e-scooters and cyclists. Head injury rates were similar. While two-thirds of cyclists were helmeted, injured e-scooter riders had a low rate of helmet use. This contributed to some serious head injury types being more prevalent among e-scooter riders than cyclists. E-scooter riders were injured more often per mile of travel than cyclists and presented to EDs more often than cyclists over the same time period. Bicycle crashes occurred more frequently on roads (50.9%) compared to e-scooters (23.5%), and bicycle crashes more often involved a moving vehicle (39.5%) compared to e-scooters (12.6%). E-scooter crashes more often occur on sidewalks where uneven pavement and other obstacles are more difficult for small scooter tires to deal with. Additional information examined includes demographics, trip characteristics, and injury treatment characteristics.

Subject Areas: Alternatives analysis; Bicycle crashes; Crash characteristics; Crash injuries; Cyclists; Electric vehicles; Helmet use; Injury severity; Scooters; Traffic crashes

Availability: Cicchino, J.B. Kulie, P.E., and McCarthy, M.L. (2020). *Injuries Related to Electric Scooter and Bicycle Use in A Washington, DC, Emergency Department*. Insurance Institute for Highway Safety, Arlington, VA. <https://www.iihs.org/topics/bibliography/ref/2215>

8.25. Title: Safe Enough: Approaches to Assessing Acceptable Safety for Automated Vehicles

Author(s): Blumenthal, M.S., Fraade-Blanar, L., Best, R., and Irwin, J.L.

Abstract: Establishing whether automated vehicles (AVs) are acceptably safe is not straightforward, and continual technology modification adds complication. RAND Corporation researchers analyzed three categories of approach—measurements, processes, and thresholds—and noted the different kinds of evidence associated with each, the ways in which different approaches can be used together, and the degree to which stakeholder groups agree on the merits of these approaches. This report complements discussion of measurement and analytical issues with a discussion of challenges in communicating about AV safety, especially to the general public. Its recommendations are aimed at both industry and government.

Subject Areas: Autonomous vehicles; Passenger traffic; Traffic accidents; Transportation safety

Availability: Blumenthal, M.S., Fraade-Blanar, L., Best, R., and Irwin, J.L. (2020). *Safe Enough: Approaches to Assessing Acceptable Safety for Automated Vehicles*. RAND Corporation, Santa Monica, CA. https://www.rand.org/pubs/research_reports/RRA569-1.html

8.26. Title: Waymo Public Road Safety Performance Data

Author(s): Schwall, M., Daniel, T., Victor, T., Favaro, F., and Hohnhold, H.

Abstract: Waymo’s mission to reduce traffic injuries and fatalities and improve mobility for all has led us to expand deployment of automated vehicles on public roads without a human driver behind the wheel. As part of this process, Waymo is committed to providing the public with informative and relevant data regarding the demonstrated safety of Waymo’s automated driving system, which we call the Waymo Driver. The data presented in this paper represents more than 6.1 million miles of automated driving in the Phoenix, Arizona metropolitan area, including operations with a trained operator behind the steering wheel from calendar year 2019 and 65,000 miles of driverless operation without a human behind the steering wheel from 2019 and the first 9 months of 2020. The paper includes every collision and minor contact experienced during these operations as well as every predicted contact identified using Waymo’s counterfactual, what if, simulation of events had the vehicle’s trained operator not disengaged automated driving. There were 47 contact events that occurred over this time period, consisting of 18 actual and 29 simulated contact events, none of which would be expected to result in severe or life threatening injuries. This paper presents the collision typology and severity for each actual and simulated event, along with diagrams depicting each of the most significant events. Nearly all the events involved one or more road rule violations or other errors by a human driver or road user, including all eight of the most severe events, which we define as involving actual or expected airbag deployment in any involved vehicle. When compared to national collision statistics, the Waymo Driver completely avoided certain collision modes that human driven vehicles are frequently involved in, including road departure and collisions with fixed objects.

Subject Areas: Automated vehicles; Traffic injuries reduction; Mobility; collision typology

Availability: Schwall, M., Daniel, T., Victor, T., Favaro, F., and Hohnhold, H. (2020). *Waymo Public Road Safety Performance Data*. Waymo LLC, Mountain View, CA.
<https://arxiv.org/ftp/arxiv/papers/2011/2011.00038.pdf>

8.27. Title: Increased Motor Vehicle Fatalities Tuesday Through Thursday During the Us Thanksgiving Holiday (1980–2018)

Author(s): Ratnapradipa, K.L. and Zhu, M.

Abstract: Traffic crashes remain a leading cause of death in the United States; holidays are known to have increased travel and traffic fatalities. Our purpose was to determine which days during Thanksgiving had the highest crash fatality risk compared to non-holiday periods. Using time series and binomial approximations, we analyzed Fatality Analysis Reporting System data (1980–2018) with a Monday–Sunday holiday and matching comparisons the weeks before and after. Fatalities included 31,263 during the holiday, 30,361 the previous week, and 29,399 the following week. Deadliest days during the holiday were Saturday (16.7% of fatalities) and Wednesday (16.0%), but odds of a traffic fatality (vs. non-holiday) were highest Wednesday [odds ratio (OR) 1.35, 95% confidence interval (CI) 1.29–1.40], Thanksgiving (OR 1.18, 95% CI 1.13–1.23), and Tuesday (OR 1.12, 95% CI 1.06–1.17). The 35 excess holiday fatalities per year may have limited practical significance considering increased holiday travel.

Subject Areas: Motor vehicle crash; Fatality; Thanksgiving; Fatality Analysis Reporting System (FARS); Binomial approximation

Availability: Ratnapradipa, K.L. and Zhu, M. (2020). “Increased Motor Vehicle Fatalities Tuesday Through Thursday During the Us Thanksgiving Holiday (1980–2018).” *Preventive Medicine Reports*, 20. <https://doi.org/10.1016/j.pmedr.2020.101245>

8.28. Title: Cardiorespiratory Fitness and Sex Assigned at Birth Contribute to Brake Reaction Time in Older Adults

Author(s): Johnson, N.F.

Abstract: Introduction: Age-related increases in reaction time (RT) are pervasive. Driver RT is a crucial component of roadway safety. Superior cardiorespiratory fitness (CRF) is associated with faster RTs on a variety of behavioral tasks. Driver RT, as with any RT measure, comprises constituent components that contribute to a total response time (TT). Simple RT (sRT) comprises the requisite sensory and central processing of TT. Movement time (MT) comprises the requisite movement of a particular behavioral response (e.g., moving your foot from the accelerator to the brake pedal). This study aimed to determine the strongest predictor of constituent components of driver RT on a brake onset test.

Methods: Cross-sectional analysis. Predictor variables included CRF, age, and sex. Participants were 50 community-dwelling older adults between the ages of 60 and 77 (mean age = 66.5 years, SD = 4.1). Maximal graded exercise tests were used to assess CRF. A driving simulator was used to assess constituent components of driving-related RT.

Results: Findings indicated that CRF was the largest contributor to sRT variance (beta = -0.35 , $p = 0.03$). Sex was the largest contributor to MT (beta = -0.44 , $p = 0.003$) and TT (beta = -0.28 , $p = 0.05$) variance. CRF also demonstrated a marginal contribution to TT variance (beta = -0.25 , $p = 0.08$). Age did not significantly contribute to sRT, MT, or TT.

Conclusions: Age-related increases in RT can jeopardize roadway safety. Findings from this study demonstrate that a modifiable lifestyle variable may have the ability to reduce roadway risk by improving constituent components of driver RT.

Subject Areas: Driving; Aging; Fitness; Mobility

Availability: Johnson, N.F. (2020). "Cardiorespiratory Fitness and Sex Assigned at Birth Contribute to Brake Reaction Time in Older Adults." *Journal of Transport & Health*, 17. <https://doi.org/10.1016/j.jth.2020.100858>

8.29. Title: Fire Damage and Loss Assessment of Recreational Vehicles (RV's)

Author(s): Siddiq, M. and Johansen, N.

Abstract: The Technical Committee for the NFPA 1192 Standard for Recreational Vehicles requested an analysis that identifies the trends in the fire damage and loss incidents of recreational vehicles over the last ten years, which excludes mobile property types that are outside the scope of the standard. In order to address this need, this project collected and analyzed statistical fire incident data on recreational vehicles to better define the fire experience and further inform future editions of the NFPA 1192 Standard and fire safety for recreational vehicles.

Subject Areas: Recreational vehicles; Fire damage; Safety concerns; Trend analysis

Availability: Siddiq, M. and Johansen, N. (2020). *Fire Damage and Loss Assessment of Recreational Vehicles (RV's)*. National Fire Protection Association, Quincy, MA.
<https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/US-Fire-Problem/RFDamageAndLossRVs.pdf>

Chapter 9. Transit Planning

9.1. Title: Investigating Public Transportation Use in the United States

Author(s): Zhylinski, M., Felkey, A.J., Lemke, R., and Treviño, E.

Abstract: Public transportation is considered to be more cost efficient and ecological than private transportation. Americans, however, use public transportation much less than citizens of European countries. How can public policy change American preferences to increase usage of public transportation? I examine the relationship between personal characteristics (e.g., education, income, and race) and public transportation usage while considering accessibility and geographic factors. In order to investigate these issues, I use data from the 2009 National Household Travel Survey. Two samples of people with different access to public transportation are compared to better understand the relationship. The results show that African Americans and people in high population density areas use public transportation more often than white Americans and people in low population areas respectively, but income has no significant effect on public transportation use. These results match most previous studies on public transportation. In conclusion, the policy should improve public transportation network systemwide, but simple-aimed gasoline taxes are predicted to be ineffective.

Subject Areas: Public transportation; Race; Population density; Household income

Availability: Zhylinski, M., Felkey, A.J., Lemke, R., and Treviño, E. (2020). “Investigating Public Transportation Use in the United States.” *Semantic Scholar*.

<https://www.semanticscholar.org/paper/Investigating-Public-Transportation-Use-in-the-Zhylinski-Felkey/946c44d85f4f69a112507d9e9c8fd488a875bbc2>

9.2. Title: Who's Ditching the Bus?

Author(s): Berrebi, S.J. and Watkins, K.E.

Abstract: This paper uses stop-level passenger count data in four cities to understand the bus ridership decline between 2012 and 2018. The local characteristics associated with ridership change are evaluated in Portland, Miami, Minneapolis/St. Paul, and Atlanta. Poisson models explain ridership as a cross section and the change thereof as a panel. While controlling for the change in frequency, jobs, and population, the correlation with local socio-demographic characteristics are investigated using data from the American Community Survey. The effect of changing neighborhood demographics on bus ridership are modeled using Longitudinal Employer-Household Dynamics data. At a point in time, neighborhoods with high proportions of non-white, carless, and most significantly, high school-educated residents are the most likely to have high ridership. Over time, the share of white residents is correlated with ridership decline. In Miami and Atlanta, places with high concentrations of residents with college education and without access to a car, also lose ridership at a faster rate. In Minneapolis/St. Paul, the proportion of college-educated residents is linked to ridership gain. The sign and significance of these results remain consistent even when controlling for intra-urban migration. Although bus ridership is declining across neighborhood characteristics, these results suggest that the underlying cause of bus ridership decline must be primarily affecting the travel behavior of white bus riders.

Subject Areas: Bus ridership; Poisson models; Neighborhood demographics; Cities; Stop-level passenger count

Availability: Berrebi, S.J. and Watkins, K.E. (2020). "Who's Ditching the Bus?" *Transportation Research Part A: Policy and Practice*, 136, pp. 21–34. <https://doi.org/10.1016/j.tra.2020.02.016>

9.3. Title: An Algorithm for Integrating Peer-to-peer Ridesharing and Schedule-based Transit System for First Mile/Last Mile Access

Author(s): Kumar, P. and Khani, A.

Abstract: Due to limited transit network coverage and infrequent service, suburban commuters often face the transit first mile/last mile (FMLM) problem. To deal with this, they either drive to a park-and-ride location to take transit, use carpooling, or drive directly to their destination to avoid inconvenience. Ridesharing, an emerging mode of transportation, can solve the transit first mile/last mile problem. In this setup, a driver can drive a ride-seeker to a transit station, from where the rider can take transit to her respective destination. The problem requires solving a ridesharing matching problem with the routing of riders in a multimodal transportation network. We develop a transit-based ridesharing matching algorithm to solve this problem. The method leverages the schedule-based transit shortest path to generate feasible matches and then solves a matching optimization program to find an optimal match between riders and drivers. The proposed method not only assigns an optimal driver to the rider but also assigns an optimal transit stop and a transit vehicle trip departing from that stop for the rest of the rider's itinerary. We also introduce the application of space-time prism (STP) (the geographical area which can be reached by a traveler given the time constraints) in the context of ridesharing to reduce the computational time by reducing the network search. An algorithm to solve this problem dynamically using a rolling horizon approach is also presented. We use simulated data obtained from the activity-based travel demand model of Twin Cities, MN, to show that the transit-based ridesharing can solve the FMLM problem and save a significant number of vehicle-hours spent in the system.

Subject Areas: Transit; Ridesharing; Transit first mile last mile; Schedule-based transit shortest path; Rolling horizon; Matching optimization; Space-time prism (STP)

Availability: Kumar, P. and Khani, A. (2020). *An Algorithm for Integrating Peer-to-peer Ridesharing and Schedule-based Transit System for First Mile/Last Mile Access*. arXiv, Cornell University, Ithaca, NY. <https://arxiv.org/abs/2007.07488>

9.4. Title: LA Metro Possible Ridership Decline Causes and Recommendations to Reverse the Trend

Author(s): Miranda, J.C.

Abstract: For the past five consecutive years, Los Angeles County Metropolitan Transportation Authority (Metro) has experienced a ridership decline. Metro seeks to develop and implement creative and feasible programs and marketing campaigns that may help reverse this trend. Metro has tasked the Metro Commute Services Department (MCS) to spearhead this effort. This project seeks to identify possible causes of ridership decline in Los Angeles County and around the United States to recommend programs and marketing campaigns to help Metro reverse this trend. Through the compilation of literature review of transit ridership related journals entries, case studies and news articles, the following set of recommendation were determined: target single occupancy commuters, offer free transit for a day or week, target the millennial generation using social media, work with transportation network companies (TNCs), work with employers to provide incentives for riding public transit, and target low-income individuals. Based on the findings in this project, these recommendations may prove to be successful in increasing ridership for Metro.

Subject Areas: Transit ridership; Trend reversal; Marketing campaigns; Los Angeles County

Availability: Miranda, J.C. (2020). *LA Metro Possible Ridership Decline Causes and Recommendations to Reverse the Trend*. California State Polytechnic University, Pomona, CA. https://broncoscholar.library.cpp.edu/bitstream/handle/10211.3/216838/MirandaJuan_Project2020.pdf?sequence=3

9.5. Title: **Transit Blues in the Golden State: Analyzing Recent California Ridership Trends**

Author(s): Taylor, B.D., Blumenberg, E., Wasserman, J., Garrett, M., Scouten, A., King, H., Paul, J., and Ruvolo, M.

Abstract: Transit patronage plunged staggeringly, from 50 to as much as 94 percent, during the first half of 2020 amidst the worst global pandemic in a century. But transit's troubles in California date much earlier. From 2014 to 2018, California lost over 165 million annual boardings, a drop of over 11 percent. This report examines public transit in California in the 2010s and the factors behind its falling ridership. We find that ridership gains and losses have been asymmetric with respect to location, operators, modes, and transit users. Transit ridership has been on a longer-term decline in regions like Greater Los Angeles and on buses, while ridership losses in the Bay Area are more recent. While overall transit boardings across the state are down since 2014, worrisome underlying trends date back earlier as patronage failed to keep up with population growth. But reduced transit service is not responsible for ridership losses, as falling transit ridership occurred at the same time as operators instead increased their levels of transit service. What factors help to explain losses in transit ridership? Increased access to automobiles explains much, if not most, of declining transit use. Private vehicle access has increased significantly in California and, outside of the Bay Area, is likely the biggest single cause of falling transit ridership. Additionally, new ridehailing services such as Lyft and Uber allow travelers to purchase automobility one trip at a time and likely serve as a substitute for at least some transit trips. Finally, neighborhoods are changing in ways that do not bode well for public transit. Households are increasingly locating in outlying areas where they experience longer commutes and less transit access to employment. At the same time, a smaller share of high-propensity transit users now live in the state's most transit-friendly neighborhoods. While the 2010s proved a difficult decade for public transit in California, and the opening of the current decade has been an even bigger challenge, transit remains an essential public service. Effectively managing transit recovery in California will require a clear-eyed understanding of the substantially altered environment within which these systems large and small must now operate.

Subject Areas: Transit; Transit ridership; California; Travel behavior; Automobile access

Availability: Taylor, B.D., Blumenberg, E., Wasserman, J., Garrett, M., Scouten, A., King, H., Paul, J., and Ruvolo, M. (2020). *Transit Blues in the Golden State: Analyzing Recent California Ridership Trends*. Institute of Transportation Studies, University of California, Los Angeles, CA. <https://escholarship.org/uc/item/32j5j0hb>

9.6. Title: Covid Flight From Transit Forces Shift to Riders Without Choices

Author(s): Rozen, C.

Abstract: Blog.

Subject Areas: Transit; Transit ridership; Rail; Travel behavior; Network planning

Availability: Rozen, C. (2020). "Covid Flight From Transit Forces Shift to Riders Without Choices." *Bloomberg Government*. <https://about.bgov.com/news/covid-flight-from-transit-forces-shift-to-riders-without-choices/>

9.7. Title: A Philadelphia Ride-Share Story: An Investigation of Rideshare's Impact on Transit

Author(s): Dong, X. and Guerra, E.

Abstract: The inconclusive impact of ride-hail on transit hinders transit agencies' efforts to improve service. The authors examine how and where ride-hail has influenced transit ridership, and who uses ride-hail and why. The authors use time series analyses to examine transit ridership change in the Philadelphia region post-ride-hail. The authors then use multilevel analyses to investigate the relationship between post-ride-hailing ridership change at bus stops and neighborhood characteristics and bus services. Finally, the authors investigate ride-hailing user and trip characteristics using a survey among 600 ride-hailing customers. The authors use mixed logit to explore factors that predict ride-hailing users' willingness to choose ride-hail over transit based on choice experiments in the survey. The findings add evidence to ride-hail's substitution effect on transit; indicate busier buses are as prone to ridership loss as less busy buses post-ride-hail; suggest that shortening transit travel time could be more effective in attracting ride-hailing customers to transit than reducing transit fares alone; remind transit agencies to heed female and lower-income residents' travel needs amid rapid growth of ride-hail.

Subject Areas: Bus stops; Impact; Logits; Mode choice; Neighborhoods; Public transit; Ridership; Ridesharing; Ride-sourcing; Surveys

Availability: Dong, X. and Guerra, E. (2020). *A Philadelphia Ride-Share Story: An Investigation of Rideshare's Impact on Transit*. University of Pennsylvania, Philadelphia, PA.
<https://sites.utexas.edu/cm2/files/2020/10/CM2-Final-Project-Report-XiaoxiaDong.pdf>

9.8. Title: Beyond Distance: Exploring the Availability of Metro Vancouver's Bus System and Who Can Access It

Author(s): Chow, L.

Abstract: In recent years, public transit agencies have expressed an interest in finding ways to address inequities in the transportation system. Unlike the inclusion of a high-level health lens (which would simply support increased investment in public transportation, cycling, and walking infrastructure), addressing inequities requires a thorough understanding of social justice, local economics and job creation, health, and transportation. The purpose of this project is to consider a way to look at how well the public transportation system serves populations most in need. While it uses a measure of income to identify Census tracts of interest, it is recognized that equity impacts are felt across a variety of spectrums and a more fulsome measure may be required for future analyses. Therefore, this project does not provide any conclusive recommendations to changes to the public transportation system, but rather suggests a way to incorporate a measure of equity to public transportation evaluation.

Subject Areas: Public transportation; Public transit; TransLink; Accessibility; Equity

Availability: Chow, L. (2020). *Beyond Distance: Exploring the Availability of Metro Vancouver's Bus System and Who Can Access It*. University of British Columbia, Vancouver, British Columbia, Canada. <http://hdl.handle.net/2429/76349>

9.9. Title: Rural Transit Fact Book, 2020

Author(s): Mattson, J. and Mistry, D.

Abstract: The *Rural Transit Fact Book* serves as a national resource for statistics and information on rural transit in America. This publication includes rural demographic and travel behavior data as well as financial and operating statistics for agencies receiving section 5311 funding. In addition to national-level data, statistics are presented by state, FTA region, tribe, and mode, as well as other agency characteristics.

The rural transit data presented in this report were obtained from the Rural National Transit Database (NTD). The 2011 edition of the *Rural Transit Fact Book* was the first published by SURTC/SURCOM and included Rural NTD data for 2007–2009. Since 2011, updates have been made to the book to provide updated data. The 2020 edition includes 2018 data from the NTD as well as additional data from the American Community Survey and National Household Travel Survey.

Subject Areas: Demographics; Financing; Operating costs; Performance measurement; Public transit; Ridership; Rural areas; Rural transit; Travel behavior; Trend; Vehicle fleets

Availability: Mattson, J. and Mistry, D. (2020). *Rural Transit Fact Book, 2020*. North Dakota State University, Fargo, ND. <https://www.ugpti.org/resources/reports/details.php?id=996>

9.10. Title: Transit Use for Single-Parent Households: Evidence from Maryland

Author(s): Wang, S. and Xu, Y.

Abstract: Single parents face unique transportation barriers in their lives. Although helping single parents obtain private vehicles (e.g., car donation programs) would be a potential solution, we cannot ignore the high expense of maintaining and operating a vehicle, which may impose a heavy financial burden on single-parent families and constrain their ability to access opportunities and services. In contrast, public transit could be a more accessible and affordable transportation mode that benefits single-parent families. This study examined the association between public transit use and single parents using 2017 National Household Travel Survey and American Community Survey data for Maryland, United States. Using zero-inflated negative binomial (ZINB) regression, we found that single parents used transit more than the average resident, and census block groups with more single-parent families had more transit commuters, holding other demographic and socioeconomic variables constant. This association was more significant in large metropolitan and urban areas than the state average. The findings highlight the vital role of public transit in single parents' daily travel. We discussed policy implications related to helping single parents access opportunities and services.

Subject Areas: Single parents; Transit; Transportation equity; Transportation barriers; Zero-inflated negative binomial (ZINB) regression

Availability: Wang, S. and Xu, Y. (2020). "Transit Use for Single-Parent Households: Evidence from Maryland." *Transportation Research Interdisciplinary Perspectives*, 8. <https://doi.org/10.1016/j.trip.2020.100223>

9.11. Title: Estimating Transit Ridership Using Wi-Fi Signals: An Enhanced Rule-Based Approach

Author(s): Wang, Y. and Zhang, X.

Abstract: This paper focused on the estimation of bus ridership using Wi-Fi probes (i.e., signals) emitted by smartphones that bus passengers carried. Smart stations—which consist of a Raspberry-Pi computer, a Wi-Fi adapter, and a GPS add-on—were programmed to sniff Wi-Fi signals and transmit signal data through a cloud service to the research computer. These smart stations were mounted onboard a network of transit buses that serve the City of Bozeman, Montana, and its surrounding areas. Two rule-based methods were developed to estimate the number of passengers onboard a bus at any given time. In the first, standard method, a signal was labeled as a passenger if it met arbitrary cutoff values from six criteria pertinent to speed (how fast the signal/device was traveling relative to the bus), duration being detected (as a proxy for how long the device remained in close proximity of the bus), and signal strength (which may correlate with the distance between the device and the bus). The second method employed a cost-function minimization via grid-search to tune the cutoff values involved in those subjective rules (e.g., a valid passenger signal should be close enough to a bus stop when it is first and last detected, but how close is close?). Results suggest a strong linear relationship between model estimates and ground-truth passenger counts—on average, the model estimates were able to capture 67% of the observed passenger counts. As Wi-Fi-enabled personal devices continue to saturate the market, a Wi-Fi-based counting tool as studied here can serve as an efficient way to monitor passenger flows of transportation systems.

Subject Areas: Grid-search; Cost-function minimization; Cloud service; Smartphones; Bus ridership; Enhanced rule-based approach; Transit ridership; Ground-truth passenger counts; Rule-based methods; Wi-Fi signals; Wi-Fi adapter; Raspberry-Pi computer; Smart stations; Wi-Fi probes

Availability: Wang, Y. and Zhang, X. (2020). “Estimating Transit Ridership Using Wi-Fi Signals: An Enhanced Rule-Based Approach.” *2020 IEEE International Conference on Systems, Man, and Cybernetics (SMC)*, pp. 2425–2431, Toronto, ON, Canada.
<https://doi.org/10.1109/SMC42975.2020.9283006>

9.12. Title: Modeling Demand for Ridesourcing as Feeder for High Capacity Mass Transit Systems With an Application to the Planned Beirut BRT

Author(s): Zgheib, N., Abou-Zeid, M., and Kaysi, I.

Abstract: Ridesourcing (Uber, Careem, Lyft, etc.) is emerging as a main player in the transportation industry. However, its relation to mass transit remains ambiguous, with divided opinions on its complementarity or substitutive effect toward high-capacity public transportation systems. This study examines the integration of ridesourcing and transit, particularly focusing on modeling the demand for mass transit when ridesourcing is used as an access or egress mode to mass transit. It extends the existing literature on the integration of transit and new mobility concepts by providing a modeling framework that incorporates all stages of multi-modal trips such as those that involve using mass transit. A mixed logit with error component structure is presented to capture correlations in unobserved factors across multi-modal alternatives sharing similar modes at certain stages. The framework incorporates uni-modal and multi-modal travel alternatives and distinguishes between access, main mode, and egress stages without applying constraints on possible combinations. An application to Beirut's planned Bus Rapid Transit (BRT) system, performed on a data set of 392 respondents, reveals that ridesourcing as a feeder mode is mostly popular with young commuters while also being perceived as more reliable than feeder buses and jitneys. Awareness and familiarity are major drivers for the service implying higher potential in the future. A complementarity effect with transit is found as the introduction of ridesourcing at the feeders' level is expected to drive an additional 2% of commuters to use the BRT. Decreasing ridesourcing fare is effective for its integration with transit, as a fare decrease of 50% increases BRT market share from 33.53% to 36.89% of all motorized trips, implying possible synergies between the two modes. Forecasting results further reveal that additional taxes on parking used by car commuters and increasing park and ride capacity at BRT stations are effective policies to augment BRT ridership.

Subject Areas: Ridesourcing; Transit; Feeders; First-mile-last-mile; Integration

Availability: Zgheib, N., Abou-Zeid, M., and Kaysi, I. (2020). "Modeling Demand for Ridesourcing as Feeder for High Capacity Mass Transit Systems With an Application to the Planned Beirut BRT." *Transportation Research Part A: Policy and Practice*, 138, pp. 70–91. <https://doi.org/10.1016/j.tra.2020.05.019>

9.13. Title: Equity of Transit Connectivity in Tennessee Cities

Author(s): Sharma, I., Mishra, S., Golias, M.M., Welch, T.F., and Cherry, C.R.

Abstract: Federal and State agencies focus on providing captive users in mobility-vulnerable population groups with access to public transit resources. One challenge to the provision of equitable access is quantifying equity-oriented metrics for public transit service. This paper utilizes an approach that utilizes the available spatial demographic data and transit network characteristics to compute multimodal transit connectivity and equity. This method is exemplified by analyzing transit connectivity for three metropolitan cities in Tennessee and overlapping that connectivity on demographic data. Results indicate that the distribution of transit services among vulnerable populations varies within and between cities. The case studies illustrate how this methodology can be used by public agencies to assess the performance of transit systems and to identify the distribution of these systems among various groups to improve the equity of transit connectivity.

Subject Areas: Public transit; Connectivity; Equity; Gini index; Open-source data

Availability: Sharma, I., Mishra, S., Golias, M.M., Welch, T.F., and Cherry, C.R. (2020). "Equity of transit connectivity in Tennessee cities." *Journal of Transport Geography*, 86. <https://doi.org/10.1016/j.jtrangeo.2020.102750>

9.14. Title: Do For-Hire Vehicles Provide First Mile/Last Mile Access to Transit?

Author(s): King, D.A., Conway, M.W., and Salon, D.

Abstract: This research examines how for-hire vehicles (Uber, Lyft, and taxicabs) are combined with other transport modes, both in daily travel tours and as parts of individual trips. Using data from the National Household Travel Survey, we find that about 75% of for-hire tours include another travel mode, and 27% of for-hire tours include transit. The California add-on sample allows us to look specifically at for-hire use for first mile/last mile access to transit. There, we find that about 11% of all for-hire tours in California include first mile/last mile transit access. However, these represent less than 3% of all tours that feature transit, and the sample size is very small. Lastly, we examine the distribution of non-auto and for-hire use within tours by time of day and show that for-hire use exceeds other non-auto use in evenings when transit service is typically reduced. These findings suggest that for-hire vehicles can act as complements to other modes both for individual trips, such as first mile access, and at the tour level where for-hire vehicles may be used for some trips in conjunction with other modes within a travel day.

Subject Areas: For-hire vehicles; Travel mode combination; First mile/last mile; Travel behavior

Availability: King, D.A., Conway, M.W., and Salon, D. (2020). "Do For-Hire Vehicles Provide First Mile/Last Mile Access to Transit?" *Transport Findings*.

<https://doi.org/10.32866/001c.12872>

Chapter 10. Travel Behavior

10.1. Title: The Evolution, Usage, and Trip Patterns of Taxis and Ridesourcing Services

Author(s): Wu, X. and MacKenzie, D.

Abstract: Ridesourcing services are transforming the way people travel. Given the rapid adoption of these services, it is critical for transportation planners and policymakers to understand their impact and keep policies up to date. This study contributes to the literature by using representative samples captured in the 2001, 2009, and 2017 National Household Travel Survey to explore how taxis and ridesourcing (T/R) services have evolved and shaped people's travel behavior pre- and post-disruption at the U.S. national level. It characterizes and visualizes trip purposes and asymmetries in demand for T/R trips, showing that ridesourcing has greatly increased T/R trips from flexible and optional activity locations to home. It also characterizes tours involving T/R services, showing that while simple optional tours (such as home-recreation-home) represent the largest share of tours involving T/R, the fastest growth has been in simple mandatory tours (such as home-work-home). Tours involving T/R grew from 0.4% of all tours in 2009 to 1% of all tours in 2017. Although less than 1% of T/R trips involved a direct transfer to or from transit, one-third of all tours containing T/R also included transit. These results point to a complicated relationship between car ownership, mode choice, and T/R use, with T/R both complementing and substituting for public transportation and active travel.

Subject Areas: Taxi and ridesourcing use; Trip purposes; Mode choice; Behavioral impact; Transit; Active travel

Availability: Wu, X. and MacKenzie, D. (2020). *The Evolution, Usage, and Trip Patterns of Taxis and Ridesourcing Services*. Transportation Research Board 99th Annual Meeting, Washington, DC. <https://annualmeeting.mytrb.org/OnlineProgramArchive/Details/13759>

10.2. Title: Assessing the VMT Effect of Ridesourcing Services in the United States: Evidence from the 2017 National Household Travel Survey

Author(s): Wu, X. and MacKenzie, D.

Abstract: The net effects of ridesourcing (RS) services on vehicle miles traveled (VMT) is ambiguous, with prior research being confounded by self-selection bias among RS users and countervailing effects on car ownership as well as mode choices at the trip and tour levels. This study uses 2017 National Household Travel Survey (NHTS) data to compare the differences in vehicle ownership and daily VMT among people based on the frequency with which they use RS. A propensity score matching method was implemented to match non-users, occasional users, and frequent users in terms of observable sociodemographic traits. The results suggest car owners who become frequent RS users generate less VMT, but those who only become occasional users actually generate more VMT. Moreover, though unsurprisingly, increasing RS use uniformly increases VMT generation among those without prior access to cars. We estimate that overall, RS generated a net increase of 3.6 million daily VMT, or 1.3 billion annual VMT, compared to a case in which all 2017 NHTS respondents were non-users of RS.

Subject Areas: Ridesourcing; Vehicle miles traveled; Car ownership; Mode choices

Availability: Wu, X. and MacKenzie, D. (2020). *Assessing the VMT Effect of Ridesourcing Services in the United States: Evidence from the 2017 National Household Travel Survey*. Transportation Research Board 99th Annual Meeting, Washington, DC.
<https://annualmeeting.mytrb.org/OnlineProgramArchive/Details/13759>

10.3. Title: Controlling for Selection and Simultaneity Biases in the Relationships Between Ridehailing Use and Vehicle Ownership in the 2017 NHTS

Author(s): Lee, Y. and Alemi, F.

Abstract: This study investigates the relationships between the use of ridehailing and vehicle holdings. In doing so, we control for two types of biases: selection biases and simultaneity biases. First, ridehailing use is a choice made by individuals for various reasons. Thus, simple regression of vehicle holdings on ridehailing generates biased estimates for ridehailing effects. Second, while ridehailing use may reduce demand for owning a car (i.e., ridehailing use affects vehicle holdings), those with limited/no access to cars are expected to use ridehailing more (i.e., vehicle holdings affect ridehailing use). We combine two analytical approaches to handle these biases: propensity score matching and non-recursive structural equations modeling. We analyze the 2017 National Household Travel Survey, and we focus on residents who live and work in the largest 50 urban areas in the United States. We first generate “matched” samples consisting of users and equivalent non-users by propensity score matching. Next, we model bidirectional relationships between ridehailing and vehicle holdings and residual correlations by non-recursive SEMs on these matched sample. We find significant effects, although not substantial in magnitude, from ridehailing use to vehicle holdings, but we do not find significant effect in the opposite direction. That is, users would have owned fewer vehicles if they had not used ridehailing, and those with good access to cars are as likely as those with limited access to cars to use ridehailing. We advise planners and policymakers to see the potential of ridehailing for vehicle shedding with caution.

Subject Areas: Ridehailing; Vehicle holdings; Bias control; Bidirectional relationships

Availability: Lee, Y. and Alemi, F. (2020). *Controlling for Selection and Simultaneity Biases in the Relationships Between Ridehailing Use and Vehicle Ownership in the 2017 NHTS*. Transportation Research Board 99th Annual Meeting, Washington, DC.
<https://annualmeeting.mytrb.org/OnlineProgramArchive/Details/13581>

10.4. Title: Adoption of Ridehailing in the United States: Evidence from the 2017 NHTS

Author(s): Dong, H. and Circella, G.

Abstract: This study investigates the adoption of ridehailing in the United States using the 2017 National Household Travel Survey data. It shows that about 10% of Americans aged 16 and older reported to use ridehailing at least once during the 30 days before participating in the survey. Despite its quick growth, ridehailing, along with traditional taxi, still serves a small portion (0.5%) of daily trips in the Nation. Both personal and neighborhood characteristics are strong predictors of whether one would use ridehailing. Younger, more educated, and wealthier individuals are more likely use ridehailing. Individuals are also more likely to use ridehailing when they own fewer cars, reside in neighborhoods of greater levels of density and mixed use, and live in larger metropolitan areas. Fewer personal and neighborhood characteristics are good predictors of how often one uses ridehailing. Major predictors of how often one uses ridehailing include age, education, vehicle ownership, and neighborhood density as well as living in a metropolitan area with more than 3 million population. Vehicle ownership and neighborhood density become statistically insignificant after controlling for other travel behavioral variables. Ridehailing/taxi trips are much more concentrated in central urban areas than transit and auto trips and thus likely cause more congestion in those central locations than their small market share might suggest. This is particularly true in the evening time when the peak hours of ridehailing/taxi trips overlap with the peak hours of auto trips.

Subject Areas: Ridehailing adoption; Personal characteristics; Built environment; Vehicle ownership; Geographical difference

Availability: Dong, H. and Circella, G. (2020). *Adoption of Ridehailing in the United States: Evidence from the 2017 NHTS*. Transportation Research Board 99th Annual Meeting, Washington, DC. <https://annualmeeting.mytrb.org/OnlineProgramArchive/Details/13798>

10.5. Title: Public Transportation, Transportation Network Companies (TNC) and Active Modes: An Analysis Based on 2009 and 2017 NHTS

Author(s): Saphores, J.

Abstract: Over the last few years, transit ridership has fallen drastically in Southern California whereas transportation network companies (TNCs) have been expanding tremendously. The decline of transit and the rise of TNCs have a number of adverse consequences, including increases in congestion in urban areas, additional air pollution, and a reduction in the physical activity of people who would otherwise walk/bike to access transit. Due to limited information on TNCs, research on these consequences are few. In this context, this project will cover three key questions related to transit, TNC, and active mode based on the 2009 and 2017 National Household Travel Survey (NHTS) data. (1) To what extent have TNCs displaced transit users in California? We will find out the difference between the travel behavior of two transit user groups under the availability/non-availability of TNC services. We will use a propensity score matching technique to match user groups based on socio-economic and land use variables. (2) To what extent does public transportation contribute to active modes in California? Transit is partly an active mode because the first and last mile of transit trips include walking/biking. This dimension of transit has not been yet explored in the context of California. Through a cross-nested logit model, we will evaluate this nature of public transportation where transit will be a part of both active and non-active nests. (3) How can we promote public transit? We will analyze transit perception questions in the 2017 NHTS. Results will be helpful to transit operators and policymakers.

Subject Areas: Transportation network companies; Transit ridership; Active mode; Air pollution; Urban; Congestion; Cross-nested logit model

Availability: Saphores, J. (2020). *Public Transportation, Transportation Network Companies (TNC) and Active Modes: An Analysis Based on 2009 and 2017 NHTS*. The National Academies of Science, Engineering, and Medicine, Washington, DC. <https://trid.trb.org/View/1690151>

10.6. Title: Analysis of Activity-Travel Patterns and Tour Formation of Transit Users

Author(s): McNally, M.

Abstract: The activity-based approach has become widely used to analyze individual and household activity patterns and associated travel behavior. The complexity of travel behavior has significantly increased over the years as individuals respond to different activity demands and to the changing supply environment, measured by both congestion and cost, as well as emerging technologies. While personal vehicles arguably provide the most flexibility in terms of managing travel needs, the more sustainable mode of transport is public transit. This study will investigate the daily activity pattern and tour formation of transit users to address the following: (1) do transit users follow different tour patterns than car users, (2) does transit put extra barriers on people's choice of tours, and (3) if so, are there any particular socio-demographics groups that are most affected? To narrow down the scope, this study envisions to analyze activity-travel patterns and tour formation for selected disadvantaged or underrepresented groups, such as captive transit riders (zero-vehicle owners), senior citizens, women, people with low income, and people living in rural areas. The study will use the 2017 National Household Travel Survey (NHTS) dataset. Several multivariate analytical techniques, such as structural equation modeling (SEM), logit models, and pattern recognition techniques, will be applied to conduct the necessary analysis. The results of this study will help to formulate necessary policies to improve mobility and to reduce access barriers for the target groups.

Subject Areas: Daily activity patterns; Transit; Vehicle ownership; Mode choice; Socio-demographics groups; Structural equation modeling; Logit models; Pattern recognition

Availability: McNally, M. (2020). *Analysis of Activity-Travel Patterns and Tour Formation of Transit Users*. The National Academies of Science, Engineering, and Medicine, Washington, DC. <https://trid.trb.org/View/1690150>

10.7. Title: Revisiting the Impact of Teleworking on Activity-Travel Behavior Using Recent Data and Sequence-Based Analytical Technique

Author(s): Goulias, K.

Abstract: Telecommuting and telework are the use of information and telecommunication technology to replace the more traditional working at workplaces and traveling to work. In the 1970s, telecommuting was envisioned as a policy tool in a Travel Demand Management (TDM) toolkit with hopes it will help us decrease congestion, air pollution, and waste of resources. Legislation and planning at many levels of government support telecommuting as a measure to benefit the public, employers, and employees. The beneficial impacts of telecommuting on transportation are questioned today as new evidence and analysis emerge. We also face a rapid transformation of work, workplaces, and as a consequence telework. In this project, we revisit telecommuting and its relationship with travel behavior to assess its efficacy as a policy tool in a multipronged way. First, we develop a new analytical tool based on sequence analysis of activity and travel patterns at fine temporal and spatial resolutions. This replaces daily summary indicators that mask person variation in travel patterns. Second, we apply this new tool to two recent travel behavior databases in California: the California Household Travel Survey with data collected in 2012–2013 and the National Household Travel Survey with data collected in 2017. Third, we perform an analysis at different geographical and social contexts in California to assess if and how telework opportunities are correlated with daily activity and travel patterns. The project concludes with a synthesis of findings about emerging patterns and trends in telecommuting impacts in light of possible radical trends in work, workplaces, mobile work, and telework.

Subject Areas: Telecommuting; Telework; Travel demand management; Travel patterns; Sequence analysis

Availability: Goulias, K. (2020). *Revisiting the Impact of Teleworking on Activity-Travel Behavior Using Recent Data and Sequence-Based Analytical Technique*. The National Academies of Science, Engineering, and Medicine, Washington, DC.
<https://trid.trb.org/View/1689996>

10.8. Title: Ridesharing, Ride-Hailing, and Transit Ridership: A National Study Using the 2017 National Household Travel Survey

Author(s): Boarnet, M.

Abstract: The principal investigator will use the 2017 National Household Travel Survey (NHTS) to study the relationship between ride-hailing and transit travel. A handful of studies have examined the question of whether ride-hailing (e.g., Uber or Lyft) is a substitute or complement for public transit. The literature so far has produced mixed results. A well-known study by Hall, Palsson, and Price (2018) concludes that on average, when Uber entered a metropolitan market, public transit ridership increased by 5 percentage points. Yet, that study finds heterogeneity across both city size and the size of transit systems. Other research suggests that the question is far from settled (e.g., Doppelt, 2018; Sadowsky and Nelson, 2018). The 2017 NHTS is the first travel survey that is available during the ride-hailing era, and the national coverage and ability to focus on individual travel behavior are advantages. We will use the NHTS to examine the link between individual ride-hailing and individual transit use. The results from travel survey data will provide more behavioral insights than have previously been possible from aggregate data and will expand our understanding of whether and in what circumstances ride-hailing substitutes for or complements transit.

Subject Areas: Ridesharing; Ride-hailing; Transit use; Uber; Lyft

Availability: Boarnet, M. (2020). *Ridesharing, Ride-Hailing, and Transit Ridership: A National Study Using the 2017 National Household Travel Survey*. The National Academies of Science, Engineering, and Medicine, Washington, DC. <https://trid.trb.org/View/1683375>

10.9. Title: The Impact of Shared Mobility on Trip Generation Behavior in the US: Findings from the 2017 National Household Travel Survey

Author(s): Jiao, J., Bischak, C., and Hyden, S.

Abstract: Shared mobility services, such as ride-hailing services, bikesharing services, and carsharing services, are relatively new forms of transportation where users gain access to a specific type of transportation for a short period of time, usually using a mobile phone-based application (app). Much has been written about whether these services are fundamentally transforming urban transportation systems or if they are simply the latest fad. However, little empirical research has been done on the effects of these services on people's travel behavior. This paper uses the 2017 National Household Travel Survey (NHTS) to assess the association between the usage of shared mobility services and individual's trip-making behavior. We fit negative binomial regression models to NHTS data to understand if the usage of shared mobility services is potentially influencing the number of trips people make on weekdays and weekends. We then perform hypothesis testing to confirm the significance of our results. We find that ride-hailing app usage does have a statistically significant association with the number of trips made per day on both weekends and weekdays, although the effect appears to be slightly more significant on weekdays than weekends. Based on our model, bikesharing and carsharing do not appear to have an association with daily trip generation behavior on either weekends or weekdays.

Subject Areas: Ridesourcing; Shared mobility; Travel behavior; Travel patterns; Trip generation; Vehicle sharing; National Household Travel Survey

Availability: Jiao, J., Bischak, C., and Hyden, S. (2020). "The Impact of Shared Mobility on Trip Generation Behavior in the US: Findings from the 2017 National Household Travel Survey." *Travel Behaviour and Society*, 19, pp. 1–7. <https://doi.org/10.1016/j.tbs.2019.11.001>

10.10. Title: Exploring the Relationship Between Ride-Sourcing Services and Vehicle Ownership, Using Both Inferential and Machine Learning Approaches

Author(s): Sabouri, S., Brewer, S., and Ewing, R.

Abstract: Ride-sourcing services are getting more popular each year, and their markets are growing. Much has been speculated, but not much has been tested regarding the impacts of ride-sourcing services on the transportation system. In this study, we examine the relationship between ride-sourcing services and vehicle ownership of households, by using the most up-to-date (2017) National Household Travel Survey data. To better capture the effect of ride-sourcing services on vehicle ownership, we controlled for the effect of socioeconomic characteristics of households and built environment variables (i.e., density, diversity, design, and distance to transit). Two approaches were used to model vehicle ownership: a probabilistic or inferential model (i.e., multilevel Poisson) and a machine-learning method (i.e., random forest). This is the first study to utilize such advanced methods to model vehicle ownership and capture non-linear relationships using the largest sample of household travel records ever assembled for such a study. The results suggest that there is a negative correlation between using ride-sourcing services and vehicle ownership. Vehicle ownership is also negatively associated with the number of years Uber, as the biggest ride-sourcing service, has operated in a county. The relative contributions of ride-sourcing variables, however, are very limited compared to other variables controlled in this study, which makes intuitive sense. For urban planning and design practices, this study suggests that the probability of car shedding will increase if the usage of ride-sourcing services becomes a habit, these services become more available, and built environments become more dense, connected, and transit-served.

Subject Areas: Ride-sourcing services; Uber; Vehicle ownership; Machine learning; Random forest; Multilevel modeling

Availability: Sabouri, S., Brewer, S., and Ewing, R. (2020). “Exploring the Relationship Between Ride-Sourcing Services and Vehicle Ownership, Using Both Inferential and Machine Learning Approaches.” *Landscape and Urban Planning*, 198.

<https://doi.org/10.1016/j.landurbplan.2020.103797>

10.11. Title: Dynamics of Travelers' Modality Style in the Presence of Mobility-on-Demand Services

Author(s): Shamshiripour, A., Rahimi, E., Shabanpour, R., and Mohammadian, A.

Abstract: Modality style—defined as a set of frequent travel modes characterizing travelers' habits, routines, and predispositions—is a key player in forming dynamics of travelers' mode choice behavior. This study aims to uncover the dynamics of modal preferences while the mobility-on-demand (MoD) services operate in the market. Using the 2017 National Household Travel Survey data, a multiple discrete continuous extreme value model is developed to analyze the dynamics of individuals' modality style. This model enables us to take into consideration marginal rates of substitutions between different transportation modes. Variables of interest in this analysis include the frequency of use of MoD services as well as the frequency of walking, biking, transit, and auto trips over the course of a month. The results of this study offer city planners and policymakers an opportunity to better understand the factors underlying modality styles and which priorities to focus on when designing a sustainable development plan for resident-centric smart cities. According to the results, age, work status, education, auto availability, and the built environments are among the significant contributors to the modality styles. The results also indicate that the extent of the substitution relationship between transit and MoD services is highly context dependent.

Subject Areas: Modality style; Mobility-on-demand; Rate of substitution; Travel habits

Availability: Shamshiripour, A., Rahimi, E., Shabanpour, R., and Mohammadian, A. (2020). "Dynamics of Travelers' Modality Style in the Presence of Mobility-on-Demand Services." *Transportation Research Part C: Emerging Technologies*, 117. <https://doi.org/10.1016/j.trc.2020.102668>

10.12. Title: America on Pause: Vehicle Travel During COVID-19 and What Comes Next

Author(s): Dutzik, T.

Abstract: Blog.

Subject Areas: COVID-19; Vehicle miles traveled; Car dependency; Air quality; Walking; Biking; Transportation system

Availability: Dutzik, T. (2020). “America on Pause: Vehicle Travel During COVID-19 and What Comes Next.” *U.S. Prig.* <https://uspirg.org/blogs/blog/usp/america-pause-vehicle-travel-during-covid-19-and-what-comes-next>

10.13. Title: Nonstandard Ridehail Use in Austin

Author(s): Edwards, M.

Abstract: Ridehailing quickly proliferated by geography and socioeconomic status following the 2012 introduction of UberX and Lyft, but did that proliferation extend to higher-priced, nonstandard-vehicle trips? What explains nonstandard ridehail use, who uses it, and where are they going? RideAustin trip-level data, land-use codes, ACS block groups, and parking data are analyzed using Geographic Information System and statistical software to find out. Results imply the nonstandard-vehicle RideAustin traveler varied from the standard-vehicle traveler in several important socioeconomic ways, including access to a car, household income, race/ethnicity, age, education, and neighborhood trips per capita. About 47% of nonstandard-vehicle trips were made in neighborhoods with the highest carless household rate, and 40% of those were made in sport utility vehicles. Better tips and higher star ratings imply standard-vehicle passengers had a higher level of satisfaction compared to nonstandard-vehicle passengers. Policy recommendations are made to incentivize carpooling in these extra-capacity vehicles through subsidies.

Subject Areas: Uber/Lyft; Ridehailing; Travel behavior; Nonstandard vehicles; Socioeconomics; Built environment

Availability: Edwards, M. (2020). "Nonstandard Ridehail Use in Austin." *Journal of Transport Geography*, 86. <https://doi.org/10.1016/j.jtrangeo.2020.102746>

10.14. Title: Structural Equation Modelling of Household Long-Distance Flexible Travel Behavior

Author(s): Zhang, J., Wang, F., Shao, C., and Mi, X.

Abstract: In recent years, more and more households plan to visit tourist destinations or visit relatives on holidays. Facing the surging demand for household travel, this paper aims to explore the generation mechanism of household long-distance flexible travel on holidays. Firstly, a questionnaire survey on long-distance flexible travel behavior was conducted among middle-income households in first- and second-tier cities. Then, multiple endogenous and exogenous variables were extracted from the survey data. On this basis, a structural equation model (SEM) was established to analyze the influence of individual attributes, economic attributes, and household attributes over the travel attributes and travel intensity of household long-distance flexible travel. The results show that economic attributes had the greatest impact on travel intensity among all exogenous variables. This means household income promotes travel intensity, especially travel duration. Besides, household attributes negatively affect travel intensity. In other words, with the growing number of elderlies, children, and employed in the household, the number of travelers in household travel will increase, while the intensity of household travel will decline; the household will prefer to travel by car. The research results provide theoretical supports to the research of household flexible travel behavior and enable tourist cities to effectively manage and optimize holiday traffic.

Subject Areas: Household as a unit; Flexible travel; Travel behavior; Structural equation model (SEM)

Availability: Zhang, J., Wang, F., Shao, C., and Mi, X. (2020). “Structural Equation Modelling of Household Long-Distance Flexible Travel Behavior.” *International Journal of Sustainable Development and Planning*, 15(4), pp. 461–467. <https://doi.org/10.18280/ijstdp.150406>

10.15. Title: Users' Perception of Value of Travel Time and Value of Ridesharing Impacts on Europeans' Ridesharing Participation Intention: A Case Study Based on MoTiV European-Wide Mobility and Behavioral Pattern Dataset

Author(s): Malichová, E., Pourhashem, G., Kováčiková, T., and Hudák, M.

Abstract: Ridesharing as a form of mobility service increased significantly and has become a popular concept in recent years among users, mobility authorities, and transport service providers. This research focused on exploring an emerging view of value of travel time (VTT) from the traveler's perspective based on the stated travel time worthwhileness, preferences, and motivations on their intention towards participation in ridesharing to evaluate individual's perception of VTT and perceived value of ridesharing (VRS) impacts on intentions to participate in car sharing for their daily commuting using a multinomial logit (MNL) model. This is particularly relevant today, as peer-to-peer mobility services are on the one hand shaping and redefining the value of technologies and services and, on the other hand, introducing new actors in the mobility eco-system. This study describes a survey of 278 people in 4 European countries: Finland, Portugal, Spain, and Slovakia as part of the "Mobility and Time Value" (MoTiV) H2020 project EU-wide data collection. In short, the empirical analysis indicates the high significance of enjoyment in terms of travel time worthwhileness on ridesharing adoption for commuting trips. Results also revealed economic benefit and enjoyment of being social as major motivators for participation in ridesharing. Findings are discussed in terms of implications for urban and transport planners, policy makers, and authorities to implement in shared mobility planning and to prepare transport policies which are tailored to individuals' ridesharing needs and travel preferences and count also on travel happiness factors to better reflect the traveler's personal ambitions. Suggestions for future research on shared mobility planning are outlined in conclusion.

Subject Areas: Ride-sharing; Mobility; View of value of travel time; Multinomial logit model

Availability: Malichová, E., Pourhashem, G., Kováčiková, T., and Hudák, M. (2020). "Users' Perception of Value of Travel Time and Value of Ridesharing Impacts on Europeans' Ridesharing Participation Intention: A Case Study Based on MoTiV European-Wide Mobility and Behavioral Pattern Dataset." *Sustainability*, 12(10), pp. 1–19.

<https://ideas.repec.org/a/gam/jsusta/v12y2020i10p4118-d359553.html>

10.16. Title: Quantifying Human Mobility Behavior Changes in Response to Non-pharmaceutical Interventions During the COVID-19 Outbreak in the United States

Author(s): Pan, Y., Darzi, A., Kabiri, A., Zhao, G., Luo, W., Xiong, C., and Zhang, L.

Abstract: Ever since the first case of the novel coronavirus disease (COVID-19) was confirmed in Wuhan, China, social distancing has been promoted worldwide, including the United States. It is one of the major community mitigation strategies, also known as non-pharmaceutical interventions. However, our understanding is remaining limited in how people practice social distancing. In this study, we construct a Social Distancing Index (SDI) to evaluate people's mobility pattern changes along with the spread of COVID-19. We utilize an integrated dataset of mobile device location data for the contiguous United States plus Alaska and Hawaii over a 100-day period from January 1, 2020, to April 9, 2020. The major findings are: (1) the declaration of the national emergency concerning the COVID-19 outbreak greatly encouraged social distancing and the mandatory stay-at-home orders in most states further strengthened the practice; (2) the States with more confirmed cases have taken more active and timely responses in practicing social distancing; (3) people in States with fewer confirmed cases did not pay much attention to maintaining social distancing and some States (e.g., Wyoming, North Dakota, and Montana) already began to practice less social distancing despite the high increasing speed of confirmed cases; and (4) some counties with the highest infection rates are not performing much social distancing (e.g., Randolph County and Dougherty County in Georgia), and some counties began to practice less social distancing right after the increasing speed of confirmed cases went down (e.g., Blaine County in Idaho), which may be dangerous as well.

Subject Areas: COVID-19; Social distancing; Social distancing index; Human mobility; Mobile device location data

Availability: Pan, Y., Darzi, A., Kabiri, A., Zhao, G., Luo, W., Xiong, C., and Zhang, L. (2020). *Quantifying Human Mobility Behavior Changes in Response to Non-pharmaceutical Interventions During the COVID-19 Outbreak in the United States*. Maryland Transportation Institute, University of Maryland, College Park, MD.
<https://arxiv.org/ftp/arxiv/papers/2005/2005.01224.pdf>

10.17. Title: Naturalistic Passenger Behavior: Postures and Activities

Author(s): Reed, M.P., Ebert, S.M., and Jones, M.L.H.

Abstract: Video cameras were installed in the passenger cabins of 75 vehicles to monitor the postures and activities of front-seat passengers. Video frames from a total of 2,733 trips were coded for 306 unique front-seat passengers. During these trips, a total of 13,638 frames were coded; each frame represents about 4 minutes of travel time. The median trip duration was 12.2 minutes, and 5% of trips were longer than 54 minutes. The distribution of trip durations was similar to that for the general population of U.S. travelers. The front-seat passenger was female in 72% of frames and most often judged to be between 17 and 30 years of age. The seat belt was worn 97% of the time, with visibly poor fit (belt on belly or lateral to the clavicle) in about 30% of frames. The most common passenger interaction was talking with the driver, while interactions with hand-held devices (typically phones) occurred in 26% of frames. Phone use was associated with a downward pitched head. The head was rotated left or right in 33% of frames, and the torso was rotated left or right about 10% of the time and pitched forward in almost 10% of frames. The front of the thighs was lifted off the seat due to the feet being shifted rearward about 40% of the time, and the legs were crossed in about 5% of frames. Resting behavior was observed more frequently in longer-duration trips and when traveling at higher speeds, while phone use increased and talking with vehicle occupants decreased with increased sitting time. No seat position or seat back angle change was noted in 40 vehicles (53%) . In the remaining 35 vehicles, seat back angle and seat position were observed to change only 16 and 61 times, respectively, so that the distributions of seat position and seat back angle on arrival were essentially unchanged during travel. The seat was positioned full rear on the seat track about 23% of the time and rear-ward of the mid-track position in 81% of frames. The mean seat back angle was 25.4 degrees (standard deviation 6.4 degrees); seat back angle was greater than 30 degrees in 15% of frames and greater than 35 degrees in less than 1% of frames. Seat back angles greater than 30 degrees were more common on longer trips and associated with a greater likelihood of the head touching the seat, lower phone use, and slightly greater frequency of resting behavior. When a second-row passenger was present behind the front-seat passenger, the seat was 5 mm further forward and 1.4 degrees more upright, on average. This study is the first to report distributions of seat positions and seat back angles for front-seat passengers and the first to provide details of passenger posture and activities from a large sample of individuals. The findings have implications for the design of current vehicles and also provide insight into the likely postures and activities of the occupants of future driverless vehicles.

Subject Areas: Motor vehicle occupants; Passengers; Behaviors; Belt use; Posture

Availability: Reed, M.P., Ebert, S.M., and Jones, M.L.H. (2020). *Naturalistic Passenger Behavior: Postures and Activities*. Transportation Research Institute, University of Michigan, Ann Arbor MI. <https://deepblue.lib.umich.edu/handle/2027.42/154855>

10.18. Title: How Accumulated Wealth Affects Driving Reduction and Cessation

Author(s): Vivoda, J.M., Walker, R.M., Cao, J., and Koumoutzis, A.

Abstract: Background and Objectives: Older adults can expect to live between 6 and 10 years after they give up driving, but driving reduction (DR) and driving cessation (DC) are not equally experienced by all groups. Individual characteristics such as poor health, impaired vision, older age, and female gender are known to affect DRC. Using cumulative disadvantage theory as a guide, this study assessed the role played by wealth in DR and DC among older adults.

Research Design and Methods: Data from the National Health and Aging Trends Study were analyzed using multinomial logistic regression techniques. This allowed for the effect of each predictor on the odds of engagement in a given driving status (full driving, DR, and DC) to be compared to each of the others.

Results: The final sample included 6,387 participants. After controlling for the effect of covariates, less wealth was associated with higher odds of DR compared to full driving, DC compared to full driving, and DC compared to DR. Confirming previous research, several other factors were also significantly related to driving status including age, health, vision, gender, race, education, relationship status, household size, and work status.

Discussion and Implications: The influence of wealth on driving status among older adults represents another disadvantage unequally distributed to some in older adulthood. Those with less wealth will have fewer resources to meet their mobility needs using alternatives and may already be facing additional financial constraints due to worse health and other challenges associated with lower socioeconomic status.

Subject Areas: Transportation; Economics; Driving; Cumulative disadvantage; Net worth; Self-regulation

Availability: Vivoda, J.M., Walker, R.M., Cao, J., and Koumoutzis, A. (2020). "How Accumulated Wealth Affects Driving Reduction and Cessation." *The Gerontologist*, 60(7), pp. 1273–1281. <https://doi.org/10.1093/geront/gnaa039>

10.19. Title: Eliciting Preferences of TNC Users and Drivers: Evidence From the United States

Author(s): Bansal, P., Sinha, A., Dua, R., and Daziano, R.A.

Abstract: Transportation network companies (TNCs) are changing the transportation ecosystem, but micro-decisions of travelers and TNC drivers need to be better understood to assess their system-level impacts. Using a unique sample ($N = 11,902$) of the U.S. population residing in TNC-served areas, we estimate preferences of TNC travelers for (1) being a rider, a driver, or a non-user of TNC services and (2) to use pooled ridesourcing. In addition, using a large sample of TNC drivers, we estimate their inclination to (1) switch to vehicles with better fuel economy and (2) buy, rent, or lease a new vehicle with driving for TNCs being a major contributing factor. The population-weighted statistical analysis indicates that TNCs are mainly attracting personal vehicle users as riders without substantially affecting demand for transit. Moreover, around 10% of TNC users reported postponing the purchase of a new car due to the availability of TNCs. Using multinomial logistic regression, we find that the likelihood of being a TNC user increases with age until 44 years and decreases afterwards. Older suburban TNC users with higher vehicle ownership are less likely to pool rides. Among TNC drivers who work daily, 65% indicated that driving for TNCs was a consideration in vehicle purchase decisions. Households with postgraduate drivers who drive daily and live in metropolitan regions are more likely to switch to fuel-efficient vehicles. These findings can inform transportation planners and TNCs in developing policies to encourage pooled ridesourcing and to improve the average fuel economy of the TNC fleet.

Subject Areas: Transport network companies; Ridesharing; Preference estimation; Logistic regression

Availability: Bansal, P., Sinha, A., Dua, R., and Daziano, R.A. (2020). "Eliciting Preferences of TNC Users and Drivers: Evidence From the United States." *Travel Behaviour and Society*, 20, pp. 225–236. <https://doi.org/10.1016/j.tbs.2020.04.002>

10.20. Title: Will Autonomous Vehicles Change Auto Commuters' Value of Travel Time?

Author(s): Zhong, H., Li, W., Burriss, M.W., Talebpour, A., and Sinha, K.C.

Abstract: This paper examines the potential impact of autonomous vehicles on commuters' value of travel time (VOTT). In particular, we focus on the effect on auto commuters in small- and medium-sized metropolitan areas concerning the spatial variability across urban areas, suburbs, and rural areas. We design a stated choice experiment to elicit potential changes in 1,881 auto commuters' valuation of travel time in autonomous vehicles and apply a mixed logit model to quantify the changes in the value of travel time if taking autonomous vehicles. The results of this study suggest that the effect of autonomous vehicles on VOTT is spatially differentiated. We find that riding in a private autonomous vehicle reduces the commuting VOTT of suburban, urban, and rural drivers by 32%, 24%, and 18%, respectively, compared to 14%, 13%, and 8% for riding in a shared autonomous vehicle. Finally, we discuss the implications of these lower values of time on transportation and land use planning.

Subject Areas: Autonomous vehicles; Value of travel time; Stated choice experiment; Mixed logit model

Availability: Zhong, H., Li, W., Burriss, M.W., Talebpour, A., and Sinha, K.C. (2020). "Will Autonomous Vehicles Change Auto Commuters' Value of Travel Time?" *Transportation Research Part D: Transport and Environment*, 83. <https://doi.org/10.1016/j.trd.2020.102303>

10.21. Title: Who and Where Rideshares? Rideshare Travel and Use in Los Angeles

Author(s): Brown, A.E.

Abstract: Carpooling rates in America have been falling for decades. But new technologies may offer solutions to traditional carpooling barriers and usher in a new chapter in shared car travel. Ride-hail services connect riders to drivers through smartphone applications. The largest ride-hail companies, Uber and Lyft, offer shared carpool (rideshare) services to connect riders traveling in the same directions and at the same times. Although researchers have recently begun to understand who uses ride-hail services, few have yet investigated ridesharing. To fill this gap, I ask and answer two questions. First, what factors are associated with where ridesharing occurs? Second, what factors are associated with who rideshares? To answer both questions, I use trip-level data of 6.3 million Lyft trips, including 1.9 million Lyft Shared trips, taken in Los Angeles County in 2016. Findings reveal that while about one-third of Lyft trips are on Lyft Shared, these rideshare trips are made by a small fraction of ride-hail users. Just one-third of ride-hail users made even one rideshare trip over the 3-month study period, and just 10% of all Lyft riders made 94% of rideshare trips. People living in dense and lower-income neighborhoods share a higher proportion of ride-hail trips compared to riders living in other neighborhoods. Less ridesharing occurs in racial and ethnically diverse neighborhoods compared to neighborhoods where clear racial or ethnic majorities exist. Cities seeking to increase sharing in ride-hail services should focus efforts on attracting non-users, including pricing to encourage shared rather than solo car trips. Implemented policies should avoid undercutting demand for transit or active travel, which remain the most efficient modes on our streets.

Subject Areas: Ride-hail; Rideshare; Transportation network company; Shared mobility

Availability: Brown, A.E. (2020). “Who and Where Rideshares? Rideshare Travel and Use in Los Angeles.” *Transportation Research Part A: Policy and Practice*, 136, pp. 120–134.

<https://doi.org/10.1016/j.tr.2020.04.001>

10.22. Title: The Impacts of Same Day Delivery Online Shopping on Local Store Shopping in Nanjing, China

Author(s): Xi, G., Cao, X., and Zhen, F.

Abstract: Same day delivery (SDD) online shopping may generate different influences on physical store shopping from conventional online shopping, but few studies have explored this new and burgeoning channel and its impacts. Using retrospective survey data in Nanjing, China, this study investigates the impacts of SDD online shopping on local store shopping. Quasi-longitudinal analyses of the retrospective data show that SDD online shopping substitutes for local store shopping and that changes in local shopping are associated with SDD online shopping frequency. These results suggest that SDD online shopping may change local shopping travel and alter the distribution of commercial land uses over time. Moreover, a comparison between quasi-longitudinal and cross-sectional analyses suggests that cross-sectional results are not reliable. Future studies should move beyond cross-sectional design.

Subject Areas: Information and communication technology; e-shopping; Shopping travel; Retrospective approach; Longitudinal design

Availability: Xi, G., Cao, X., and Zhen, F. (2020). “The Impacts of Same Day Delivery Online Shopping on Local Store Shopping in Nanjing, China.” *Transportation Research Part A: Policy and Practice*, 136, pp. 35–47. <https://doi.org/10.1016/j.tra.2020.03.030>

10.23. Title: An Assessment of Age and Gender Characteristics of Mixed Traffic with Autonomous and Manual Vehicles: A Cellular Automata Approach

Author(s): Tanveer, M., Kashmiri, F.A., Naeem, H., Yan, H., Qi, X., Rizvi, S.M.A., Wang, T., and Lu, H.

Abstract: Traffic congestion has become increasingly prevalent in many urban areas, and researchers are continuously looking into new ways to resolve this pertinent issue. Autonomous vehicles are one of the technologies expected to revolutionize transportation systems. To this very day, there are limited studies focused on the impact of autonomous vehicles in heterogeneous traffic flow in terms of different driving modes (manual and self-driving). Autonomous vehicles in the near future will be running parallel with manual vehicles, and drivers will have different characteristics and attributes. Previous studies that have focused on the impact of autonomous vehicles in these conditions are scarce. This paper proposes a new cellular automata model to address this issue, where different autonomous vehicles (cars and buses) and manual vehicles (cars and buses) are compared in terms of fundamental traffic parameters. Manual cars are further divided into subcategories on the basis of age groups and gender. Each category has its own distinct attributes, which make it different from the others. This is done in order to obtain a simulation as close as possible to a real-world scenario. Furthermore, different lane-changing behavior patterns have been modeled for autonomous and manual vehicles. Subsequently, different scenarios with different compositions are simulated to investigate the impact of autonomous vehicles on traffic flow in heterogeneous conditions. The results suggest that autonomous vehicles can raise the flow rate of any network considerably despite the running heterogeneous traffic flow.

Subject Areas: Autonomous vehicle; Age; Gender; Manual vehicle; Cellular automata

Availability: Tanveer, M., Kashmiri, F.A., Naeem, H., Yan, H., Qi, X., Rizvi, S.M.A., Wang, T., and Lu, H. (2020). "An Assessment of Age and Gender Characteristics of Mixed Traffic with Autonomous and Manual Vehicles: A Cellular Automata Approach." *Sustainability*, 12(7). <https://doi.org/10.3390/su12072922>

10.24. Title: A Study of the Impact of COVID-19 on Home Delivery Purchases and Expenditures

Author(s): Unnikrishnan, A. and Figliozi, M.A.

Abstract: Lockdowns caused by the COVID-19 pandemic have significantly affected shopping behavior. This study surveys people living in Portland-Vancouver-Hillsboro Metropolitan area on household and demographic characteristics, e-commerce and home delivery service and product preferences, number of deliveries made before and during the COVID-19 lockdown, and household expenditures on home deliveries. Ordered choice models are developed to understand factors that affect the number of online deliveries made before COVID-19, and the number and household expenditures on online deliveries during the COVID-19 lockdown. Results indicate that higher-income households are more likely to make more online deliveries and spend more money on home deliveries during the COVID-19 lockdown. Higher levels of technology utilization are also associated with higher levels of deliveries and expenditures. Same-day or next-day services are expected for items such as groceries or meals. Respondents who are concerned about product costs at brick and mortar stores are less likely to have high levels of house deliveries, but respondents who are worried about health issues are more likely to spend more money and have more home deliveries during COVID-19 lockdown. The results have important implications in terms of equity and access to e-commerce and house grocery deliveries.

Subject Areas: COVID-19; Home deliveries; E-commerce

Availability: Unnikrishnan, A. and Figliozi, M.A. (2020). *A Study of the Impact of COVID-19 on Home Delivery Purchases and Expenditures*. Working Paper, Portland State University, Portland, OR. <https://archives.pdx.edu/ds/psu/33410>

10.25. Title: COVID-19 and Income Profile: How People in Different Income Groups Responded to Disease Outbreak, Case Study of the United States

Author(s): Sun, Q., Zhou, W., Kabiri, A., Darzi, A., Hu, S., Younes, H., and Zhang, L.

Abstract: Due to immature treatment and rapid transmission of COVID-19, mobility interventions play a crucial role in containing the outbreak. Among various non-pharmacological interventions, community infection control is considered to be a quite promising approach. However, there is a lack of research on improving community-level interventions based on a community's real conditions and characteristics using real-world observations. Our paper aims to investigate the different responses to mobility interventions between communities in the United States with a specific focus on different income levels. We produced six daily mobility metrics for all communities using the mobility location data from over 100 million anonymous devices on a monthly basis. Each metric is tabulated by three performance indicators: "best performance," "effort," and "consistency." We found that being high-income improves social distancing behavior after controlling multiple confounding variables in each of the eighteen scenarios. In addition to the reality that it is more difficult for low-income communities to comply with social distancing, the comparisons between scenarios raise concerns on the employment status, working condition, accessibility to life supplies, and exposure to the virus of low-income communities.

Subject Areas: COVID-19; Mobility interventions; Income levels; Social distancing

Availability: Sun, Q., Zhou, W., Kabiri, A., Darzi, A., Hu, S., Younes, H., and Zhang, L. (2020). *COVID-19 and Income Profile: How People in Different Income Groups Responded to Disease Outbreak, Case Study of the United States*. arXiv, Cornell University, Ithaca, NY.
<https://arxiv.org/abs/2007.02160>

10.26. Title: Gender Differences in Commuting Travel in the U.S.: Interactive Effects of Race/Ethnicity and Household Structure

Author(s): Hu, L.

Abstract: This research investigates the interactive effects of the household structure and race/ethnicity on gender differences in commuting travel in the United States. Existing research has established that both the household structure and race/ethnicity affect the gender differences, but little has examined if and how the effects of the household structure differ across racial/ethnic groups. Using the 2017 U.S. National Household Travel Survey, I estimate gender differences in commuting distance and in the probability of automobile commute in five household types and in four racial/ethnic groups. Results suggest differing effects of household types across racial/ethnic groups: the effects are particularly large in Hispanic people and small in Black people; the effects are moderate in white and Asian people. The research provides an analytical framework that jointly considers the two important factors that explain gendered commuting travel, and it reveals nuanced findings that can inform people-based and context-sensitive transport policies.

Subject Areas: 2017 National Household Travel Survey; Commute distance; Automobile; Women; Multi-level regression

Availability: Hu, L. (2020). “Gender Differences in Commuting Travel in the U.S.: Interactive Effects of Race/Ethnicity and Household Structure.” *Transportation*.

<https://doi.org/10.1007/s11116-020-10085-0>

10.27. Title: How Many People Come to Our Door?

Author(s): Mesaric, R., Meister, A., Winkler, C., Schatzmann, T., and Axhausen, K.W.

Abstract: This paper analyzes the traffic generated by delivery services and the drivers of demand behind it. The evaluation is based on a regression analysis of four surveys conducted in Switzerland and Singapore during the COVID-19 pandemic. The demand for delivery services has strongly increased in recent years. Despite the fact that a lot of research is addressing the question of more efficient business models to mitigate the negative implications of delivery services on traffic and environment, little is known about the actual traffic volume generated by delivery services and the drivers of demand. This paper analyzes these topics based on a regression analysis of survey data from four surveys conducted in Switzerland and Singapore during the COVID-19 pandemic. The applied regression models confirm the results of the descriptive analysis and show the impact of age, gender, income, education and family situation as well as the general shopping behavior on the demand for deliveries. Food orders are often made by younger people without children and lower education levels, while parcels are more often received by younger people with children, higher income and higher education levels. For both food and parcel deliveries, complementary effects between consumer behavior, online and in-store shopping can be observed.

Subject Areas: COVID-19; Delivery services; Demand analysis; Survey data; Zero-inflated regression analysis

Availability: Mesaric, R., Meister, A., Winkler, C., Schatzmann, T., and Axhausen, K.W. (2020). *How Many People Come to Our Door?* ETH Zürich, Zürich, Switzerland.
<https://doi.org/10.3929/ethz-b-000429814>

10.28. Title: Modeling and Analysis of Excess Commuting with Trip Chains

Author(s): Hu, Y. and Li, X.

Abstract: Commuting, like other types of human travel, is complex in nature, such as trip-chaining behavior involving making stops of multiple purposes between two anchors. According to the 2001 National Household Travel Survey, about half of weekday U.S. workers made a stop during their commute. In excess commuting studies that examine a region's overall commuting efficiency, commuting is, however, simplified as nonstop travel from homes to jobs. This research fills this gap by proposing a trip-chaining-based model to integrate trip-chaining behavior into excess commuting. Based on a case study of the Tampa Bay region of Florida, this research finds that traditional excess commuting studies underestimate both actual and optimal commute and overestimate excess commuting. For chained commuting trips alone, for example, the mean minimum commute time is increased by 70 percent from 5.48 minutes to 9.32 minutes after trip-chaining is accounted for. The gaps are found to vary across trip-chaining types by a disaggregate analysis by types of chain activities. Hence, policymakers and planners are cautioned with regards to omitting trip-chaining behavior in making urban transportation and land use policies. In addition, the proposed model can be adopted to study the efficiency of nonwork travel.

Subject Areas: Excess commuting; Trip-chaining; Linear programming; Jobs-housing balance; Non-work travel

Availability: Hu, Y. and Li, X. (2020). "Modeling and Analysis of Excess Commuting with Trip Chains." *Annals of the American Association of Geographers*.
<https://doi.org/10.1080/24694452.2020.1835461>

10.29. Title: How Is COVID-19 Reshaping Activity-Travel Behavior? Evidence From a Comprehensive Survey in Chicago

Author(s): Shamshiripour, A., Rahimi, E., Shabanpour, R., and Mohammadian, A.

Abstract: The novel COVID-19 pandemic has caused upheaval around the world and has led to drastic changes in our daily routines. Long-established routines such as commuting to workplace and in-store shopping are being replaced by telecommuting and online shopping. Many of these shifts were already underway for a long time, but the pandemic has accelerated them remarkably. This research is an effort to investigate how and to what extent people’s mobility-styles and habitual travel behaviors have changed during the COVID-19 pandemic and to explore whether these changes will persist afterward or will bounce back to the pre-pandemic situation. To do so, a stated preference-revealed preference (SP-RP) survey is designed and implemented in the Chicago metropolitan area. The survey incorporates a comprehensive set of questions associated with individuals’ travel behaviors, habits, and perceptions before and during the pandemic, as well as their expectations about the future. Analysis of the collected data reveals significant changes in various aspects of people’s travel behavior. We also provide several insights for policymakers to be able to proactively plan for more equitable, sustainable, and resilient cities.

Subject Areas: COVID-19; Lifestyle; Online shopping; Telecommuting; Transit; Active transportation

Availability: Shamshiripour, A., Rahimi, E., Shabanpour, R., and Mohammadian, A. (2020). “How Is COVID-19 Reshaping Activity-Travel Behavior? Evidence From a Comprehensive Survey in Chicago.” *Transportation Research Interdisciplinary Perspectives*, 7. <https://doi.org/10.1016/j.trip.2020.100216>

10.30. Title: Can the Coronavirus Bring Back the '70s Heyday of Carpooling?

Author(s): Lauer, A.

Abstract: Blog.

Subject Areas: COVID-19; Commuting; Carpooling

Availability: Lauer, A. (2020). "Can the Coronavirus Bring Back the '70s Heyday of Carpooling?" *InsideHook*. <https://www.insidehook.com/article/vehicles/coronavirus-bring-back-70s-heyday-carpooling>

10.31. Title: ICT's Impacts on Ride-Hailing Use and Individual Travel

Author(s): Kong, K., Moody, J., and Zhao, J.

Abstract: Previous studies have explored the relationships between an individual's use of information and communication technology (ICT) and their travel. However, these studies often focus on one specific type of travel and have not considered new forms of mobility, such as ride-hailing, that are enabled by greater ICT penetration. This paper focuses on how ICT use impacts an individual's self-reported travel behavior—including total number of trips, personal miles traveled (PMT), and vehicle miles traveled (VMT) in a typical travel day—and ride-hailing use in the past month. Specifically, we investigate whether substitution or complementarity dominates the relationships between ICT use and an individual's net travel; how ICT impacts individual ride-hailing adoption and frequency of use; and how ride-hailing use is associated with an individual's overall travel behavior. Using data from the 2017 U.S. National Household Travel Survey (NHTS), we estimate a structural equation model that includes a robust set of individual, household, built environment, and travel characteristics, frequency of ICT use, and a hurdle model (two-part regression) of the adoption and frequency of ride-hailing use. Results reveal that greater ICT is not significantly related to the total number of trips that an individual takes, but it does significantly predict higher PMT and VMT. Greater ICT use is positively and substantively correlated with whether or not the individual has used ride-hailing in the past 30 days, but has no significant relationship with the frequency of ride-hailing use with this bounded outcome being controlled for. We further find that an individual's ride-hailing use has a small negative correlation with their PMT and VMT after controlling for other common factors. Our results indicate the importance of future research examining the mechanisms by which ICT use increases the distance individuals travel and the role that new ICT-enabled modes, such as ride-hailing, play in changing these mechanisms at both the individual and system levels.

Subject Areas: Information and communication technology (ICT); Ride-hailing use; Individual travel; Hurdle model

Availability: Kong, K., Moody, J., and Zhao, J. (2020). "ICT's Impacts on Ride-Hailing Use and Individual Travel." *Transportation Research Part A: Policy and Practice*, 141, pp. 1–15.
<https://doi.org/10.1016/j.tra.2020.08.012>

10.32. Title: Compact Development and Adherence to Stay-at-home Order During the COVID-19 Pandemic: A Longitudinal Investigation in the United States

Author(s): Hamidi, S. and Zandiatashbarb, A.

Abstract: In the absence of a vaccine and medical treatments, social distancing remains the only option available to governments in order to slow the spread of global pandemics such as COVID-19 and save millions of lives. Despite the scientific evidence on the effectiveness of social distancing measures, they are not being practiced uniformly across the U.S. Accordingly, the role of compact development on the level of adherence to social distancing measures has not been empirically studied. This longitudinal study employs a natural experimental research design to investigate the impacts of compact development on reduction in travel to three types of destinations representing a range of essential and non-essential trips in 771 metropolitan counties in the U.S during the shelter-in-place order amid the COVID-19 pandemic. We employed Multilevel Linear Modeling (MLM) for the three longitudinal analyses in this study to model determinants of reduction in daily trips to grocery stores, parks, and transit stations; using travel data from Google and accounting for the hierarchical (two-level) structure of the data. We found that the challenges of practicing social distancing in compact areas are not related to minimizing essential trips. Quite the opposite, residents of compact areas have significantly higher reduction in trips to essential destinations such as grocery stores/pharmacies, and transit stations. However, residents of compact counties have significantly lower reduction in their trips to parks possibly due to the smaller homes, lack of private yards, and the higher level of anxiety amid the pandemic. This study offers a number of practical implications and directions for future research.

Subject Areas: Social distancing; Shelter-in-place; Compact development; Urban sprawl; COVID-19 pandemic

Availability: Hamidi, S. and Zandiatashbarb, A. (2020). "Compact Development and Adherence to Stay-at-home Order During the COVID-19 Pandemic: A Longitudinal Investigation in the United States." *Landscape and Urban Planning*, 205.
<https://doi.org/10.1016/j.landurbplan.2020.103952>

10.33. Title: Shedding NHTS Light on the Use of “Little Vehicles” in Urban Areas

Author(s): Krizek, K.J. and McGuckin, N.

Abstract: Bicycles, scooters, Segways, skateboards, and more are placing new demands on urban streets in big cities. These modes, termed “little vehicles” (LVs) here, share common characteristics. This research leverages the 2017 National Household Travel Survey to understand and benchmark key characteristics for current users and trip characteristics of LVs. Our findings show that young men are the predominant users of these modes for a wide range of purposes, including recreational and social activities, shopping and errands, and work travel. In the biggest metro areas in the United States, three-quarters of the trips by LVs are less than 4 km (2.5 mi), and half are shorter than 2 km (1.2 mi) (median)—a distance band that is often considered too far to walk, but shorter than most trips currently taken by car.

Subject Areas: Disruptive technology; E-scooters; Urban new modes

Availability: Krizek, K.J. and McGuckin, N. (2019). “Shedding NHTS Light on the Use of ‘Little Vehicles’ in Urban Areas.” *Transport Findings*.

https://www.researchgate.net/publication/336477155_Shedding_NHTS_Light_on_the_Use_of_'Little_Vehicles'_in_Urban_Areas

10.34. Title: Trip Purpose Prediction Based on Hidden Markov Model with GPS and Land Use Data

Author(s): Chen, Y., Jin, Z., and Li, C.

Abstract: Trip purpose is vital to infer travel behavior and predict travel demand for transportation planning. Therefore, trip purpose prediction has been becoming an important field of research that can improve people's travel efficiency through travel information, such as travel mode, time, location and so on. However, there are a few challenges linked with collecting data via the surveys and the spatial complexity of human travel. To solve the above problems effectively, the study adopts GPS data and land use data and proposes a machine learning method and prediction model as forecasting process. The prediction model is used to automatically predict trip purpose, while the machine learning method is used to constantly updating the prediction model, based on surveys from participants. Compared with traditional models, the method can significantly improve destination prediction accuracy by dynamically updating. In addition, the estimation model is developed employing the Markov model, the structure of model can use for a short training period. Meanwhile, the research can apply to crowded place analysis or in trip distribution prediction, which shows a broad application in transportation planning and management.

Subject Areas: Hidden Markov models; Global Positioning System; Markov processes; Predictive models; Machine learning; Estimation; Transportation

Availability: Chen, Y., Jin, Z., and Li, C. (2020). "Trip Purpose Prediction Based on Hidden Markov Model with GPS and Land Use Data." *2020 IEEE 5th International Conference on Intelligent Transportation Engineering (ICITE)*, pp. 55–59, Beijing, China.

<https://doi.org/10.1109/ICITE50838.2020.9231419>

10.35. Title: Neighborhood Disparities in Access to Street Arts Festivals: Evidence from Chicago

Author(s): Shin, E.J.

Abstract: This study explores the neighborhood disparities in access to street arts festivals (SAFs) based on a case study of Chicago. The city's street closure permit database is used to identify the locations of SAFs and examine how access to SAFs is associated with the characteristics of neighborhoods. The results show that SAFs are highly spatially concentrated and are not equally accessible from different types of neighborhoods. Specifically, access to SAFs within walking distance declines significantly as the proportions of Black, Hispanic, and elderly residents increase. A comparative analysis finds that SAFs are even less accessible than museums/art galleries from Black or Hispanic neighborhoods and areas with a higher share of elderly residents. However, neighborhood income is not a significant predictor of SAF accessibility. This study's findings have important implications for policymakers because they suggest that SAFs further disadvantage certain types of historically underserved neighborhoods, especially Black neighborhoods, regarding arts accessibility.

Subject Areas: Street arts festivals; Accessibility; Neighborhood disparities; Race

Availability: Shin, E.J. (2020). "Neighborhood Disparities in Access to Street Arts Festivals: Evidence from Chicago." *Journal of Urban Affairs*.

<https://doi.org/10.1080/07352166.2020.1820871>

10.36. Title: Do People Walk More in Transit-Accessible Places?

Author(s): Choi, Y. and Guhathakurta, S.

Abstract: While transit-oriented developments (TODs) are generally believed to promote the use of sustainable travel modes, the degree to which various components of TODs influence travel behavior is still debatable. This paper revisits Chatman's (2013) question: "Does TOD need the T?" by addressing the effect of rail transit access in influencing walking behavior in TOD areas. In particular, we compare TODs to other similar areas, with rail transit access being the key variable, and examine whether people are more likely to walk in TODs for purposes other than transit use. This hypothesis is tested using traffic analysis zones (TAZs) in the Atlanta Metropolitan Region. First, we identify TAZs within rail catchment areas and use propensity scores to match them with other TAZs with similar built environmental characteristics except for rail transit access. We then conduct a statistical analysis comparing walking trips for both commuting and non-commuting trips in these two TAZ groups. Our results confirm that the likelihood of walking trips increases in transit-accessible TAZs compared to other similar areas without transit. Therefore, states and localities can maximize the benefits of pedestrian-friendly built environments by making rail transit access an important part of their planning and design.

Subject Areas: Transit-oriented development; Transit access; Walking; Travel behavior; Built environment

Availability: Choi, Y. and Guhathakurta, S. (2020). "Do People Walk More in Transit-Accessible Places?" *Journal of Transport and Land Use*, 13(1), pp. 343–365.
<https://doi.org/10.5198/jtlu.2020.1530>

10.37. Title: Determinants of Healthcare Trips and Travel Burden in the Southwest USA

Author(s): Hensley, M.

Abstract: The paper starts off by highlighting the differences between those that report a healthcare trip, and those that do not report a healthcare trip. Significant differences include: those with mobility disabilities, older adults, and those in low-income households were more likely to report a healthcare trip. Having a mobility disability and being driver with vehicle access were significant factors in determining if an adult reported a healthcare trip for some groups. Similar to Chapter 3, race, gender, and ethnicity played a statistically significant role in determining if adults experienced travel burden during healthcare trips.

Subject Areas: Healthcare trip; Distance burden; Time burden; Mobility disability; Age; Income; Race and ethnicity; Gender

Availability: Hensley, M. (2020). *Determinants of Healthcare Trips and Travel Burden in the Southwest USA*. University of New Mexico, Albuquerque, NM. <https://econ.unm.edu/ph.d-program/job-market/jobmarketpapers/mhensley-fa2020v2.pdf>

10.38. Title: Cities That Have Been Taking the Most Road Trips

Author(s): Lattice Publishing.

Abstract: Blog.

Subject Areas: COVID-19; Long distance road trips; Tourism

Availability: Lattice Publishing. (2020). "Cities That Have Been Taking the Most Road Trips." *News-Press Now*. https://www.newspressnow.com/news/local_news/cities-that-have-been-taking-the-most-road-trips/article_465c5da8-1de8-11eb-9b8a-abeb84dea691.html

10.39. Title: A Data-Driven Approach to Discover the Vitality around Transit Stations in the U.S.

Author(s): Li, Y.

Abstract: Transit-oriented development (TOD), which promotes dense, mixed-use urban development with substantial walking and biking connections around transit stations, is a useful concept for urbanizing regions and cities. By employing this concept when planning the urban area, problems like traffic congestion and air pollution could be partially alleviated, as fewer people would choose automobiles for travel if the area around transit stations were more accessible. This thesis aims to use a data-driven approach to evaluate the vitality around transit stations, and compare the typology of transit stations of different urban areas in the U.S. To study the relationship between the surrounding environment of transit stations and vitality, I collected data from open datasets and employed k-means clustering, a machine learning approach. The development pattern around transit stations showed specific patterns in different urban areas in the U.S., with various human activities influencing the form of urban growth and the subsequent TOD. I then analyzed the factors for successful TOD projects, and made policy recommendations for future successful TOD planning in urban areas.

Subject Areas: Transit-oriented development; Walking and biking connections; K-means clustering; Urban

Availability: Li, Y. (2020). *A Data-Driven Approach to Discover the Vitality around Transit Stations in the U.S.* Tufts University, Medford, MA.

<https://search.proquest.com/openview/4c0346de870f3269c9fd6559a6e0f694/1?pq-origsite=gscholar&cbl=44156>

10.40. Title: Beyond Accessibility and Behavioral Outcomes: Reconceptualizing Equity in Transportation through the Capabilities Approach

Author(s): Wang, J.

Abstract: In the past decades, transportation equity has attracted increasing attention from transportation researchers and policymakers. Nonetheless, there is a lack of theoretical understanding of transportation equity. The dissertation engages the Capability Approach of Sen and Nussbaum as a theory of justice and well-being to conceptualize transportation equity as the process of the production of the equality of mobility capabilities, the substantial freedom people have to travel. Specifically, I propose an equity evaluative framework of five evaluation domains, including 1) Access to basic resources, services, and activities sites; 2) The freedom of physical movement around places; 3) Opportunities for active travel (walking and bicycling); 4) Opportunities to conduct safe and psychologically satisfied trips; 5) Access to political engagement activities. The dissertation also applies the CA framework to two different empirical contexts. One assesses the inequalities of mobility outcomes and capabilities of traveling within low-car ownership households. The results reveal that low-car ownership people of different socio-economic groups achieve different mobility outcomes under the different levels of mobility capabilities. The analysis suggests the joint evaluation of mobility capability and outcomes in informing transportation inequity and disadvantage. The second examines the inequalities of travel mood among different socio-demographic groups and how mobility capabilities, measured as modal options and access destination opportunities, interact with travel mood. The results reveal the significant impacts of mobility capabilities on travel mood and the moderation effects of mobility capabilities on the relationship between mode and mood. The findings highlight the importance of explicit consideration of mobility capabilities– in policy debates and planning initiatives. The concluding chapter contextualizes these findings within the transportation literature and proposes several take-away for policy and future research directions.

Subject Areas: Capability approach; Mobility; Social justice; Transportation equity; Urban planning; Well-being

Availability: Wang, J. (2020). *Beyond Accessibility and Behavioral Outcomes: Reconceptualizing Equity in Transportation through the Capabilities Approach*. Doctoral Dissertation, University of Minnesota, Minneapolis, MN. <https://hdl.handle.net/11299/217162>

10.41. Title: Time Constraints and Travel Behavior

Author(s): Metz, D.

Abstract: Considerable observational evidence indicates that travel time, averaged across a population, is stable at about an hour a day. This implies both an upper and a lower bound to time that can be expended on travel. The upper bound explains the self-limiting nature of road traffic congestion, as well as the difficulty experienced in attempting mitigation: the prospect of delays deters some road users, who are attracted back following interventions aimed at relieving congestion. The lower bound implies that time savings cannot be the main economic benefit of transport investment, which means that conventional transport economic appraisal is misleading. In reality, the main benefit for users is increased access to desired destinations, made possible by faster travel, which is the origin of induced traffic. Access is subject to saturation, consistent with the evidence of travel demand saturation. However, access is difficult to monetize for inclusion in cost–benefit analysis. Consequential uplift in real estate values may be a more practical way of estimating access benefits, which is relevant to the possibility of capturing part of such uplift to help fund transport investment that enhances such access.

Subject Areas: Travel time; Time savings; Induced traffic; Access; Land value; Demand saturation

Availability: Metz, D. (2020). “Time Constraints and Travel Behavior.” *Transportation Planning and Technology*, 44(1), pp. 16–29. <https://doi.org/10.1080/03081060.2020.1851445>

10.42. Title: Children, Income, and the Impact of Home Delivery on Household Shopping Trips

Author(s): Spurlock, C.A., Todd-Blick, A., Wong-Parodi, G., and Walker, V.

Abstract: Expanding e-commerce and delivery benefit consumers through increased flexibility and convenience. However, there is a potential impact on vehicle miles traveled (VMT) by delivery and personal vehicles, and the resulting energy consumption, air quality, and congestion. Delivery trips could replace personal vehicle trips, but, if not a replacement, could add to (or supplement) shopping-related VMT for a given household. We examined the benefits of e-commerce to consumers and the impact on personal shopping trips, and how these differed across item types, household child status, and income. We found that high-income households and households with children cared relatively more about time saving from deliveries. We found that, on average, deliveries substituted for 12% of vehicle shopping trips, but supplemented personal shopping trips for 9% of purchase deliveries. Underlying these averages were two main types of households: those for whom all deliveries substitute for trips (between 55% and 70% of households) and those for whom all deliveries supplement trips (between 20% and 35% of households). There was significant heterogeneity across households with and without children and with high or low incomes with respect to the use of delivery. Although time savings were more likely to motivate higher-income households and households with children to use delivery, this did not translate through to these households substituting for more of their trips; deliveries of prepared meals for both these categories of household were relatively more likely (15% for households with children, and 12% for higher-income households) to supplement, and not substitute for, personal trips.

Subject Areas: Vehicle miles traveled; Household shopping trips; E-commerce; Delivery; Travel behavior

Availability: Spurlock, C.A., Todd-Blick, A., Wong-Parodi, G., and Walker, V. (2020). "Children, Income, and the Impact of Home Delivery on Household Shopping Trips." *Transportation Research Record: Journal of the Transportation Research Board*, 2674(10), pp. 335–350. <https://journals.sagepub.com/doi/10.1177/0361198120935113>

Chapter 11. Trend Analysis and Market Segmentation

11.1. Title: A Portrait of Zero-Car and Car-Ownning Household Mobility Trends in the United States: Insights from the 2009 and 2017 National Household Travel Survey

Author(s): Abou-Zeid, G., McQueen, M., Crespo-Leiva, A., and Clifton, K.

Abstract: The mobility of zero-car households is substantially constrained compared to their car-owning counterparts, especially given that zero-car households are disproportionately low income. Households that lack access to vehicles due to economic constraints exhibit an increased dependence on active and transit modes. There is early evidence that demonstrates how new modes of shared mobility, like ridehailing services, may increase automobile access for these households. However, the effect of these new modes on mobility of zero-car households on a nationwide scale compared to other modes is still unclear. In order to promote policies that increase mobility for zero-car households in the context of shared mobility, climate change, and increased multimodality, a more indepth understanding of their recent travel behavior is crucial. This paper investigates trends and characteristics of mobility in zero-car households versus car-owning households. Use of the 2009 and 2017 National Household Travel Survey captures the impact of rising shared mobility modes, growing transit infrastructure, and economic recovery. Our findings indicate that although person miles traveled (PMT) is increasing across both car ownership and income categories, there still exists a mobility gap between zero-car households and car-owning households and between zero-car households across income groups. Car-owning households earning $\geq \$75,000$ annually make over nine times the PMT and approximately three times number of trips of zero-car households earning $\leq \$14,000$. Further, we find less affluent zero-car households may be subject to displacement, further constraining their mobility.

Subject Areas: Mobility; Zero-car households; Household income; Trend; Person miles traveled

Availability: Abou-Zeid, G., McQueen, M., Crespo-Leiva, A., and Clifton, K. (2020). *A Portrait of Zero-Car and Car-Ownning Household Mobility Trends in the United States: Insights from the 2009 and 2017 National Household Travel Survey*. Transportation Research Board 99th Annual Meeting, Washington, DC. <https://annualmeeting.mytrb.org/OnlineProgramArchive/Details/13494>

11.2. Title: Webinar: The Adoption and Travel Impacts of Teleworking: Will It Be Different This Time?

Author(s): Mokhtarian, P.

Abstract: From Alvin Toffler's (1980) "electronic cottage," to Peter Drucker's (1993) declaration that commuting to an office was obsolete, through countless disruptions ever since, people have predicted the widespread adoption of working from home, with concomitant benefits to congestion, fuel consumption, and emissions. Yet, while telecommuting has seen steady growth in the "information era," overall levels have remained modest until recently, when the COVID-19 pandemic has forced its adoption on an unprecedented scale. What will happen when it is safe to go back to the office? Will managers and staff alike embrace the benefits of working from home, or will it be back to business as usual? This webinar offers a snapshot of the present, reviews past research and experience on the adoption and travel-related impacts of telecommuting, and reflects on future implications for transportation.

Subject Areas: Telecommuting; COVID-19

Availability: Mokhtarian, P. (2020). *Webinar: The Adoption and Travel Impacts of Teleworking: Will It Be Different This Time?* Eno Center for Transportation, Washington, DC.
<https://www.youtube.com/watch?v=oS7vogPVRa0>

11.3. Title: Everything You Need to Know Before Buying an Electric Bike

Author(s): Sisson, P.

Abstract: Blog.

Subject Areas: Electric bike; Commute; Safety; Environment

Availability: Sisson, P. (2020). "Everything You Need to Know Before Buying an Electric Bike." *Curbed*. <https://www.curbed.com/2020/2/20/21144019/transit-cycling-electric-bike-car-free>

11.4. Title: Identifying Micro-Level Determinants that Influence the Transportation Network Companies (TNCs) Growth Through Analysis of Transportation Users' Preferences and Attitudes

Author(s): Sarjana, S.

Abstract: In recent years, the use of Transportation Network Companies (TNCs), such as Uber and Lyft, as a mode of travel has been growing at a significant pace. Despite the rapid growth of several TNC markets, analyses of potential and actual impacts of TNC presence on preferences and travel patterns of TNC-aware users are still very limited. Such analyses require detailed trip data, which are not easily available due to privacy concerns as well as technical and financial feasibility issues.

To address some of these issues, the objective of this study was to document the factors that influence transportation users in the Birmingham, AL, region to select TNCs such as Uber and Lyft for completing typical day trips. In order to meet the study objective, a travel diary questionnaire survey was developed in accordance with the *Institute of Transportation Engineers (ITE) Manual on Transportation Engineering Studies* and used to obtain information about travel preferences, typical trips, and demographic data. The Qualtrics Research Core tool was used to develop the questionnaire and administer the survey.

The questionnaire was used to survey over 451 transportation users in the Birmingham metro area. The survey participants provided detailed trip information for a typical 24-hour day along with demographic data and travel preference information. The analysis of responses shed light on users' awareness, usage, and proliferation of TNC services in the region. The survey responses were used to understand the leading reasons and conditions driving the use of TNC services in the Birmingham metro area.

The document introduces the scope of the study, describes the study approach, discusses findings from the analysis of responses, and summarizes conclusions and impacts. The findings provide high-resolution, micro-level indicators of travel preferences and behaviors in a TNC-served area, which is a much-needed type of information for researchers and planning agencies.

Subject Areas: Transportation network company (TNC); Travel preferences; Mode choice; Uber; Lyft; Questionnaire survey; Travel patterns; Birmingham, AL

Availability: Sarjana, S. (2020). *Identifying Micro-Level Determinants that Influence the Transportation Network Companies (TNCs) Growth Through Analysis of Transportation Users' Preferences and Attitudes*. Master's Thesis, The University of Alabama at Birmingham, Birmingham, AL. <https://search.proquest.com/openview/1a499376ec584c65c9516ece40efbc57/1?pq-origsite=gscholar&cbl=18750&diss=y>

11.5. Title: Freight Distribution in Urban Areas: A Method to Select the Most Important Loading and Unloading Areas and a Survey Tool to Investigate Related Demand Patterns

Author(s): Diana, M., Pirra, M., and Woodcock, A.

Abstract: Cities all around the world are observing increasing levels of urban freight activities owing to the growth of Internet shopping combined with traditional distribution to shops, creating additional problems in terms of congestions and environmental impacts. This study, developed within the European Project SUITS framework, aims at showing how local authorities can effectively observe freight flows from the demand side. This led to the design, implementation, and testing of a spatial cluster analysis approach to understand which are the most important loading/unloading parking spots in an urban setting by processing the GPS traces of a fleet of logistic vehicles. Later field activities should focus on these important areas to maximize the efficiency of the survey. A survey of retailers and shops in such areas to observe delivering activities is then proposed. The whole process, namely the spatial analysis and the field survey, was then tested to the real case of an Italian city (Turin) to assess the potentiality of the methods. The methodology proposed can give useful insights to local authorities on a way of monitoring the freight distribution patterns at the more disaggregated individual loading/unloading area.

Subject Areas: Urban freight activities; Congestion; Environmental impacts; Spatial cluster analysis approach; loading/unloading parking; Field survey

Availability: Diana, M., Pirra, M., and Woodcock, A. (2020). "Freight Distribution in Urban Areas: A Method to Select the Most Important Loading and Unloading Areas and a Survey Tool to Investigate Related Demand Patterns." *European Transport Research Review*, 12(40).
<https://etr.springeropen.com/articles/10.1186/s12544-020-00430-w>

11.6. Title: Not Minding the Gap: Does Ride-Hailing Serve Transit Deserts?

Author(s): Barajas, J. and Brown, A.

Abstract: Transit has long connected people to opportunities, but access to transit varies greatly across space. In some cases, unevenly distributed transit supply creates transit service needs gaps which may impede travelers' abilities to cross space and access jobs or other opportunities. With the advent of ride-hailing services like Uber and Lyft, however, travelers now have a new potential to gain automobility without high car purchase costs and in the absence of reliable transit service. Research remains mixed on whether ride-hailing serves as a modal complement or substitute to transit or whether ride-hailing serves to fill transit service needs gaps. This study measures transit supply in Chicago and compares it to ride-hail origins and destinations to examine if ride-hailing fills existing transit service gaps. Findings reveal clustering of ride-hail pickups and drop-offs across the city, but that the number of ride-hail pickups and drop-offs is most strongly associated with high neighborhood median household income rather than measures of transit supply. At the same time, temporal variations in transit supply and ride-hail trips suggest that a potential complement between transit and ride-hailing exists at select times. Policymakers should consider ways to encourage ride-hailing companies to fill transit gaps in low-income communities when options to increase service are limited.

Subject Areas: Transit; Ride-hailing; Automobility; Origins and destinations

Availability: Barajas, J. and Brown, A. (2020). "Not Minding the Gap: Does Ride-hailing Serve Transit Deserts?" *SocArXiv*. <https://doi.org/10.31235/osf.io/y4jwk>

11.7. Title: Public Transit and Micro-Mobility: Identifying the Impacts of Bikeshare on Public Transit Ridership in the City of Chicago

Author(s): Trisha, S.M.

Abstract: The variation of transit and bike share access amongst the communities in Chicago in terms of their social, ethnic, and economic segregation was investigated. The findings identify the area suitable for implementation of micro-mobility as a first and last mile option. Based on transit connectivity and population mix, the communities are ranked into five groups: (1) Central—excellent transit and bike share access serving the micro-mobility purpose; (2) North Side—good transit access which can be improved further amongst young age groups to improve transit ridership; (3) Far North Side—disproportionate transit and bike share distribution with excellent connectivity of transit and bike share in east and poor moving west; (4) North West, West, and Near West and Southwest Side—has majority of Hispanic, black, and low-income populations with a poor access to transit and bike share; and (5) South Side, Far South West Side, and Far South East Side—high population of low-income, senior, disability, and black with very poor access to bus and bike share; extensive improvements in transit service; and bike share access and cost subsidy is needed. Severe imbalance exists in access to transit and bike share amongst the 77 communities in Chicago.

Bikeshare's contribution towards increase or decrease in transit ridership was also investigated. A 25.9% increase in average bus stop level ridership and a 10.7% increase in average rail station level ridership was found to be associated with introducing bike share.

Subject Areas: Transit; Bikeshare access; Segregation; Micro-mobility; Connectivity

Availability: Trisha, S.M. (2020). *Public Transit and Micro-Mobility: Identifying the Impacts of Bikeshare on Public Transit Ridership in the City of Chicago*. The University of Wisconsin–Milwaukee, Milwaukee, WI.

<https://search.proquest.com/openview/4d83859930d170a2604e0ef2f1c4fc88/1?pq-origsite=gscholar&cbl=18750&diss=y>

11.8. Title: Exploratory Analysis of Recent Trends in School Travel Mode Choices in the U.S.

Author(s): Lidbe, A., Li, X., Adanu, E.K., Nambisan, S., and Jones, S.

Abstract: The study explores the recent trends in school travel using the 2017 National Household Travel Survey data. The study also investigates the exogenous factors affecting the school travel mode choice using the random parameters multinomial logit (RPMNL) model. The results indicate that urban school trips range between 3 and 5 miles, whereas average rural trips are longer than 6 miles. School commute times are higher among lower-income households. Further, the share of school bus and auto has declined, while that of walking and biking has increased in 2017. This change is significant among high school students. Like other studies, the findings of the RPMNL model confirm that students within shorter distances from school are more likely to walk or bike to school. However, the likelihood of riding a school bus for distances >15 miles is higher than that of auto, indicating a policy implication to support school transportation budgets, especially in rural school districts. Lower-income households have a higher likelihood of riding the school bus. Females are more likely to use a car and less likely to bike to school. Interestingly, households with more than three vehicles are more likely to use the school bus compared to no-vehicle households. Children living in rented houses are less likely to ride the school bus or car. Also, an increase in gas price is indirectly but positively linked with walking, biking, and auto use. The findings from this study will assist policymakers in formulating policies and planning decisions towards improvements in the current school travel trends.

Subject Areas: 2017 National Household Travel Survey data; School travel; Trip mode choice; School bus; Walk; Bike

Availability: Lidbe, A., Li, X., Adanu, E.K., Nambisan, S., and Jones, S. (2020). "Exploratory Analysis of Recent Trends in School Travel Mode Choices in the U.S." *Transportation Research Interdisciplinary Perspectives*, 6. <https://doi.org/10.1016/j.trip.2020.100146>

11.9. Title: Urban Air Mobility: Viability of Hub-Door and Door-Door Movement by Air

Author(s): Bulusu, V. and Sengupta, R.

Abstract: Owing to a century of innovation in connected and automated aircraft design, for the first time in history, air transport presents a potential competitive alternative to road for hub-to-door and door-to-door urban services. In this article, we study the viability of air transport for moving people and goods in an urban area based on three metrics: en-route travel time, fuel cost, and carbon dioxide emissions. We estimate the metrics from emission standards and operational assumptions on vehicles based on current market data and compare electric air travel to gasoline road travel. For passenger movement, air is faster than road for all distances. It fares better on fuel cost and emissions only for longer distances (specific transition distances are stated in the text). For consolidated movement of goods, air is at par with road. Finally, for movement of unconsolidated goods, air again fares better than road on all three metrics. It is also noteworthy that these results are based on a road-friendly urban design. Changes in design that facilitate easier access to air based hub-to-door and door-to-door services would only make the case stronger for Urban Air Mobility (UAM), especially with connected and automated aircraft, as the next revolution in urban transportation.

Subject Areas: Urban air mobility; Unmanned; Emission; Electric air travel; electric Vertical takeoff and landing (eVTOL)

Availability: Bulusu, V. and Sengupta, R. (2020). *Urban Air Mobility: Viability of Hub-Door and Door-Door Movement by Air*. Institute of Transportation Studies, University of California-Berkeley, Berkeley, CA. <https://doi.org/10.7922/G2QJ7FK0>

11.10. Title: Telework and Daily Travel: New Evidence From Sweden

Author(s): Elldér, E.

Abstract: Telework, long promoted as a way to reduce daily travel and address congestion problems, has been extensively studied in transport research. Empirical consensus has long held that telework reduces overall travel, but several updated studies now suggest the opposite. Meanwhile, telework has steadily increased in many countries, and few studies have examined contexts where regular teleworkers have grown to form an early majority. We study how telework influences daily travel in such a context, namely Sweden, from 2011 to 2016. Using representative micro-data from the Swedish National Travel Survey, this study also captures travel behavior during the defined period when the telework was actually practiced, distinguishing different telework arrangements and analyzing a range of travel behavioral outcomes. We conclude that telework leads to reduced travel demand, more use of active transport modes, and congestion relief. Important differences between full- and part-day teleworkers are also highlighted, stressing the importance of understanding telework as a diversified coping strategy for organizing the spatio-temporality of everyday life.

Subject Areas: Telework; Telecommuting; Daily travel; Travel demand; Mode choice; Sweden

Availability: Elldér, E. (2020). "Telework and Daily Travel: New Evidence From Sweden." *Journal of Transport Geography*, 86. <https://doi.org/10.1016/j.jtrangeo.2020.102777>

11.11. Title: Telecommuting and its Impact on the Trips Made Daily by Telecommuters

Author(s): Shah, S.

Abstract: The advancements in technology over the last few decades have had a profound impact on how people in various societies engage or participate in socioeconomic activities, including that of work. Prior to these advancements, workers had to journey to and from their employment locations each weekday, contributing to the congestion witnessed on roadway facilities during morning and evening peak periods. However, with advancements in technology, more workers have chosen and are choosing to telecommute from home or telecommuting centers. Given that trips to and from work are concentrated in specific time periods on weekday mornings and afternoons, transportation engineers have sought to exploit telecommuting as a means of addressing the negative aspects of travel by automobile in urban areas. Thus, a number of studies have been conducted in local jurisdictions to better understand who telecommutes are and what impact telecommuting has on travel during peak periods on weekdays. The results have been mixed, pointing to a need for more empirical studies.

This research, using data collected in two national cross-sectional surveys (the National Household Travel Survey conducted in 2009 and 2017, respectively), investigates whether the profile of telecommuters has changed over time, what demographic and spatial characteristics are determinants of being a telecommuter, what demographic and spatial characteristics are predictors of the frequency of telecommuting, and what impact telecommuting has on the number of trips made daily by telecommuters.

The results of the descriptive and statistical analysis show that there were significant differences between the socioeconomic and household characteristics of telecommuters and non-telecommuters in 2009 and 2017. They also show that the likelihood of telecommuting by a worker increases with educational attainment. Gender plays a role in the decision to telecommute, with male workers being more likely to telecommute in comparison to female workers. Workers with children in their households were more likely to telecommute in comparison to workers without any children at home. Also, workers with higher household family incomes were more likely to adopt telecommuting in comparison to workers from households having lower family incomes. In terms of impact on daily travel, in 2009, telecommuting was found to be associated.

Subject Areas: Telecommuting; Socioeconomic and household characteristics; Daily trips

Availability: Shah, S. (2020). *Telecommuting and its Impact on the Trips Made Daily by Telecommuters*. Master's Thesis, Tennessee Technological University, Cookeville, TN.
<https://search.proquest.com/openview/1564c8f0c319c7b2f690128916e14323/1?pq-origsite=gscholar&cbl=18750&diss=y>

11.12. Title: Exploratory Analysis of Real-Time E-Scooter Trip Data in Washington, D.C.

Author(s): Zou, Z., Younes, H., Erdoğan, S., and Wu, J.

Abstract: The proliferation of micro-mobility, evolving from station-based to dockless bikeshare programs, has dramatically accelerated since 2017 with an influx of investment from the private sector to a new product, dockless e-scooter share. As an alternative to pedal bikes, e-scooters have become widespread across the United States, owing to the unprecedented convenience they bring to commuters and travelers with electric-power propulsion and freedom from docking stations. In cities like Washington, DC, e-scooter share can play an important role to support transportation sustainability and boost accessibility in less-connected communities. This study takes advantage of publicly available but not readily accessible e-scooter share data in Washington, DC, for an initial view of the travel patterns and behaviors related to this new mode. The study adopted an innovative approach to scrape and process general bikeshare feed specification data in real time for e-scooters. Not only locational time-series data, but also e-scooter share trip trajectories were generated. The trip trajectory data provide a unique opportunity to examine travel patterns at the street link level—a level of analysis that has not been reached before for e-scooter share to the authors' knowledge. The paper first provides descriptive statistics on e-scooter share trips, followed by an exploratory analysis of trip trajectories conjoined with street link level features. Important insights on e-scooter route choice are derived. Lastly, policy and regulatory implications in relation to e-scooter facility design and safety risks are discussed.

Subject Areas: Dockless e-scooter; Micro-mobility; Transportation sustainability; Accessibility; Travel patterns; Trip trajectories

Availability: Zou, Z., Younes, H., Erdoğan, S., and Wu, J. (2020). "Exploratory Analysis of Real-Time E-Scooter Trip Data in Washington, D.C." *Transportation Research Record: Journal of the Transportation Research Board*, 2674(8), pp. 285–299. <https://doi.org/10.1177/0361198120919760>

11.13. Title: Determinants of Vehicle Ownership in Nigeria

Author(s): Ukonze, F.I., Nwachukwu, M.U., Mba, H.C., Okeke, D.C., and Jiburum, U.

Abstract: Vehicle ownership has increased tremendously in Nigeria over the past few decades. This study determined factors that influence vehicle ownership intending to develop a more appropriate basis for forecasting vehicle ownership in the country. Multiple linear regression technique was used to identify the factors that influence vehicle ownership using national data from secondary sources. The results showed that four socioeconomic factors, namely, gross domestic product, per capita income, fuel price, and literacy level, as well as one physical factor, namely, stock of public transport vehicles, have significant effects on vehicle ownership at 0.01 significance level. Vehicle ownership was 35.3 million in 2018. It will increase to 48.7, 66.2, and 76.1 million in 2030, 2040, and 2050, respectively. Consequently, the formulation of appropriate policy that will be useful for monitoring key parameters is germane for predicting vehicle ownership in the country.

Subject Areas: Vehicle ownership; Socioeconomic factors; Physical factors; Determinants; Forecast

Availability: Ukonze, F.I., Nwachukwu, M.U., Mba, H.C., Okeke, D.C., and Jiburum, U. (2020). "Determinants of Vehicle Ownership in Nigeria." *SAGE Open*, pp. 1–13.
<https://doi.org/10.1177/2158244020922970>

11.14. Title: Modeling Electric vehicle consumer behavior for improved power systems operation and planning

Author(s): Rahman, M.R.U., Manoharan, A.K., and Gampa, S.

Abstract: The transition to electric vehicles (EVs) from fossil fuel-based vehicles is well underway, with more than 1 million EVs on U.S. roads as of October 2018. In addition, customers are purchasing EVs in record numbers, and electric companies are working with stakeholders to move the EV infrastructure market forward. Forecasts shows around 3.5 million EVs will be on the road by 2030. To accommodate this incremental load on the existing power system, a residential EV charging management scheme considering the behavior of EV owners is proposed in this work. According to a study by Consumer Electronics Association (CEA), “running out of battery charge” was cited by 71% of the people as a disadvantage. To get over this phobia, current EV users tend to charge their car full even though they may not need it. In terms of range (the miles their car can go in a single charge), 80% of Americans want at least 200+ miles when, on average, they only drive 50 miles a day. This research work analyzes the driving behavior using the National Household Travel Survey (NHTS) data. The results show that charging behavior has a high correlation to household size, number of vehicles in the household occupation, etc. A model is developed for the EV charging demand using the above correlation, and a preliminary study on test systems shows the significance of such techniques in the near future.

Subject Areas: Electric vehicles; Electric vehicle charging demand; Consumer behavior

Availability: Rahman, M.R.U., Manoharan, A.K., and Gampa, S. (2020). “Modeling Electric Vehicle Consumer Behavior for Improved Power Systems Operation and Planning.” *Proceedings of the 16th Annual Symposium on Graduate Research and Scholarly Projects*, p. 56, Wichita State University, Wichita, KS. <https://soar.wichita.edu/handle/10057/17615>

11.15. Title: How Have Ride-Railing Applications Disrupted the Taxi Industry in New York?

Author(s): Patino, J. and Engren, C.

Abstract: Background: The taxi industry was the only market competing until the ride-hailing market entered the existing market in 2010 in New York.

Purpose: To identify impacts done to the existing market by the ride-hailing industry by proving new research that has never been conducted before.

Method: Use of data and regression analysis.

Conclusion: The results show that there have been several negative impacts to taxi drivers and the taxi industry as a whole; however, there has been a positive impact in the society with benefits outweighing the costs.

Subject Areas: Shared economy; Ride-hailing; Oligopoly; Monopolistic competition and legislation

Availability: Patino, J. and Engren, C. (2020). *How Have Ride-Railing Applications Disrupted the Taxi Industry in New York?* Bachelor Thesis, Jönköping University, Jönköping, Sweden.
<https://www.diva-portal.org/smash/get/diva2:1439817/FULLTEXT01.pdf>

11.16. Title: E-shopping Changes and the State of E-grocery Shopping in the US—Evidence From National Travel and Time Use Surveys

Author(s): Saphores, J. and Xu, L.

Abstract: In spite of the popularity of e-shopping, only 16% of U.S. adults have ordered groceries online, and 7 out of 10 of those who currently buy groceries online do so at most twice a month. Understanding the determinants of e-grocery shopping is important for grocers, supply chain managers, and urban planners. In this context, we first explore how deliveries from online shopping have been changing over time. From our analysis of the 2009 and 2017 National Household Travel Survey, we found that online shopping has been embraced by increasingly diverse households, although income, education, and some racial/ethnic differences persist. Our analysis of the 2017 American Time Use Survey shows that Americans are 24 times more likely to shop for groceries in stores than online. Moreover, in-store grocery shoppers are more likely to be female and unemployed but less likely to belong to younger generations, to have less than a college degree, or to be African American. The gender imbalance in grocery shopping is larger online than in stores, but e-grocery shoppers do not otherwise differ from the general population. Future travel and e-shopping surveys (especially for e-grocery) should combine time use and travel questions with retrospective questions about online purchases.

Subject Areas: E-grocery; Online shopping; National Household Travel Survey; American Time Use Survey

Availability: Saphores, J. and Xu, L. (2020). “E-shopping Changes and the State of E-grocery Shopping in the US—Evidence From National Travel and Time Use Surveys.” *Research in Transportation Economics*. <https://doi.org/10.1016/j.retrec.2020.100864>

11.17. Title: Job Accessibility, Commuting Time and Travel Complexity in the Mexico City Metropolitan Area (MCMA)

Author(s): Bautista, D.

Abstract: Transportation equity is an important dimension of urban sustainability. Specifically, the journey to work, which is still the main source of intra-urban trips in many cities around the world, is a key issue of urban transportation policy (Rode et al., 2014). This research aims to understand the relationship between urban structure and commuting patterns using the Mexico City Metropolitan Area (MCMA) as case study. Two complementary approaches are followed, one at the Traffic Analysis Zone (TAZ) level and the other at the individual level analyzing the commuting trip patterns in a weekday. The first approach analyzes spatial variation in job accessibility in MCMA using two indicators (gravity-based accessibility and the indicator developed by Shen, 1998) to determine the relative impact of location and mode choice of transportation (chapter 2). Spatial regressions are applied to determine the relation between one-way Average Commute Time (ACT) and job accessibility (chapter 3). In the second approach, the unit of analysis is the traveler to work, aiming to understand how the relation of commute on travel complexity is driven by urban structure (chapter 4). Overall, the results of this project offer evidence to support the identification of priority areas and groups of people to target specific transport policies to improve equity. They also offer insights to better understand the driven forces of trip chaining patterns of commuters in the context of the global south.

Subject Areas: Transportation equity; Urban sustainability; Urban structure; Commuting pattern; Mexico City Metropolitan Area; Traffic analysis zone; Spatial regression

Availability: Bautista, D. (2020). *Job Accessibility, Commuting Time and Travel Complexity in the Mexico City Metropolitan Area (MCMA)*. Doctoral Dissertation, University of Washington, Seattle, WA.

https://digital.lib.washington.edu/researchworks/bitstream/handle/1773/45553/Bautista_washington_0250E_21173.pdf?sequence=1&isAllowed=y

11.18. Title: Public Acceptance and Adoption of Shared-Ride Services in the Ride-Hailing Industry

Author(s): Lippke, K. and Noyce, C.

Abstract: On-demand ride-hailing companies like Uber and Lyft, often referred to as transportation network companies (TNCs), now provide shared-ride services, such as UberPool or Lyft Shared. Shared-ride services match riders with similar origins and destinations together. Passengers benefit from these services by paying reduced fares for the additional time spent picking up and dropping off additional passengers. This study seeks to provide a deeper understanding of the social and behavioral considerations associated with travelers' acceptance of shared-rides and how those considerations factor into individuals' willingness to pay (WTP) for shared-ride services. We conducted a survey of TNC users through Qualtrics in February 2020, which had 1,609 respondents from 10 major metropolitan areas across the United States. In addition to the survey, we also conducted one focus group in Detroit, MI, which supplements our survey results with the narratives of actual TNC users. We found that: (1) the average WTP is significantly less for a shared-ride than a solo-ride and that this average decreases at a decreasing rate with each additional passenger; (2) the average WTP for a commuter ride is less than a leisure ride, which could be due to feelings that ridesharing is unreliable and inconvenient in regard to fixed work schedules; (3) the average WTP for a leisure ride is higher than a commute ride, which could be due to the value that individuals place on not having to drink and drive and to avoid parking hassles; and (4) the presence of an option that allows riders to be matched based on social preferences of "happy to chat," "quiet preferred," or "no preference" results in a decrease in WTP. This study revealed that although most interventions are viewed as positive additions to TNC services and that social and behavioral motivation for using shared-ride services are relevant, they matter less when compared to traditional factors, such as time and cost.

Subject Areas: On-demand ride-hailing; Uber; Lyft; Transportation network companies; Shared ride service; Willingness to pay; Survey

Availability: Lippke, K. and Noyce, C. (2020). *Public Acceptance and Adoption of Shared-Ride Services in the Ride-Hailing Industry*. University of Michigan, Ann Arbor, MI.
<https://deepblue.lib.umich.edu/bitstream/handle/2027.42/154994/Public%20Acceptance%20and%20adoption%20of%20shared%20ride%20services.pdf?sequence=1>

11.19. Title: Dockless E-scooter Usage Patterns and Urban Built Environments: A Comparison Study of Austin, TX, and Minneapolis, MN

Author(s): Bai, S. and Jiao, J.

Abstract: In recent years, the popularization of dockless shared electric scooters (e-scooters) across many American cities has provided a great opportunity to reduce short-distance automobile trips. However, there is not enough research that examines e-scooter usage patterns and their association with the urban environment. Moreover, the question of whether this association would vary across different cities also remains unanswered. To bridge these gaps, this study investigated e-scooter ridership in Austin and Minneapolis using Geographic Information System hotspot spatial analysis and negative binomial regression models. The spatial analysis results showed that the densest e-scooter usage happened in downtown areas and university campuses in both cities. However, the temporal characteristics of the two cities' e-scooter usage patterns turned out to be different. In Austin, afternoons and weekends experienced greater e-scooter traffic, whereas Minneapolis showed larger evening ridership and stable daily vehicle miles traveled throughout the week. Finally, regression results showed that proximity to the city center, better access to transit, and greater land-use diversity positively correlated with higher e-scooter ridership in both cities. Compared to single-family residential areas, office and institutional land use were more likely to relate to higher ridership in both cities. Curiously, the statistically positive relationship with commercial areas and parks only existed in Austin. This study contributes to transportation literature and practice by providing empirical evidence on e-scooter trips in the U.S. cities and by highlighting the importance of local uniqueness by comparing two cities.

Subject Areas: Dockless e-scooter; Travel patterns; Built environment; Geographic Information System

Availability: Bai, S. and Jiao, J. (2020). "Dockless E-scooter Usage Patterns and Urban Built Environments: A Comparison Study of Austin, TX, and Minneapolis, MN." *Travel Behaviour and Society*, 20, pp. 264–272. <https://doi.org/10.1016/j.tbs.2020.04.005>

11.20. Title: Know Your User: Building a Predictive Model of Consumer Preference for Driverless Cars

Author(s): Milner, M.N.

Abstract: Introduction: This dissertation identifies factors significantly predicting participants' preference for riding in an autonomous vehicle rather than flying on a commercial aircraft. A plethora of research has investigated these two transportation industries independently; however, scarcely any research has considered the impact these two industries will have on each other. Travelers' preference for riding in an autonomous vehicle rather than a commercial aircraft was investigated through four different scenarios.

Method: A regression equation was created to predict participants' preferred travel method and validated through a two-stage process. Stage 1 involved the creation of the regression equation, and a total of 1,008 participants responded to an online survey, providing information on demographics, travel-related behavior, and their preference for riding in an autonomous vehicle rather than flying on a commercial aircraft. Stage 2 involved validation of the regression equation, and 1,008 participants responded to the same online survey. Stage 2 participants' scores were predicted using the regression equation created in stage 1. Then, their predicted scores and actual scores were compared to validate the equation throughout four different travel scenarios.

Results: In stage 1, a backward stepwise regression assessed the 20 predictive factors (age, gender, ethnicity, social class, price, perceived value, familiarity, fun factor, wariness of new technology, personality (openness, conscientiousness, extraversion, agreeableness, and neuroticism), general vehicle affect, general airplane affect, vehicle comfort, vehicle external factors, airplane comfort, and airplane external factors). These factors were tested in four different scenarios, which varied only in the length of time participants would spend traveling.

Conclusion: A predictive model was created for each scenario, and then all four models were validated in stage 2 using participants' predicted scores and actual scores. Models were validated using a *t*-test, correlation, and comparison of cross-validated R^2 . The most robust model was for the 4-hour trip, with six variables significantly predicting participants' preferred travel method, which accounted for 50.7% of the variance in the model (50.1% adjusted). Upper social class, vehicle affect, airplane affect, and vehicle comfort were the only significant predictors throughout all four scenarios. These four predictors will help other researchers and experts in the vehicle industry identify the first adopters of this new technology. The implications of the results and suggestions for future research are discussed.

Subject Areas: E-mobility; Electric vehicle; Mobility as a service; Sustainable mobility; New technologies; Local emissions; Environmental impacts

Availability: Milner, M.N. (2020). *Know Your User: Building a Predictive Model of Consumer Preference for Driverless Cars*. Doctoral Dissertation, Embry-Riddle Aeronautical University, Daytona Beach, FL. <https://commons.erau.edu/cgi/viewcontent.cgi?article=1505&context=edt>

11.21. Title: Approximate Ridesharing of Personal Vehicles Problem

Author(s): Gu, Q., Liang, J., and Zhang, G.

Abstract: The ridesharing problem is that given a set of trips, each trip consists of an individual, a vehicle of the individual and some requirements, select a subset of trips and use the vehicles of selected trips to deliver all individuals to their destinations satisfying the requirements. Requirements of trips are specified by parameters including source, destination, vehicle capacity, preferred paths of a driver, detour distance and number of stops a driver is willing to make, and time constraints. We analyze the relations between the time complexity and parameters for two optimization problems: minimizing the number of selected vehicles and minimizing total travel distance of the vehicles. We consider the following conditions: (1) all trips have the same source or same destination, (2) no detour is allowed, (3) each participant has one preferred path, (4) no limit on the number of stops, and (5) all trips have the same departure and same arrival time. It is known that both minimization problems are NP-hard if one of Conditions (1), (2) and (3) is not satisfied. We prove that both problems are NP-hard and further show that it is NP-hard to approximate both problems within a constant factor if Conditions (4) or (5) is not satisfied. We give $\frac{k+2}{2}$ -approximation algorithms for minimizing the number of selected vehicles when condition (4) is not satisfied, where K is the largest capacity of all vehicles.

Subject Areas: Ridesharing problem; Optimization problems; Approximation algorithms; Algorithmic analysis

Availability: Gu, Q., Liang, J., and Zhang, G. (2020). *Approximate Ridesharing of Personal Vehicles Problem*. arXiv, Cornell University, Ithaca, NY. <https://arxiv.org/abs/2007.15154>

11.22. Title: Big Data and Unsupervised Machine Learning Approach to Understand Why People Ride E-Scooter in Nashville, Tennessee

Author(s): Shah, N.

Abstract: In the past few decades, several mobility options have emerged as a potential solution to urban transportation problems, such as air pollution, congestion, etc. A shared e-scooter system is an example of recent micro-mobility, which prospered with the advancement in payment technique (online payment), vehicle tracking (GPS tracing through cellphone) as well as the evolution of the business model (to the dockless system). The popularity of e-scooters is also considered “disruptive,” as they make us reconsider our perception of urban mobility. One of the fundamental aspects of considering e-scooter as a part of the urban transportation system is to understand how and why people use e-scooters. Several cities have implemented a pilot program to regulate and evaluate the e-scooters, which also includes a recall-survey of the riders on how they use e-scooters. However, the data collected from this approach can only capture user behavior for a limited timeframe and often contains response bias. As an alternative approach, the author applied unsupervised machine learning methods to identify patterns in all 79,009 trips taken among seven e-scooter service providers during March 2019 in Nashville, Tennessee. The combination of trip data with the land use data suggests nine general patterns. Also, a visualization of the individual cluster in a map added contextual information about those trip clusters. The clustering approach did not reveal any typical commuting pattern like other micro-mobility vehicles, like bike share, while only 4% of the trips are purely recreational such as riding around the park. Whereas more than half of the trips were for a social purpose that reflected characteristics of trips for evening dinner, lunch, or running errands. Also, 21% of all trips that started from 8 pm to 7 am had bars nearby at start or end locations. These findings will be of interest to city planners, infrastructure designers, and e-scooter operators. For instance, identifying the trip start and/or end nearby bars at night could be critical to improving the safety of e-scooter riders, who could be riding under the influence. Moreover, the methodology developed in the study could be one of the applications of open-source Micro-mobility Data Specification (MDS) to better understand the usage of these vehicles.

Subject Areas: Micro-mobility Data Specification; Dockless e-scooter; Unsupervised machine learning; Land use data; Trip patterns

Availability: Shah, N. (2020). *Big Data and Unsupervised Machine Learning Approach to Understand Why People Ride E-Scooter in Nashville, Tennessee*. Master’s Thesis, University of Tennessee, Knoxville, TN. https://trace.tennessee.edu/utk_gradthes/5554/

11.23. Title: Essays in Urban and Real Estate Economics

Author(s): Gorback, C.

Abstract: This dissertation studies how the built environment responds to increasingly interconnected markets. The first chapter studies how improvements in local accessibility influence cities' distributions of economic activity. Exploiting UberX's entry interacted with a location's prior accessibility, I measure how local economic activity responds to changes in access. After ridesharing's entry, restaurant net creation doubles in previously inaccessible locations, from 5% to 10%. As these areas open up, the median house price rises by 4% and rent by 1%. I quantify the impacts of these changes on welfare using a spatial equilibrium framework. Resident welfare depends on the trade-off between accessibility and amenity benefits versus housing costs. In the post-period, all residents benefit from ridesharing's entry. Homeowners are willing to pay \$1,060 per year for ridesharing's entry, while renters are willing to pay \$430, as they do not realize equity gains. The second chapter studies how interconnected capital markets allow mobile global capital to flow into immobile local assets. We document how international capital impacts U.S. housing markets. Other countries introduced foreign-buyer taxes meant to deter Chinese housing investment beginning in 2011. We first show house prices grew 8pp more in U.S. zip codes with high foreign-born Chinese populations after 2011. Second, we use the international tax policy changes as a U.S. housing demand shock and estimate local house price and quantity elasticities with respect to international capital. We find that a 1% increase in foreign capital raises house prices by 0.6%, and housing supply by 0.004%. Finally, we use the two elasticities to construct a new local house price elasticity of supply. We find that for the largest 100 Core-Based Statistical Areas (CBSAs), supply elasticities average 0.1 and vary between 0.02 and 0.7, suggesting that local housing markets are inelastic in the short run with substantial spatial heterogeneity.

Subject Areas: Accessibility; Resident welfare; Ridesharing; Housing markets; International capital; Supply elasticity

Availability: Gorback, C. (2020). *Essays in Urban and Real Estate Economics*. Master's Thesis, University of Pennsylvania, Philadelphia, PA.

<https://search.proquest.com/openview/4bb6309e8f357fd959b7f75fb598c9a7/1?pq-origsite=gscholar&cbl=18750&diss=y>

11.24. Title: Marin Voice: E-Bikes Are a Perfect Fit for Our Remote-Work Lifestyle

Author(s): Gould, J.

Abstract: Blog.

Subject Areas: E-bikes; Remote-work; COVID-19; Travel behavior; Commuting

Availability: Gould, J. (2020). “Marin Voice: E-Bikes Are a Perfect Fit for Our Remote-Work Lifestyle.” *Marin Independent Journal*. <https://www.marinij.com/2020/07/01/marin-voice-time-has-come-to-truly-embrace-the-power-of-remote-working-and-electric-bikes/>

11.25. Title: Work from Home After the COVID-19 Outbreak

Author(s): Bick, A., Blandin, A., and Mertens, K.

Abstract: Based on rich novel survey data on almost 5,000 working age adults, we document that 35.2 percent of the workforce worked entirely from home in May 2020, up from 8.2 percent in February 2020. Highly educated, high-income, and white individuals were much more likely to shift to remote work and to maintain employment following the virus outbreak. Using available estimates of the potential number of home-based workers suggests that a large majority (71.7 percent) of US workers that could work from home effectively did so in May. We provide some evidence indicating that apart from the potential for homebased work, industry business conditions and labor demand also mattered for employment outcomes following the virus outbreak.

Subject Areas: COVID-19; Working from home; Telecommuting; Social distancing; Employment

Availability: Bick, A., Blandin, A., and Mertens, K. (2020). *Work from Home After the COVID-19 Outbreak*. Federal Reserve Bank of Dallas, Dallas, TX.

<https://www.dallasfed.org/~media/documents/research/papers/2020/wp2017.pdf>

11.26. Title: Predicting the Regional Adoption of Electric Vehicle (EV) With Comprehensive Models

Author(s): Jia, J., Shi, B., Che, F., and Zhang, H.

Abstract: Adoption of electric vehicles (EVs) has been regarded as one of the most important strategies to address the issues of energy dependence and greenhouse effect. Empirical reviews demonstrate that wide acceptance of EV is still difficult to achieve. This research proposes to investigate the factors that might trigger the wide usage of EVs to support the energy policy. The real-world owners of EV were extracted from the 2017 National Household Travel Survey (NHTS), which provides large-scale individual characteristics. NHTS dataset was processed to establish the comprehensive estimation model for EV adoption with considering vehicle, personal and household factors. Besides the commonly social-economic factors, the gasoline price and car sharing program were found to be significant for EV adoption. Additionally, since the EV owners are only 1.29% of all vehicle owners, this article introduced the imbalanced dataset technique, which was seldom considered in existing research. Subsequently, several machine learning methods were utilized to build the prediction model, and the model performance analysis indicates the Decision Tree (DT) model outperforms other models. A regional EV penetration map was also generated for the U.S. to validate the proposed approach. Implications for further research, transport policy, and EV market are discussed.

Subject Areas: Electric vehicles adoption; Socio-economic factors; 2017 National Household Travel Survey; Imbalanced dataset; Comprehensive models

Availability: Jia, J., Shi, B., Che, F., and Zhang, H. (2020). "Predicting the Regional Adoption of Electric Vehicle (EV) With Comprehensive Models." *IEEE Access*, 8, pp. 147275–147285.

<https://doi.org/10.1109/ACCESS.2020.3014851>

11.27. Title: National Association of City Transportation Officials: 136 Million US Micro-Mobility Trips in 2019

Author(s): Spencer, B.

Abstract: Blog.

Subject Areas: National Association of City Transportation Officials (NACTO); Micro-mobility; Imbalanced dataset; Bike-share; Dockless e-bikes; E-scooters; Docked bike-share

Availability: Spencer, B. (2020). "National Association of City Transportation Officials: 136 Million US Micro-Mobility Trips in 2019." *ITS International*.

<https://www.itsinternational.com/its17/news/nacto-136m-us-micromobility-trips-2019>

11.28. Title: Delivery Robots Could Generate Trillions For U.S. Economy, Transform Last-Mile Delivery: Study

Author(s): Moffat, C.

Abstract: Blog.

Subject Areas: E-commerce; Grocery delivery; Autonomous vehicles; Last-mile logistics; Nuro; Steer group

Availability: Moffat, C. (2020). "Delivery Robots Could Generate Trillions For U.S. Economy, Transform Last-Mile Delivery: Study." *Bisnow Houston*.

https://www.bisnow.com/houston/news/technology/delivery-robots-could-transform-last-mile-delivery-generate-trillions-for-us-economy-study-105931?utm_source=outbound_pub_23&utm_campaign=outbound_issue_42005&utm_content=outbound_link_2&utm_medium=email

11.29. Title: Electric Vehicle Adoption in Illinois

Author(s): Zhou, Y., Mintz, M., Stephens, T., Aeschliman, S., and Macal, C.

Abstract: At the request of ComEd, this study analyzed a scenario in which plug-in electric vehicles (PEVs) are adopted at an accelerated rate in Illinois. Postulating a goal that 15% of on road vehicles would be PEVs by 2032, we examined successful PEV adoption policies implemented elsewhere in the United States and abroad, characterized trajectories of new PEV sales and turnover of the existing vehicle fleet, projected PEV utilization and charging patterns, and computed resulting effects on energy demand, greenhouse gas emissions, and charging load. Based on the scale and scope of the goal, the body of evidence from the academic literature, and the dynamics of vehicle sales and replacement, we conclude that it will take a combination of strong incentives to achieve 15% PEV penetration in Illinois. First, the equivalent monetized value of incentives to vehicle purchasers will need to be a significant fraction of the price of the vehicle in order to induce a large fraction of consumers to purchase a PEV instead of a comparable conventional vehicle. Second, incentives and other policies need to be in place for several years to make a significant impact on the on-road stock. Third, federal, state, and local governments, automakers, dealerships, and non-profit organizations need to take concerted action to promote the adoption of PEVs. No single agent can implement policies that are likely to promote sufficient PEV adoption to accomplish the goal of 15% on-road penetration.

Subject Areas: Plug-in electric vehicles adoption; Charging patterns; Energy demand; Greenhouse gas emissions; Charging load

Availability: Zhou, Y., Mintz, M., Stephens, T., Aeschliman, S., and Macal, C. (2020). *Electric Vehicle Adoption in Illinois*. Argonne National Laboratory (ANL), Argonne, IL.
<https://doi.org/10.2172/1658594>

11.30. Title: Small Business and the COVID-19 Pandemic: The Role of Work from Home

Author(s): Zhang, T., Gerlowski, D., and Acs, Z.

Abstract: While work from home (WFH) becomes the new norm in the COVID-19 pandemic and while small businesses could be more vulnerable in crisis, whether the WFH norm will fade after the stay-at-home mandate ended and whether WFH could be a Schumpeterian “creative” force that helps small businesses do well in the pandemic is unknown. The study first builds a theoretical framework based on marginal revenue product cost utility theory subject to a “contagion” agglomeration parameter and argues that WFH is a rational choice for businesses. Then, we compiled from multiple data sources an up-to-date real-time daily and weekly multifaceted data set tracking WFH propensity from March 20 through July 28. Our empirical analysis estimated a variety of fixed-effects panel data models, population-averaged generalized linear panel-data models with the generalized estimating equation (GEE) approach, and two-level mixed-effects panel-data models. After controlling for the local pandemic, economic, and demographic factors, we find: (1) after the stay-at-home order ended, WFH rate got higher and (2) small businesses in states with higher WFH rate are more likely to have higher increases in operating revenue, better cash flow, and lower chances of temporary closure. Our robust empirics confirm our theories and hypotheses and demonstrate WFH as a potential force that expedited the “creative destruction” into a new efficient work paradigm.

Subject Areas: Work from home; COVID-19; Small business; Stay-at-home order; Generalized estimating equation

Availability: Zhang, T., Gerlowski, D., and Acs, Z. (2020). “Small Business and the COVID-19 Pandemic: The Role of Work from Home.” *Research Square*. <https://doi.org/10.21203/rs.3.rs-83264/v1>

11.31. Title: National and Metropolitan Trends in Public Transit Use, Transit-Related Walking, and Ridesharing Between 2009 and 2017

Author(s): Tribby, C.P., Graubard, B.I., and Berrigan, D.

Abstract: Introduction: Walking is a common form of physical activity and is the most frequent way to access public transit. On-going changes in the US transportation system are occurring, notably increases in smartphone application-based ridesharing. The goal of this research is to assess whether increasing use of ridesharing was associated with a change in transit-related walking. This is important to both public health and transportation, as it can inform changes in active transportation which promotes both physical activity and transit use.

Methods: We examined the association between change in transit use, transit-related walking, and ridesharing nationally and for selected metropolitan areas using the 2009 and 2017 National Household Travel Survey (≥ 18 years; $n = 263,572$ and $n = 230,592$, respectively). Analyses were conducted in 2019. Covariates included sex, age, race/ethnicity, education, employment, work from home, household size, number of vehicles, population density, Census region, metro area size and heavy rail transit category and season.

Results: The national prevalence of transit use in the past month in 2009 was 16.9% (95% CI: 16.4%–17.4%) and in 2017 was 16.1% (15.6%–16.6%), a significant decrease ($p < 0.02$). The prevalence of daily transit-related walking in 2009 was 4.2% (4.0%–4.4%) and in 2017 was 4.4% (4.2%–4.6%; $p = 0.22$). The prevalence of daily taxi use in 2009 was 0.5% (0.4%–0.6%) and taxi/rideshare in 2017 was 1.1% (1.0%–1.2%), a significant increase ($p < 0.0001$). The relationships remained after covariate adjustment. Finally, there was not a significant change in transit-related walking or interaction between year and taxi/rideshare use after additional adjustment for taxi/rideshare. Changes in transit-related walking in metros were largely not significant, whereas increases in taxi/rideshare were largely significant.

Conclusions: Results suggest that increased use of ridesharing may not be linked with changes in transit-related walking. Continued surveillance of travel mode prevalence is required to track potential reductions in population-level physical activity with technology-related changes in travel.

Subject Areas: Public transit; Walking; Physical activity; Ridesharing

Availability: Tribby, C.P., Graubard, B.I., and Berrigan, D. (2020). “National and Metropolitan Trends in Public Transit Use, Transit-Related Walking, and Ridesharing Between 2009 and 2017.” *Journal of Transport & Health*, 19. <https://doi.org/10.1016/j.jth.2020.100918>

11.32. Title: Human Mobility Trends During the Early Stage of the COVID-19 Pandemic in the United States

Author(s): Lee, M., Zhao, J., Sun, Q., Pan, Y., Zhou, Q., Xiong, C., and Zhang, L.

Abstract: In March of this year, COVID-19 was declared a pandemic, and it continues to threaten public health. This global health crisis imposes limitations on daily movements, which have deteriorated every sector in our society. Understanding public reactions to the virus and the non-pharmaceutical interventions should be of great help to fight COVID-19 in a strategic way. We aim to provide tangible evidence of the human mobility trends by comparing the day-by-day variations across the U.S. from January 2020 to early April 2020. Large-scale public mobility at an aggregated level is observed by leveraging mobile device location data and the measures related to social distancing. Our study captures spatial and temporal heterogeneity as well as the sociodemographic variations and teleworking trends regarding the pandemic propagation and the non-pharmaceutical mobility interventions. All metrics adapted capture decreased public movements after the national emergency declaration. The population staying home has increased in all states before the stay-at-home mandates implemented and becomes more stable after the order with a smaller range of fluctuation. The public had been taking active responses, voluntarily staying home more, to the in-state confirmed cases while the stay-at-home orders stabilize the variations. As the estimated teleworking rates also continue to incline throughout the study period, the teleworking trend can be another driving factor for the growing stay-at-home population. We confirm that there exists overall mobility heterogeneity between the income or population density groups. The study suggests that public mobility trends are in line with the government message urging to stay home. We anticipate our data-driven analysis offers integrated perspectives and serves as evidence to raise public awareness and, consequently, reinforce the importance of social distancing while assisting policymakers.

Subject Areas: COVID-19; Human mobility trends; Stay-at-home orders; Teleworking; Data-driven analysis

Availability: Lee, M., Zhao, J., Sun, Q., Pan, Y., Zhou, Q., Xiong, C., and Zhang, L. (2020). "Human Mobility Trends During the Early Stage of the COVID-19 Pandemic in the United States." *PLoS ONE*, 15(11). <https://doi.org/10.1371/journal.pone.0241468>

11.33. Title: Connected and Autonomous Vehicles in Smart Cities

Editor(s): Mouftah, H.T., Erol-Kantarci, M., and Sorour, S.

Abstract: This book presents a comprehensive coverage of the five fundamental yet intertwined pillars paving the road towards the future of connected autonomous electric vehicles (CAEVs) and smart cities. The connectivity pillar covers all the latest advancements and various technologies on vehicle-to-everything (V2X) communications/networking and vehicular cloud computing, with special emphasis on their role towards vehicle autonomy and smart cities applications. On the other hand, the autonomy track focuses on the different efforts to improve vehicle spatiotemporal perception of its surroundings using multiple sensors and different perception technologies. Since most of connected and autonomous vehicles (CAVs) are expected to run on electric power, studies on their electrification technologies, satisfaction of their charging demands, interactions with the grid, and the reliance of these components on their connectivity and autonomy, is the third pillar that this book covers.

On the smart services side, the book highlights the game-changing roles CAV will play in future mobility services and intelligent transportation systems. The book also details the ground-breaking directions exploiting CAVs in broad spectrum of smart cities applications. Example of such revolutionary applications are autonomous mobility on-demand services with integration to public transit, smart homes, and buildings. The fifth and final pillar involves the illustration of security mechanisms, innovative business models, market opportunities, and societal/economic impacts resulting from the soon-to-be-deployed CAVs.

This book contains an archival collection of top quality, cutting-edge and multidisciplinary research on connected autonomous electric vehicles and smart cities. The book is an authoritative reference for smart city decision makers, automotive manufacturers, utility operators, smart-mobility service providers, telecom operators, communications engineers, power engineers, vehicle charging providers, university professors, researchers, and students who would like to learn more about the advances in CAEVs connectivity, autonomy, electrification, security, and integration into smart cities and intelligent transportation systems..

Subject Areas: Vehicle-to-everything (V2X); Connected autonomous electric vehicles (CAEVs); Smart cities; Vehicular cloud computing; Connected and autonomous vehicles (CAVs); Connectivity; Autonomy; Electrification; Security; Integration; Intelligent transportation systems

Availability: Mouftah, H.T., Erol-Kantarci, M., and Sorour, S. (2020). *Connected and Autonomous Vehicles in Smart Cities*. Taylor&Francis Group, London, UK.

<https://www.routledge.com/Connected-and-Autonomous-Vehicles-in-Smart-Cities/Mouftah-Erol-Kantarci-Sorour/p/book/9780367350345>

11.34. Title: The Role of Flexibility at Work on Residential Location: From the Work-Life Balance Perspective

Author(s): Kim, J.

Abstract: As Information and Communication Technology (ICT) advances, working conditions become more flexible with the help of telecommuting. Indeed, this change improves the work-life balance for existing employees and provides new job opportunities in a regional economy. This paper aims to describe how flexible working conditions contribute to the distance to work by using the National Household Travel Survey 2009 and 2017. First, the Geographic Information System (GIS) illustrates a distance increase from home to work at the state level. Then, the nested multinomial logit models examine how flexibility at work correlates with the distance between home and work. The results support that flexible working conditions correlate with employees' distant residence from work, which potentially contributes to affordable housings and work-life balance.

Subject Areas: Flexible working; Telecommuting; Distant residence; Work-life balance

Availability: Kim, J. (2020). "The Role of Flexibility at Work on Residential Location: From the Work-Life Balance Perspective." *Population Change and Public Policy*, pp. 243–257.
https://doi.org/10.1007/978-3-030-57069-9_12

11.35. Title: The Role of Urban Form in the Performance of Shared Automated Vehicles

Author(s): Wang, K. and Zhang, W.

Abstract: The technology of Shared Automated Vehicles (SAVs) has advanced significantly in recent years. However, existing SAV studies primarily focus on the system design while limited studies have examined the impacts of exogenous variables, especially urban form, on SAV performance. Therefore, it remains unclear what key urban form measurements may influence SAV system's sustainability. This study fills the research gap by conducting simulation experiments using data collected from 286 cities. This study identifies critical urban form measurements correlated with the simulated SAV performance using fixed effects regression models. The results suggest that SAVs are more efficient and generate less VMT in denser cities with more connected networks and diversified land use development patterns. The model results can help provide insights on land use and transportation policies to curb the adverse effects of SAVs in the future and generalize existing SAV simulation results to the rest of U.S. cities.

Subject Areas: Shared automated vehicles (SAVs); Urban form; Simulation; Cross-city comparison; SAV performance

Availability: Wang, K. and Zhang, W. (2020). *The Role of Urban Form in the Performance of Shared Automated Vehicles*. arXiv, Cornell University, Ithaca, NY. <https://arxiv.org/abs/2012.01384>

11.36. Title: A Framework for Evaluating the Economic Viability of Autonomous Vehicles

Author(s): Yamada, K.

Abstract: This research aims to develop a framework investigating the viability of autonomous vehicles (AVs) in an urban area that enables multiple travel ways that potentially compete or coordinate with them. Based on the Household Activity Pattern Problem (HAPP) developed by Recker (1995), this research attempts to simulate travel-activity patterns with AVs by reformulating the original HAPP model. The revised framework succeeds in assessing the condition under which AVs can be advantageous over conventional vehicles (CVs) for a hypothetical household. It explicitly captures AVs' zero-occupancy trips and searching behavior for parking spots leading to the increase in vehicle travel miles. Finally, this research extends the formulation of HAPP to be capable of simulating multimodal transportation systems. In addition to conventional private vehicles and AVs, various private modes, rideshare (taxi), and public transit are incorporated into the framework. This extension distinguishes the framework from other activity-based models in depicting the coordination or competition between AVs and other modes. Thus, this framework shows that the availabilities of other transportation modes, as well as AVs' costs and households preferences, will affect households' decisions to embrace AVs. The results of this research imply that the proposed framework potentially serves as the demand-side component in an operational system for innovative transportation services such as Mobility as a Service.

Subject Areas: Autonomous vehicles; Travel-activity patterns; Household Activity Pattern Problem (HAPP); Travel-activity patterns

Availability: Yamada, K. (2020). *A Framework for Evaluating the Economic Viability of Autonomous Vehicles*. Master's Thesis, University of California, Irvine, CA.
<https://escholarship.org/uc/item/69c6x1h3>