National Household Travel Survey

Compendium of Uses

January 2018 – December 2018
Introduction
This compendium contains various uses and applications of the National Household Travel Survey (NHTS) data used in transportation planning and research from January 2018 to December 2018. Published journal articles and reports that cite the use of NHTS data were selected using the Transportation Research Board (TRB) Annual Meeting Online Portal http://amonline.trb.org/, Google Scholar https://scholar.google.com/, and Google Alerts, notification emails sent by Google when new search results matched predetermined search terms pertaining to NHTS data. The key word and search engine terms used in both online sources were the National Household Travel Survey and NHTS.

The research papers were grouped into 11 categories that were created based on the Subject Areas and index terms identified in each abstract as well as category titles used in previous NHTS compendium databases. The categories are as follows:

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

A short description of each paper is provided which includes the Title, Authors, Abstract, Subject Areas, and Availability.

Research articles and reports in this document 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 American Journal of Public Health, the International Journal of Behavioral Nutrition and Physical Activity, and the National Center for Transit Research. Several papers were also submitted by researchers and graduate students for presentation and publication to the Transportation Research Board 97th Annual Meeting and can be found in the 2018 TRB Annual Meeting Compendium of Papers. Please note that this 2018 compendium consists of 370 research papers and articles. This document was updated on an on-going 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 Apara Banerjee (MacroSys), who also categorized and formatted the paper abstracts.
# TABLE OF CONTENTS

## Contents

1 Bicycle and Pedestrian Studies

1.1 Title: Middle Modalism: The Proliferation of E-Bikes and Implications for Planning and Urban Design ....................................................... 19

1.2 Title: Can the Built Environment Explain Gender Gap in Cycling? An Exploration of University Students’ Travel Behavior in Toronto, Canada ........................................... 20

1.3 Title: Impact of County-Level Built Environment and Regional Accessibility on Walking: A Washington, DC-Baltimore Case Study ........................................... 21

1.4 Title: Why do People like Bicycling? Modeling affect toward Bicycling .......................... 22

1.5 Title: High Impact Prioritization of Bikeshare Program Investment to Improve Underserved Communities’ Access to Jobs and Essential Services ............................... 23

1.6 Title: Cycling in Small Suburban Communities: A Case Study of Georgetown, TX ................................................................. 24

1.7 Title: Pedestrians’ Receptivity Toward Fully Automated Vehicles: Research Review and Roadmap for Future Research ......................................................... 25

1.8 Title: Bicyclist’s Perceived Level of Comfort in Dense Urban Environments: How do Ambient Traffic, Engineering Treatments, and Bicyclist Characteristics Relate? ......................................................... 26

1.9 Title: Do Satisfying Walking and Cycling Trips Result in More Future Trips with Active Travel Modes? An Exploratory Study ......................................................... 27

1.10 Title: Uber’s Plan to Rent Electric Bikes Is Good for Uber, Traffic, and You .......................... 28

1.11 Title: Walking, Biking Trail is Important Part of Infrastructure ........................................ 29

1.12 Title: Infrastructure Bill should include Walking and Biking Trails ........................... 30

1.13 Title: Pittsburgh Bike Share Program Expanding with New Stations ........................................ 31

1.14 Title: Biking to work this spring? It just got more expensive under the new tax law ................................................................. 32

1.15 Title: Let’s get Connected ........................................................................ 33

1.16 Title: OKC celebrates 13th annual Bike to Work Day on May 18. ................................. 34

1.17 Title: It’s National Bike Month. Let’s Ride Bikes! .................................................. 35

1.18 Title: Why Little Vehicles Will Conquer the City ................................................. 36

1.19 Title: Geographic and Urban-Rural Differences in Walking for Leisure and Transportation ........................................................................ 37

1.20 Title: Persistent Differences in Walking across the Socioeconomic Spectrum: Variations by Trip Purpose ................................................................. 38
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.21 Title: A Comparison of Bicyclist Attitudes in Two Urban Areas in USA and Italy</td>
<td>39</td>
</tr>
<tr>
<td>1.22 Title: Walkability in the Connected and Automated Vehicle Era: A U.S. Perspective on Research Needs</td>
<td>40</td>
</tr>
<tr>
<td>1.23 Title: Metropolis-Hasting based Expanded Path Size Logit Model for Cyclists’ Route Choice using GPS Data</td>
<td>41</td>
</tr>
<tr>
<td>1.24 Title: Measuring the Wind through your Hair? Unravelling the Positive Utility of Bicycle Travel</td>
<td>42</td>
</tr>
<tr>
<td>1.25 Title: User Preferences of Bicycle Infrastructure</td>
<td>43</td>
</tr>
<tr>
<td>1.26 Title: Help! New Guidance Available on Shared Bikes and Scooters</td>
<td>44</td>
</tr>
<tr>
<td>1.27 Title: Do bike lanes have to be white lanes?</td>
<td>45</td>
</tr>
<tr>
<td>1.28 Title: Spin cities: Bike- and scooter-sharing startups move forward in fits and starts</td>
<td>46</td>
</tr>
<tr>
<td>1.29 Title: Novelty of Scooters Poses Serious Challenge to Cars’ Reign</td>
<td>47</td>
</tr>
<tr>
<td>1.30 Title: Meeting to focus on walking, biking benefits as you age</td>
<td>48</td>
</tr>
<tr>
<td>1.31 Title: CalAmp and PWS Expand Access to Personal Micro-Mobility</td>
<td>49</td>
</tr>
<tr>
<td>1.32 Title: Mate X raises $10 million for its foldable electric bike</td>
<td>50</td>
</tr>
<tr>
<td>1.33 Title: Car Companies rush to embrace Scooters and Bikes</td>
<td>51</td>
</tr>
<tr>
<td>1.34 Title: Gotcha Unveils New Portfolio of E-Mobility Products</td>
<td>52</td>
</tr>
<tr>
<td>1.35 Title: Re-legalizing Fourplexes Would Also Be Fantastic for Bike Transportation</td>
<td>53</td>
</tr>
<tr>
<td>2 Energy Consumption</td>
<td>54</td>
</tr>
<tr>
<td>2.1 Title: Modeling and Forecasting Household Energy Consumption and Related CO₂ Emissions Integrating UrbanSim And Transportation Models: An Atlanta Beltline Case Study</td>
<td>54</td>
</tr>
<tr>
<td>2.2 Title: System and Method for Estimating and Predicting Vehicle Trip Energy Consumption</td>
<td>55</td>
</tr>
<tr>
<td>2.3 Title: Relative Economic Competitiveness of Light-Duty Battery Electric and Fuel Cell Electric Vehicles</td>
<td>56</td>
</tr>
<tr>
<td>2.4 Title: GIS-based Probabilistic Modeling of BEV Charging Load for Australia</td>
<td>57</td>
</tr>
<tr>
<td>2.5 Title: Planning for Electric Vehicle Needs by Coupling Charging Profiles with Urban Mobility</td>
<td>58</td>
</tr>
<tr>
<td>2.6 Title: The Feasibility of Using V2G to Face the Peak Demand in Warm Countries</td>
<td>59</td>
</tr>
<tr>
<td>2.7 Title: Multi-agent Modeling and Analysis of EV Users’ Travel Willingness based on an integrated Causal/Statistical/Behavioral Model.</td>
<td>60</td>
</tr>
<tr>
<td>2.8 Title: Improving Voltage Profile and Optimal Scheduling of Vehicle to Grid Energy based on a New Method</td>
<td>61</td>
</tr>
<tr>
<td>2.9 Title: Battery Technologies for Mass Deployment of Electric Vehicles</td>
<td>62</td>
</tr>
<tr>
<td>2.10 Title: Voltage-dependent Modelling of Fast Charging Electric Vehicle Load Considering Battery Characteristics</td>
<td>63</td>
</tr>
<tr>
<td>2.11 Title: A Charging Pricing Strategy of Electric Vehicle Fast Charging Stations for the Voltage Control of Electricity Distribution Networks</td>
<td>64</td>
</tr>
</tbody>
</table>
2.12 Title: Implication of Replacing the Federal and State Fuel Taxes with a National Vehicle Mile Traveled Tax ............................................ 65
2.13 Title: Spatial and Temporal Optimization Strategy for Plug-In Electric Vehicle Charging to Mitigate Impacts on Distribution Network ........... 66
2.14 Title: Well-being Analysis of Distribution Network in the Presence of Electric Vehicles .......................................................... 67
2.15 Title: Alternative Utility Factor Versus the SAE J2841 Standard Method for PHEV and BEV Applications ....................................... 68
2.16 Title: Clean Vehicles as an enabler for a Clean Electricity Grid ........... 69
2.17 Title: Landscape Analysis: The Electric Car (Is it a Viable Alternative?) 70
2.18 Title: Changes in Time Use and their Effect on Energy Consumption in the United States .......................................................... 71
2.19 Title: Grid Integration of Large-Scale Electric Vehicles: Enabling Support through Power Storage .................................................. 72
2.20 Title: Do Electric Vehicles need Subsidies? Ownership Costs for Conventional, Hybrid, and Electric Vehicles in 14 US Cities ....................... 73
2.21 Title: Markov Chain Monte Carlo Simulation of Electric Vehicle Use for Network Integration Studies .............................................. 74
2.22 Title: Quantitative Calculation and Optimization of Demand for Electric Vehicle Charging Stations .................................................. 75
2.23 Title: The Impact of High Occupancy Vehicle (HOV) Lane Access on Hybrid-electric Vehicle Adoption: Evidence from US States ............... 76
2.24 Title: Research on an Electric Vehicle Owner-Friendly Charging Strategy Using Photovoltaic Generation at Office Sites in Major Chinese Cities 77
2.25 Title: Charging Electric Vehicles in Smart Cities: An EVI-Pro Analysis of Columbus, Ohio .......................................................... 78
2.26 Title: Probabilistic Multi-Objective Optimal Scheduling of Plug-in Hybrid Electric Vehicles in the Distribution System ................................. 80
2.27 Title: A Multi-objective Framework for Energy Resource Scheduling in Active Distribution Networks .............................................. 81
2.28 Title: An Optimal Domestic Electric Vehicle Charging Strategy for Reducing Network Transmission Loss While Taking Seasonal Factors into Consideration ......................................................... 82
2.29 Title: Evolving Controllers for Electric Vehicle Charging .................. 83
2.30 Title: Elasticity of Vehicle Miles of Travel to Changes in the Price of Gasoline and the Cost of Driving in Texas ..................................... 84
2.31 Title: Assessment and Enhancement Frameworks for System Reliability Performance Using Different PEV Charging Models ..................... 85
2.32 Title: A Method for Determining The Optimal Delivered Hydrogen Pressure for Fuel Cell Electric Vehicles ......................................... 86
2.33 Title: Range-extending Zinc-air Battery for Electric Vehicle ............... 87
2.34 Title: Multicriterion Optimal Electric Drive Vehicle Selection based on Lifecycle Emission and Lifecycle Cost .................................. 88
2.35 Title: Probabilistic-possibilistic Model for a Parking Lot in the Smart Distribution Network Expansion Planning ................................. 89
2.36 Title: Ancillary Services Participation for Electric Vehicle Fleets .......... 90
2.61 Title: Ownership Cost Comparison of Battery Electric and Non-Plugin Hybrid Vehicles: A Consumer Perspective ........................................... 115
2.62 Title: Ownership Cost Comparison of Battery Electric and Non-Plugin Hybrid Vehicles: A Consumer Perspective ........................................... 116
2.63 Title: How Do US Passenger Vehicle Fuel Economy Standards Affect Purchases of New and Used Vehicles? ........................................... 117
2.64 Title: Smart Deregulated Grid Frequency Control in Presence of Renewable Energy Resources by EVs Charging Control ........................................... 118
2.65 Title: The Impact of Electric Vehicle Penetration and Charging Patterns on the Management of Energy Hub—A Multi-agent System Simulation ........................................... 119
2.66 Title: Comparing the Emissions Benefits of Centralized vs. Decentralized Electric Vehicle Smart Charging Approaches: A Case Study of the Year 2030 California Electric Grid ........................................... 120
2.67 Title: Design of Residential Plug-in Electric Vehicle Charging Station with Time of Use Tariff and IoT Technology ........................................... 121
2.68 Title: Quantifying the Flexibility of Hydrogen Production Systems to Support Large-Scale Renewable Energy Integration ........................................... 122
2.69 Title: The Development and Key Technologies of Smart Distribution Network Planning Converging High Penetration Level of EVs ........................................... 123
2.70 Title: Fuel Consumption and Gasoline Prices: The Role of Assortative Matching between Households and Automobiles ........................................... 124
2.71 Title: Consumer Willingness to Pay for Vehicle Attributes: What do we Know? ........................................... 125
2.72 Title: Stochastic Residential Energy Management System with Vehicle-to-Home and Photovoltaic Penetration ........................................... 126
2.73 Title: Stochastic Modeling of the Charging Behavior of Electromobility ........................................... 127
2.74 Title: Optimal sizing of PEV fast charging stations with Markovian demand characterization ........................................... 128
2.75 Title: Aggregated Electric Vehicle Resource Modelling for Regulation Services Commitment in Power Grid ........................................... 129
2.76 Title: Bi-Level Planning Model of Charging Stations Considering the Coupling Relationship between Charging Stations and Travel Route ........................................... 130
2.77 Title: Environmental Attributes of Electric Vehicle Ownership and Commuting Behavior in Maryland: Public Policy and Equity Considerations ........................................... 131
2.78 Title: A Prediction Method of Electric Vehicle Charging Load Considering Traffic Network and Travel Rules ........................................... 132
2.79 Title: Quantifying Vehicle Waste Heat: A Case Study of Phoenix, Arizona ........................................... 133
2.80 Title: Real-time Optimal Energy Management Controller for Electric Vehicle Integration in Workplace Microgrid ........................................... 134
2.81 Title: Energy-saving Benefits from Plug-in Hybrid Electric Vehicles: Perspectives Based on Real-World Measurements ........................................... 135
2.82 Title: Distributionally Robust Distributed Generation Hosting Capacity Assessment in Distribution Systems ........................................... 136
2.83 Title: Reliability Modeling of Electric Vehicles and Its Impact on Distribution Network ........................................... 137
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Title: Mapping The Influence of Food Waste in Food Packaging Environmental Performance Assessments</td>
<td>161</td>
</tr>
<tr>
<td>3.2</td>
<td>Title: Carbon Footprint Planning: Quantifying Local and State Mitigation Opportunities for 700 California Cities</td>
<td>162</td>
</tr>
<tr>
<td>3.3</td>
<td>Title: Estimating Individualized Exposure Impacts from Ambient Ozone Levels: A Synthetic Information Approach</td>
<td>163</td>
</tr>
<tr>
<td>3.4</td>
<td>Title: The Influence of the Built Environment of Neighborhoods on Residents’ Low-Carbon Travel Mode</td>
<td>164</td>
</tr>
<tr>
<td>3.5</td>
<td>Title: A Life Cycle Assessment of the Environmental Impacts of A Beef System in the USA</td>
<td>165</td>
</tr>
<tr>
<td>3.6</td>
<td>Title: Future of Mobility White Paper</td>
<td>166</td>
</tr>
<tr>
<td>3.7</td>
<td>Title: Optimizing One-day Driving Restriction using Mathematical Programming</td>
<td>167</td>
</tr>
<tr>
<td>3.8</td>
<td>Title: Optimal Energy Taxation in Cities</td>
<td>168</td>
</tr>
<tr>
<td>3.9</td>
<td>Title: Energy Use and Life Cycle Greenhouse Gas Emissions of Drones for Commercial Package Delivery</td>
<td>169</td>
</tr>
<tr>
<td>3.10</td>
<td>Title: Appraising the Environmental Benefits of Ride-sharing: The Paris Region Case Study</td>
<td>170</td>
</tr>
<tr>
<td>3.11</td>
<td>Title: Multiagent Spatial Simulation of Autonomous Taxis for Urban Commute: Travel Economics and Environmental Impacts</td>
<td>171</td>
</tr>
<tr>
<td>3.12</td>
<td>Title: Travel Effects and Associated Greenhouse Gas Emissions of Automated Vehicles</td>
<td>172</td>
</tr>
<tr>
<td>3.13</td>
<td>Title: Carbon Mitigation in Domains of High Consumer Lock-in</td>
<td>173</td>
</tr>
<tr>
<td>3.14</td>
<td>Title: Cities’ Role in Mitigating United States Food System Greenhouse Gas Emissions</td>
<td>174</td>
</tr>
<tr>
<td>3.15</td>
<td>Title: Research on the Effect of Large-scale Electric Vehicle based on Smart Wearable Equipment Access to Grid</td>
<td>175</td>
</tr>
<tr>
<td>3.16</td>
<td>Title: A Review on Energy, Environmental, and Sustainability Implications of Connected and Automated Vehicles</td>
<td>176</td>
</tr>
<tr>
<td>3.17</td>
<td>Title: Developing Commute Optimization System to Minimize Negative Environmental Impacts and Time of Business Commuters</td>
<td>177</td>
</tr>
<tr>
<td>3.18</td>
<td>Title: Understanding Our Future</td>
<td>178</td>
</tr>
<tr>
<td>3.19</td>
<td>Title: Achieving Public Health and Climate Change Goals: What do we Need to Know about the Transportation System?</td>
<td>179</td>
</tr>
<tr>
<td>4</td>
<td>Health</td>
<td>180</td>
</tr>
<tr>
<td>4.1</td>
<td>Title: Understanding Temporal Change of Spatial Accessibility To Healthcare: An Analytic Framework For Local Factor Impacts</td>
<td>180</td>
</tr>
<tr>
<td>4.2</td>
<td>Title: Dietary and Physical Activity Interventions for Colorectal Cancer Survivors: A Randomized Controlled Trial</td>
<td>181</td>
</tr>
<tr>
<td>4.3</td>
<td>Title: CTASS: An Intelligent Framework for Personalized Travel Behaviour Advice to Cardiac Patients</td>
<td>182</td>
</tr>
<tr>
<td>4.4</td>
<td>Title: VA Using Telemedicine to Provide Therapy to Rural Veterans With PTSD</td>
<td>183</td>
</tr>
</tbody>
</table>
4.5 Title: Is promoting public transit an effective intervention for obesity?: A longitudinal study of the relation between public transit usage and obesity ......................................................... 184
4.6 Title: Actions to Improve Physical Activity Surveillance in the United States .................................................................................................................. 185
4.7 Title: A Multi-modal Relative Spatial Access Assessment Approach to Measure Spatial Accessibility to Primary Care Providers ............ 186
4.8 Title: Behavior Model Calibration for Epidemic Simulations .......... 187
4.9 Title: Facility Location Model for Free Clinics to Address Healthcare Disparities in Portland, OR .......................................................... 188
4.10 Title: Getting There: There are more places to park than you probably think ................................................................................................................ 189
4.11 Title: During a Flu Epidemic, Dispensing Flu Vaccines at Pharmacies Could Save Lives and Costs ......................................................... 190

5 Policy and Mobility 191
5.1 Title: Development of a Multi-modal Travel Demand Module for the Regional Strategic Planning Model .......................................................... 191
5.2 Title: An Overview of Transportation Data ........................................ 192
5.3 Title: Evolution of Transportation Policy and Economics .................. 193
5.4 Title: Devolution of Transportation: Reducing Big-Government Involvement in Transportation Decision Making ................................. 194
5.5 Title: Not so Fast? Examining Neighborhood-Level Effects of Traffic Congestion on Job Access ......................................................... 196
5.6 Title: Mobility and Congestion in Urban India ..................................... 197
5.7 Title: The Road to Inequality: How the Federal Highway Program Polarized America and Undermined Cities ......................................................... 198
5.8 Title: Developing Policy for Urban Autonomous Vehicles: Impact on Congestion .......................................................... 199
5.9 Title: An Agent-Based Simulation Model for Shared Autonomous Taxi System ................................................................................................. 200
5.10 Title: The Geography of Poverty and Nutrition: Food Deserts and Food Choices across the United States ......................................................... 201
5.11 Title: The Housing Crisis isn’t just about Affordability – It’s about Economic Mobility, too .......................................................... 202
5.12 Title: The Future of the Micro-Mobility Industry ................................. 203
5.13 Title: Developing a Spatial Transferability Platform to Analyze National-Level Impacts of Connected Automated Vehicles ..................... 204
5.14 Title: Capturing the Built Environment-travel Interaction for Strategic Planning: Development of a Multimodal Travel Module for the Regional Strategic Planning Model (RSPM) .......................................................... 205
5.15 Title: The Effect of Competition of Transport Modes on Mobility ...... 206
5.16 Title: Bridging the Gap between Mobility Haves and Have-Nots .......... 207
5.17 Title: Network influences on the development and implementation of active transportation policies in six U.S. cities .......................... 208
5.18 Title: The Impact of Anti-Congestion Policies and the Role of Labor-supply Margins ................................................................. 209
5.19 Title: Shared Mobility: The Potential of Ridehailing and Pooling ..... 210

6 Special Population Groups
6.1 Title: Examining the Possible Impact of Daily Transport on Depression Among Older Adults Using an Agent-Based Model .................. 211
6.2 Title: Do Not Forget About Public Transportation: Analysis of the Association of Active Transportation to School Among Washington, DC Area Children With Parental Perceived Built Environment Measures . 212
6.3 Title: Active Travel, Public Transportation Use, and Daily Transport Among Older Adults: The Association of Built Environment ........ 213
6.4 Title: Residence in Unsafe Neighborhoods is associated with Active Transportation among Poor Women: Geographic Research on Wellbeing (GROW) Study ........................................... 214
6.5 Title: How Do Stressed Workers Make Travel Mode Choices That Are Good For Their Health, Safety, and Productivity? .................. 215
6.6 Title: Understanding and Modeling the Activity-Travel Behavior of University Commuters at a Large Canadian University ........... 216
6.7 Title: E-hail (Rideshare) Knowledge, Use, Reliance, And Future Expectations Among Older Adults .............................................. 217
6.8 Title: Turn taking Behavior in Dual Earner Households with Children: A Focus on Escorting Routines ........................................... 218
6.9 Title: Young People’s Travel – What’s Changed and Why? .............. 219
6.10 Title: A Survey of Restraint Methods for the Safe Transport of Children in Ground Ambulances .................................................. 220
6.11 Title: Sharing is Caring: The Potential of the Sharing Economy to Support Aging in Place .......................................................... 221
6.12 Title: The Gender Earnings Gap in the Gig Economy: Evidence from over a Million Rideshare Drivers ................................. 222
6.13 Title: An Investigation into the Role of Information and Communication Technologies on Travel Behaviour of Working Adults and Youth ...................................................... 223
6.14 Title: The Alabama VIP Older Driver Study Rationale and Design: Examining The Relationship Between Vision Impairment and Driving Using Naturalistic Driving Techniques 224
6.15 Title: When rideshare companies strand seniors the Jewish community does the driving .............................................................. 225
6.16 Title: Millennials Are Driving Again (but Not the Rich Ones) ........ 226
6.17 Title: Uber gender pay gap ‘explained’ — Men drive faster than Women 227
6.18 Title: An Examination of Children’s School Travel: A Focus on Active Travel and Parental Effects ......................................... 228
6.19 Title: Travel Patterns of American Adults with Disabilities .......... 229
6.20 Title: What Explains Neighborhood Sorting by Income and Race? ..... 230
6.21 Title: Essays on Aging Americans’ Travel Preferences: Behavioral Survey Analyses ................................................................. 231
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does Economic Vulnerability moderate the association between</td>
<td>233</td>
</tr>
<tr>
<td>Transportation Mode and Social Activity Restrictions in Later Life?</td>
<td></td>
</tr>
<tr>
<td>Analytical Method to Determine Transportation Service Gaps for</td>
<td>234</td>
</tr>
<tr>
<td>Transportation Disadvantaged Populations</td>
<td></td>
</tr>
<tr>
<td>Does Location Matter? Performance Analysis of the Affordable</td>
<td>235</td>
</tr>
<tr>
<td>Housing Programs with Respect to Transportation Affordability in</td>
<td></td>
</tr>
<tr>
<td>Dallas Fort Worth (DFW) Metropolis</td>
<td></td>
</tr>
<tr>
<td>Building Supportive Infrastructure For Low-income Entrepreneurs</td>
<td>236</td>
</tr>
<tr>
<td>Understanding Mobility Characteristics and Needs of Older Persons in</td>
<td>237</td>
</tr>
<tr>
<td>Urban Pakistan with Respect to use of Public Transport and</td>
<td></td>
</tr>
<tr>
<td>Self-Driving</td>
<td></td>
</tr>
<tr>
<td>Correlated Grouped Random Parameters Hazard-Based Duration Analysis</td>
<td>238</td>
</tr>
<tr>
<td>of Elderly Travel Times and Distances</td>
<td></td>
</tr>
<tr>
<td>How Vehicle Access Enables Low-Income Households to Live in Better</td>
<td>239</td>
</tr>
<tr>
<td>Neighborhoods</td>
<td></td>
</tr>
<tr>
<td>Factors Preventing the Use of Alternative Transport Modes to the Car</td>
<td>240</td>
</tr>
<tr>
<td>in Later Life</td>
<td></td>
</tr>
<tr>
<td>Quantification of Free-Living Community Mobility in Healthy</td>
<td>241</td>
</tr>
<tr>
<td>Older Adults Using Wearable Sensors</td>
<td></td>
</tr>
<tr>
<td>NYC's Battle With Uber And Lyft Could Hurt Middle Income Riders</td>
<td>242</td>
</tr>
<tr>
<td>Optimizing Copious Activity Type Classes Based on Classification</td>
<td>243</td>
</tr>
<tr>
<td>Accuracy and Entropy Retention</td>
<td></td>
</tr>
<tr>
<td>Tool for Querying the National Household Travel Survey Data</td>
<td>244</td>
</tr>
<tr>
<td>Assessing the Effects of A Mixed-Mode Design in a Longitudinal</td>
<td>245</td>
</tr>
<tr>
<td>Household Travel Survey</td>
<td></td>
</tr>
<tr>
<td>Are Cars Used Differently in Germany than in California? Findings</td>
<td>246</td>
</tr>
<tr>
<td>from Annual Car-Use Profiles</td>
<td></td>
</tr>
<tr>
<td>Aggregation Biases in Discrete Choice Models</td>
<td>247</td>
</tr>
<tr>
<td>An Investigation of Tour Generation Models Combining Two Waves of</td>
<td>248</td>
</tr>
<tr>
<td>Household Travel Surveys through Pooled Models</td>
<td></td>
</tr>
<tr>
<td>Human-Machine Interaction for Vehicles: Review and Outlook</td>
<td>249</td>
</tr>
<tr>
<td>How Commuters’ Motivations to drive relate to Propensity to Carpool</td>
<td>250</td>
</tr>
<tr>
<td>Evidence from the United Kingdom and the United States</td>
<td></td>
</tr>
<tr>
<td>Construction of Register-based Commuting Measures</td>
<td>251</td>
</tr>
<tr>
<td>Are We Ready to Embrace Connected and Self-Driving Vehicles?</td>
<td>252</td>
</tr>
<tr>
<td>A Case Study of Texans</td>
<td></td>
</tr>
<tr>
<td>Detecting Popular Temporal Modes in Population-scale Unlabelled</td>
<td>253</td>
</tr>
<tr>
<td>Trajectory Data</td>
<td></td>
</tr>
<tr>
<td>Residential Location Choice in the Era of Shared Autonomous</td>
<td>254</td>
</tr>
<tr>
<td>Vehicles</td>
<td></td>
</tr>
<tr>
<td>Applying Census Data for Transportation: 50 Years of Transportation</td>
<td>255</td>
</tr>
<tr>
<td>Planning Data Progress</td>
<td></td>
</tr>
</tbody>
</table>
Title: Effects of additional capacity on vehicle kilometers of travel in the U.S.: Evidence from National Household Travel Surveys

Title: Selectivity Correction in Discrete-Continuous Models for the Willingness to Work as Crowd-Shippers and Travel Time Tolerance

Title: Reporting Quality of Travel and Non-Travel Activities: A Comparison of Three Different Survey Formats

Title: Workshop Synthesis: Household Travel Surveys in an Era of Evolving Data Needs for Passenger Travel Demand

Title: Estimation of a Nonseparable Heterogeneous Demand Function with Shape Restrictions and Berkson Errors

Title: Development of the TRAISI Web Survey Builder: Designing to Reduce Bias and Respondent Burden in Household Travel Surveys

Title: An Empirical Assessment of the Complexity and Realism of Synthetic Social Contact Networks

Title: Travel time use over Five Decades

Title: Incorporating Long-Distance Travel into Transportation Planning in the United States

Title: Area Sampling

Title: Dynamic Ride Sharing using Traditional Taxis and Shared Autonomous Taxis: A Case Study of NYC

Title: Big Data Fusion to Estimate Driving Adoption Behavior and Urban Fuel Consumption

Title: Hands Off the Wheel in Autonomous Vehicles?: A Systems Perspective on over a Million Miles of Field Data

Title: A High-Injury Network for Atlanta: How are Severe and Fatal-Injury Crashes Concentrated on Atlanta’s Streets?

Title: The Exploration of Factors That Affect Travel Safety of Child Passengers

Title: Sturdy Inference and the Amelioration Potential For Driverless Cars: The Reduction of Motor Vehicle Fatalities due to Technology

Title: Work Zone Intrusion Report Interface Design

Title: “Complete Streets” Policies and Eliminating Pedestrian Fatalities

Title: The Post-Discharge Car Seat Challenge: An Investigation of Utilization and Feasibility

Title: Awareness of Vision Zero among United States’ Road Safety Professionals

Title: Evaluation of Surrogate Measures for Pedestrian Trips at Intersections and Crash Modeling

Title: Integrated Modeling Approach for Non-Motorized Mode Trips and Fatal Crashes in the Framework of Transportation Safety Planning

Title: Potential Effects of lowering the BAC limit on Injuries, Fatalities, and Costs

Title: Not all Crashes are Created Equal: Associations between the Built Environment and Disparities in Bicycle Collisions
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Total Costs from Non-fatal and Fatal Bicycle Crashes</td>
<td>281</td>
</tr>
<tr>
<td>in the USA: 1997–2013</td>
<td></td>
</tr>
<tr>
<td>Street Intersection Characteristics and Their Impacts on Perceived</td>
<td>282</td>
</tr>
<tr>
<td>Bicycling Safety</td>
<td></td>
</tr>
<tr>
<td>Investigating Proximity of Crash Locations to Aging Pedestrian</td>
<td>283</td>
</tr>
<tr>
<td>Residences</td>
<td></td>
</tr>
<tr>
<td>Child Passenger Safety</td>
<td>284</td>
</tr>
<tr>
<td>An Assessment of Traffic Safety Between Drivers and Bicyclists</td>
<td>285</td>
</tr>
<tr>
<td>Based on Roadway Cross-Section Designs and Countermeasures Using</td>
<td></td>
</tr>
<tr>
<td>Simulation</td>
<td></td>
</tr>
<tr>
<td>Aging Road User Survey and Crash Analysis to Identify Issues and</td>
<td>286</td>
</tr>
<tr>
<td>Applicable Improvement Strategies for Kansas Conditions</td>
<td></td>
</tr>
<tr>
<td>Self-driving Startup Nuro Delivers Safety Report to Feds</td>
<td>288</td>
</tr>
<tr>
<td>Understanding the Difference Between Safety and Access</td>
<td>289</td>
</tr>
<tr>
<td>Transit Planning</td>
<td>290</td>
</tr>
<tr>
<td>The Impacts of Built Environment Characteristics of Rail Station</td>
<td>290</td>
</tr>
<tr>
<td>Areas on Household Travel Behavior</td>
<td></td>
</tr>
<tr>
<td>Determining Transit Service Coverage by Non-Motorized Accessibility</td>
<td>291</td>
</tr>
<tr>
<td>to Transit: Case Study of Applying GPS Data in Cincinnati Metropoli-</td>
<td></td>
</tr>
<tr>
<td>tan Area</td>
<td></td>
</tr>
<tr>
<td>Can Public Transportation Compete with Automated and Connected Cars?</td>
<td>292</td>
</tr>
<tr>
<td>Multi-level Urban Form and Commuting Mode Share in Rail Station</td>
<td>293</td>
</tr>
<tr>
<td>Areas across the United States; A Seemingly Unrelated Regression</td>
<td></td>
</tr>
<tr>
<td>Approach</td>
<td></td>
</tr>
<tr>
<td>Can Metro Transit Reduce Driving? Evidence from Xi’an, China</td>
<td>294</td>
</tr>
<tr>
<td>Comparative Trip Generation Models of the US Households: With and</td>
<td>295</td>
</tr>
<tr>
<td>Without Heavy Rail System</td>
<td></td>
</tr>
<tr>
<td>Just Around the Corner: The Future of US Public Transportation</td>
<td>296</td>
</tr>
<tr>
<td>Associations between Public Transit Usage and Bikesharing Behaviors</td>
<td>297</td>
</tr>
<tr>
<td>in The United States</td>
<td></td>
</tr>
<tr>
<td>Transit in the 2000s: Where Does It Stand and Where Is It Headed?</td>
<td>298</td>
</tr>
<tr>
<td>Transit Fare Structure and Equity: Case of MARTA, Atlanta</td>
<td>299</td>
</tr>
<tr>
<td>A Transport Justice Evaluation of Employer-Based Transit Subsidies</td>
<td>300</td>
</tr>
<tr>
<td>Trade-offs between Headway, Fare, and Real-Time Bus Information</td>
<td>301</td>
</tr>
<tr>
<td>under different Weather Conditions</td>
<td></td>
</tr>
<tr>
<td>Elevating access: Comparing Accessibility to Jobs by Public Transport</td>
<td>302</td>
</tr>
<tr>
<td>for Individuals With and without a Physical Disability</td>
<td></td>
</tr>
<tr>
<td>Public Transit in America 2017</td>
<td>303</td>
</tr>
<tr>
<td>Does Investing in Rail Transit Benefit the Poor? A Comparative Study</td>
<td>304</td>
</tr>
<tr>
<td>of Rail and Bus Travel by Low-Income Households in the California</td>
<td></td>
</tr>
<tr>
<td>Household Travel Survey</td>
<td></td>
</tr>
<tr>
<td>The Impact of Oil Boom and Bust Cycles on Western North Dakota</td>
<td>305</td>
</tr>
<tr>
<td>Factors Affecting Travel Demand by Bus: An Empirical Analysis at U.S.</td>
<td>306</td>
</tr>
<tr>
<td>Metropolitan Statistical Area Level</td>
<td></td>
</tr>
</tbody>
</table>
9.18 Title: Immigration, Income, and Public Transit Perceptions: Findings from an Intercept Survey .......................................................... 307
9.19 Title: Urban Decongestion Solution: Expansion of Light Rail Transit . . 308
9.20 Title: Understanding the Effects of Demographic and Socio-Economic Factors on Public Transit Ridership Trends .................................. 309
9.21 Title: Productivity in Transit: A New Measure of Labor Productivity for Urban Transit Systems .......................................................... 310
9.22 Title: First and Last Mile Assessment For Transit Systems ................. 311
9.23 Title: Services like UberPool are making traffic worse, study says ....... 312
9.24 Title: Calhan Connection bringing public transportation to rural El Paso County ................................................................................. 313
9.25 Title: 10 Shocking Takeaways on Public Transit and Commuting From a Month in Cleveland Without a Car ............................................. 314

10 Travel Behavior 315
10.1 Title: Does Context Matter? A Comparative Study Modelling Autonomous Vehicle Impact on Travel Behaviour for Germany and the USA, ........ 315
10.2 Title: Metropolitan Size and the Impacts of Telecommuting on Personal Travel ............................................................................... 316
10.3 Title: Understanding Urban Travel Behaviour by Gender for Efficient and Equitable Transport Policies ................................................. 317
10.4 Title: Transportation Impacts of Affordable Housing: Informing Development Review With Travel Behavior Analysis .............................. 318
10.5 Title: Estimating Revenue Neutral Mileage-Based Fees For Urban And Rural Households In Eight Western States ................................. 319
10.6 Title: The Relationship Between Urban Environment and Travel Behav-

ior ............................................................................................................. 320
10.7 Title: Does Telecommuting Promote Sustainable Travel and Physical Activity? ................................................................. 321
10.8 Title: An Analysis of the Relationship between Land Use and Weekend Travel: Focusing on the Internal Capture of Trips ......................... 322
10.9 Title: Ridehail Revolution: Ridehail Travel and Equity in Los Angeles ... 323
10.10 Title: Are Activity Patterns Stable or Variable? Analysis of Three-Year Panel Data ............................................................................. 324
10.11 Title: Perceptions and Preferences of Autonomous and Shared Autonomous Vehicles: A Focus on Dynamic Ride-Sharing ......................... 325
10.12 Title: Examining the Relationship between Different Urbanization Settings, Smartphone use to Access the Internet and Trip Frequencies . . 327
10.13 Title: Analyzing Destination Choices of Tourists and Residents from Location Based Social Media Data ................................................. 328
10.14 Title: Getting Paid to Commute: Will it Work? ..................................... 329
10.15 Title: Microsimulation of Activity Participation, Tour Complexity, and Mode Choice within an Activity-Based Travel Demand Model System . 330
10.16 Title: Modality, Activity Participation and Well-being: Evidence from Commuters in Beijing .......................................................... 331
10.43 Title: Average vehicle occupancy in US remains unchanged from 2009
to 2017 ................................................................. 359
10.44 Title: US households took fewer vehicle trips in 2017 ................. 360
10.45 Title: Nearly 60% of all vehicle trips in US in 2017 were less than six miles361
10.46 Title: New ASU Research Shows Impacts and Trends in Ride-Hailing . 362
10.47 Title: Ride-hailing not pushing households to abandon cars .......... 363
10.48 Title: Daily Vehicle Miles traveled in US Varies with the Number of
Household Vehicles ................................................ 364

11 Trend Analysis and Market Segmentation ................................ 365
11.1 Title: Evaluating Effects of Future Shared Mobility and Electrification
Trends on Key Intermediate Indicator of Aluminum Transportation De-
mand: US Vehicle Fleet Size ................................................. 365
11.2 Title: Dynamic Ride-sharing and Fleet Sizing for a System of Shared
Autonomous Vehicles in Austin, Texas ............................... 366
11.3 Title: A Hazard-based Approach to Modelling the Effects of Online
Shopping on Intershopping Duration ................................. 367
11.4 Title: Shared Autonomous Vehicles and their Potential Impacts on House-
hold Vehicle Ownership: An Exploratory Empirical Assessment ...... 368
11.5 Title: The Impact of Private Autonomous Vehicles on Vehicle Owner-
ship and Unoccupied VMT Generation ............................. 369
11.6 Title: Ridesourcing, the Sharing Economy, and the Future of Cities ... 370
11.7 Title: Trends Found by the 2017 National Household Travel Survey
May Surprise You ......................................................... 371
11.8 Title: Transportation Capital and Its Effects on the US Economy: A Gen-
eral Equilibrium Approach ............................................. 372
11.9 Title: Impacts of Transit and Walking Amenities on Robust Local Knowl-
dge Economy ............................................................... 373
11.10 Title: The Great Divide: What Consumers Are Buying vs. The Invest-
ments Automakers & Suppliers Are Making in Future Technologies,
Products & Business Models ............................................ 374
11.11 Title: The Ongoing Transformation of the Global Transportation Sys-
tem: A US DOT Volpe Center Thought Leadership Series .......... 375
11.12 Title: Defining The Sharing Economy, Part I: Excess Capacity ......... 376
11.13 Title: Americans’ Plans for Acquiring and Using Electric, Shared, and
Self-Driving Vehicles and Costs and Benefits of Electrifying and Au-
tomating US Bus Fleets .................................................. 377
11.14 Title: Can Tolling Help Everyone? Estimating the Aggregate and Dis-
tributional Consequences of Congestion Pricing ..................... 378
11.15 Title: Trends in Taxi Use and the Advent of Ridehailing, 1995–2017:
Evidence from the US National Household Travel Survey ......... 379
11.16 Title: Influence of Choice Experiment Designs on Eliciting Preferences
for Autonomous Vehicles ............................................... 380
11.17 Title: Analyzing the Dynamic Ride-sharing Potential for Shared Au-
tonomous Vehicle Fleets using Cellphone Data from Orlando, Florida . 381
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts of Renewable Hydrogen Production from Wind Energy in Electricity Markets on Potential Hydrogen Demand for Light-Duty Vehicles</td>
<td>382</td>
</tr>
<tr>
<td>An Empirical Analysis of Post-work Grocery Shopping Activity Duration using Modified Accelerated Failure Time Model to differentiate Time-Dependent and Time-Independent Covariates</td>
<td>383</td>
</tr>
<tr>
<td>The Interaction between E-Shopping and Store Shopping: Empirical Evidence from Nanjing, China</td>
<td>384</td>
</tr>
<tr>
<td>Age, Autos, and the Value of a Statistical Life</td>
<td>385</td>
</tr>
<tr>
<td>Transportation Infrastructures and Socioeconomic Statuses: A Spatial Regression Analysis at the County Level in the Continental United States, 1970–2010</td>
<td>386</td>
</tr>
<tr>
<td>Quantifying the Benefits of the Introduction of the Hybrid Electric Vehicle</td>
<td>387</td>
</tr>
<tr>
<td>Professional Sporting Events and Traffic: Evidence from U.S. Cities</td>
<td>388</td>
</tr>
<tr>
<td>Time of Use Price based Vehicle to Grid Scheduling of Electric Vehicle Aggregator for Improved Market Operations</td>
<td>389</td>
</tr>
<tr>
<td>From Census Tracts to Local Environments: An Egocentric Approach to Neighborhood Racial Change</td>
<td>390</td>
</tr>
<tr>
<td>Income Growth and the Distributional Effects of Urban Spatial Sorting</td>
<td>391</td>
</tr>
<tr>
<td>Technology Adoption and Critical Mass: The Case of the U.S. Electric Vehicle Market</td>
<td>392</td>
</tr>
<tr>
<td>Measuring Long-Run Price Elasticities in Urban Travel Demand</td>
<td>393</td>
</tr>
<tr>
<td>US households are holding on to their vehicles longer</td>
<td>394</td>
</tr>
<tr>
<td>Average vehicle age rises; car shoppers buy used, delay new purchases</td>
<td>395</td>
</tr>
</tbody>
</table>
1. Bicycle and Pedestrian Studies

1.1. Title: Middle Modalism: The Proliferation of E-Bikes and Implications for Planning and Urban Design

Authors: Healy, J. and Chisholm, D.

Abstract: Motorized bicycles are different from non-motorized bicycles. They have greater range, cost, and weight as well as higher average and top speeds. For this reason, powered bikes, a type of Light Electric Vehicle (LEV), require consideration by urban planners and designers. Key differences for urban planners include presumed larger bike-sheds — the potential capture area for trips around any given destination and higher speeds, which will affect the design of shared “bike” facilities. As of yet, the planning community has not developed specialized treatments and approaches for LEVs.

Subject Areas: E-Bikes; Non-motorized bicycles; Planning

1.2. Title: Can the Built Environment Explain Gender Gap in Cycling? An Exploration of University Students’ Travel Behavior in Toronto, Canada

Authors: Mitra, R. and Nash, S.

Abstract: The benefits of cycling as a healthier and more sustainable transportation alternative to private automobile is emphasized in both literature and policy. One key policy challenge in improving cycling rates is the significant gender gap in cycling that exists across urban regions in North America. In this study, travel behavior of >10,000 students attending four universities in Toronto, Canada, was analyzed to explore gender-based differences in cycling uptake. The mode share for cycling was higher for non-commute trips (9%) when compared to commuting trips to universities (7.6%). In addition, men had higher cycling rates than women, for both commute and non-commute trips. Results from binomial logistic regression models indicate that the built environment-related correlates were different between male and female students, and between commute and non-commute trips. Access to bicycle lanes or cycle tracks was found to increase the odds of female commuter cycling. This effect, however, was moderate in the neighborhoods with higher land use mix. Further, high-speed traffic was a significant barrier to cycling among female commuters. Noticeably, our analysis did not find major gender-based differences in the coefficients relating to travel attitudes and preferences. The findings provide a Canadian comparison to the limited international research on this topic, as well as offer new insights particularly relating to cycling for non-commute trips. The results identify potential avenues for policy intervention regarding the promotion of healthy and sustainable travel behavior among post-secondary students, and more broadly, the millennial generation.

Subject Areas: Commute; Cycling Facilities; Millennials; Non-Commute; Post-Secondary Students; Travel Attitudes

1.3. Title: Impact of County-Level Built Environment and Regional Accessibility on Walking: A Washington, DC-Baltimore Case Study

Authors: Mahmoudi, J. and Zhang, L.

Abstract: Existing research on built environment’s impact on nonmotorized travel behavior has focused on neighborhood-level factors. However, because people live and work at a regional scale — using transit and cars to access jobs and other destinations — it can be hypothesized that a region’s built environment can also be influential in nonmotorized travel behavior. This study examines the role of county-level built environment and regional accessibility in walking by developing mixed-effects models applied to household data from the Washington, DC and Baltimore metropolitan areas. The results indicate that in addition to neighborhood-level built environment, county-level built environment and regional accessibility can affect walking travel behavior by residents. The findings suggest that land-use policies to promote walking will not be fully effective if only considered at the neighborhood level. More effective land-use policies are those that consider the overall physical form of urban areas, including the composition of population and employment, the extent of street network connectivity, and regional accessibility across an entire metropolitan area.

Subject Areas: Built environment; Walking; Landuse; Nonmotorized travel behavior

1.4. Title: Why do People like Bicycling? Modeling affect toward Bicycling

Authors: Xing, Y., Volker, J. and Handy, S.

Abstract: Studies show that the way an individual feels about bicycling – the degree to which they like bicycling – is an important predictor of whether or not they bicycle. But why do some people like bicycling and others don’t? This study explores factors that may influence an individual’s liking of bicycling, or more formally, their bicycling affect. We analyze a rich dataset from a cross-sectional survey of residents of six small U.S. cities using an ordered logit model. Results show that bicycling behavior has the strongest association with liking bicycling, with bicycling constraints following as the second most important factor. Individual cognitions, including perceptions and normative beliefs, also play important roles in predicting bicycling affect. Individual measures of the physical environment do not correlate with liking of bicycling, but the perception that biking to various destinations is safe does. Social environment factors influence liking of bicycling as well. Longitudinal research is needed to better understand the reciprocal relationship between bicycling affect and bicycling behavior as well as the effect over time of factors such as the physical environment. Nevertheless, this study offers an initial understanding of the potential determinants of bicycling affect that provides a starting point for further research as well as direction for the development of policies for getting more people on bicycles.

Subject Areas: Bicycling; Cycling; Attitude formation; Affect; Liking; Behavior

Title: High Impact Prioritization of Bikeshare Program Investment to Improve Underserved Communities’ Access to Jobs and Essential Services

Authors: Niemeier, D. and Qian, X.

Abstract: Bikeshare programs are increasingly popular in the United States, and they are an important part of sustainable transportation systems. They offer an important alternative mode choice for many types of last mile trips. Most of the current research on bikeshare focuses on bikeshare benefits (e.g., how to replace auto trips with bike trips and reduce greenhouse-gas emissions) and bikeshare system management (e.g., bike repositioning between stations). Far less attention has been paid to the programmatic potential for providing greater access to jobs and essential services for underserved communities. To date, there is virtually no quantitative research aimed at designing bikeshare systems for underserved communities. We develop a new spatial index that identifies bikeshare station locations exhibiting a high potential for providing service for underserved communities. The index can: 1) facilitate the identification of priority areas for bikeshare investment based on current infrastructure and the potential for increased job or essential service access; 2) inform the siting of bikeshare stations and investment in bike infrastructure to better assist underserved populations, and finally 3) provide an estimate of the potential for improved job and social services access via bike-to-transit.

Subject Areas: Bikeshare programs; Sustainable transportation systems; Spatial index

1.6. Title: Cycling in Small Suburban Communities: A Case Study of Georgetown, TX

Author: Li, Q.

Abstract: Small communities have natural advantages in promoting cycling: Smaller geographic scale, major destinations within biking distances, and relatively low volumes of vehicle traffic. Davis, CA and Boulder, CO are known exemplary cycling-friendly communities in the United States. In Texas, however, cycling in small communities remains rare as a transportation means. This study aimed at understanding the driving factors for cycling in Texas suburban communities. The report presents a case study of Georgetown, a suburban city in the Austin Metropolitan Area in Texas. Georgetown is contemplating a Bike Master Plan to address the growing interest in and concerns over cycling in the community. A survey on cycling in Georgetown was conducted in fall 2016, for which this author was a member of the survey team. The survey included two parts, an online version of questionnaire and an onsite version for environmental audits, covering the following main topics: public opinions on cycling, cycling behavioral characteristics, environmental/infrastructure conditions for cycling. The report analyzes survey results and discusses opportunities and challenges facing Georgetown to cycling. The study findings help inform the Bike Master Plan effort by Georgetown, TX planners. Lessons learned from the Georgetown study are also valuable to the state-wide endeavor to promote cycling, particularly in small communities in Texas.

Subject Areas: Small suburban cities; Cycling; Texas; Senior people cycling; Characteristics

1.7. Title: Pedestrians’ Receptivity Toward Fully Automated Vehicles: Research Review and Roadmap for Future Research

Authors: Deb, S., Rahman, M.M., Strawderman, L.J. and Garrison, T.M.,

Abstract: This paper summarizes and synthesizes the existing literature relevant to pedestrian receptivity toward Fully Automated Vehicles (FAVs). Objectives of this review are to identify research gaps that need to be filled and to propose a roadmap for future research. Since FAVs are operated by software and hardware, with no human driver required, interactions between other road users and FAVs must be understood, and potential risks must be addressed. This is especially true for pedestrians, who often exhibit unpredictable behavior and are one of the most vulnerable road-user groups. A comprehensive review was conducted of 1) different aspects of pedestrian interaction with forthcoming fully automated vehicles, and 2) the existing research approaches (surveys and simulator studies) for investigating risky pedestrian behavior as well as public acceptance of fully automated vehicles. The review identified three major gaps in pedestrian research: 1) lack of a pedestrian behavior questionnaire for FAV research, 2) lack of a validated pedestrian simulator for FAV research, and 3) lack of research investigating pedestrian design suggestions for FAVs. A future research roadmap to facilitate investigating pedestrian receptivity toward FAVs was designed. Achieving pedestrian acceptance of FAVs will require investigation of pedestrian risks and needs by transportation researchers and communication of the results to vehicle manufacturers and regulatory agencies. This review will be useful to transportation researchers and automated vehicle manufacturers to help guide planning for future design and production of FAVs in order to ensure their successful implementation.

Subject Areas: Pedestrian behavior questionnaire; Autonomous vehicles; Human-automation interaction; Simulation; Virtual reality (VR)

1.8. Title: Bicyclist’s Perceived Level of Comfort in Dense Urban Environments: How do Ambient Traffic, Engineering Treatments, and Bicyclist Characteristics Relate?

Authors: Abadi, M.G. and Hurwitz, D.S.

Abstract: In dense urban environments, truck loading zones introduce multimodal conflicts that could decrease the bicyclist’s perceived level of comfort (PLOC), potentially reducing bicycle mode share. This study investigated the PLOC of bicyclists near urban loading zones, according to different levels of ambient traffic (low traffic volume, high traffic volume, and truck traffic), bicycle lane pavement markings (white lane markings, solid green, and dashed green), and traffic signs (no sign or warning sign). An online survey was designed and randomly distributed to 10,000 potential participants. A total of 342 participants successfully completed the survey. Repeated-measures ANOVA results indicated that when bicycling on a conventionally striped bike lane, truck traffic had the most significant effect on bicyclist PLOC, decreasing it by more than 42%. Pavement markings were more effective than traffic signs at improving bicyclist PLOC, but no difference was observed between solid and dashed green lane markings. Finally, the results of cluster analysis indicated that the effect of gender and experience on bicyclist PLOC varied with different levels of traffic and engineering treatments. Women were more affected than men by the presence of a truck in the adjacent lane but they were also more prone to a considerable increase in PLOC values due to the implementation of engineering treatments. Findings of this study could inform future policies regarding transportation infrastructure design to support safer and more comfortable bicycling in dense urban environments.

Subject Areas: Truck loading zones; Bicyclist safety; Bicyclist perceived level of comfort; Dense urban environments

1.9. Title: Do Satisfying Walking and Cycling Trips Result in More Future Trips with Active Travel Modes? An Exploratory Study

Authors: De Vos, J., Schwanen, T., Van Acker, V. and Witlox, F.

Abstract: Previous studies have indicated that travel satisfaction – the experienced emotions during, and cognitive evaluation of, a trip – can be affected by travel mode choice and other trip characteristics. However, as satisfactory trips might improve a person’s attitude towards the used mode, persons may be more likely to use that same mode for future trips of the same kind. Hence, a cyclical process between travel mode choice and travel satisfaction might occur. In this paper we begin to analyse this process – using a structural equation modelling approach on cross-sectional data – for people who engage in walking and cycling for leisure trips in the Belgian city of Ghent. The focus on walking and cycling reflects recent studies indicating that active travel is often associated with the highest levels of travel satisfaction. Results of this exploratory analysis offer tentative support for the idea of a cyclical process: the evaluation of walking and cycling trips positively affects the respondents’ attitude towards the respective mode, which in turn has a positive effect on choosing that mode.

Subject Areas: Active travel; Residential location; Structural equation modelling; Travel mode choice; Travel satisfaction; Travel-related attitudes

1.10. Title: Uber’s Plan to Rent Electric Bikes Is Good for Uber, Traffic, and You

Author: Grabar. H.

Abstract: Blog

Subject Areas: Electric Bike; Uber; Bikeshare

1.11. Title: Walking, Biking Trail is Important Part of Infrastructure

Author: Colby, A.

Abstract: Blog

Subject Areas: Walk; Bike; Trail; Transport infrastructure

1.12. Title: Infrastructure Bill should include Walking and Biking Trails

Author: Schwier, L.

Abstract: Blog

Subject Areas: Walk; Bike; Trail; Transport infrastructure

Availability: Schwier, L., 2018. Infrastructure Bill should include Walking and Biking Trails. The Brunswick Beacon. https://www.brunswickbeacon.com/content/infrastructure-bill-should-include-walking-and-biking-trails
1.13. Title: Pittsburgh Bike Share Program Expanding with New Stations

Author: Elliott, S.

Abstract: Blog

Subject Areas: Bike share program; Healthy Ride

1.14. Title: Biking to work this spring? It just got more expensive under the new tax law

Author: Malito, A.

Abstract: Blog

Subject Areas: Biking; Tax law; Workers; Lower-income

1.15. **Title:** Let’s get Connected

**Author:** Schwier, L.

**Abstract:** Blog

**Subject Areas:** Biking; Walking; Infrastructure Bill

**Availability:** Schwier, L., 2018. *Let’s get Connected.* StarnewsOnline. 
http://www.starnewsonline.com/opinion/20180508/letters-may-8-renowned-expert-on-shorelines-weighs-in-on-beach-cliffs
1.16. Title: OKC celebrates 13th annual Bike to Work Day on May 18.

Author: Sheldon, D.

Abstract: Blog

Subject Areas: Bike to work day; National Bike Month

http://city-sentinel.com/2018/05/okc-celebrates-13th-annual-bike-to-work-day-on-may-18/
1.17. Title: It's National Bike Month. Let's Ride Bikes!

Author: Horn, A.

Abstract: Blog

Subject Areas: National Bike Month; Bike trips

1.18. Title: Why Little Vehicles Will Conquer the City

Author: Schneider, B.

Abstract: Blog

Subject Areas: Dockless bikes; Electric Scooter

1.9. Title: Geographic and Urban-Rural Differences in Walking for Leisure and Transportation


Abstract: Introduction: Walking can serve many purposes, such as transportation (to get some place) or leisure (for fun, relaxation, or exercise); therefore, it provides many opportunities for people to be physically active. This study examines geographic and urban-rural differences in walking in the U.S.

Methods: Adult respondents (aged ≥18 years) to the 2015 National Health Interview Survey reported participation in and time spent (minutes per week) walking for transportation and leisure in the past week. In 2017, prevalence and time spent walking (among walkers) for any, leisure, and transportation walking were estimated by nine expanded regions and urban-rural designation.

Results: Prevalence of any walking ranged from 50.8% (East South Central) to 72.4% (Pacific); for leisure walking 43.9% (East South Central) to 60.6% (Pacific); and transportation walking 17.8% (East South Central) to 43.5% (New England). Among walkers, mean minutes spent walking per week ranged from 77.4 (East South Central) to 101.6 (Pacific); for leisure walking 70.5 (West South Central) to 85.9 (Mountain); and for transportation walking 47.4 (East South Central) to 66.4 (Middle Atlantic). Overall, there were urban-rural differences in prevalence of walking; however, differences depended on walking purpose and expanded region. Time spent walking was similar in urban and rural areas.

Conclusions: Regional differences in walking prevalence and time spent walking exist. Urban-rural differences in prevalence of walking differ based on region and purpose; however, rural areas had a lower prevalence of walking than urban areas regardless of purpose in southern regions. Opportunities exist to improve walking, particularly among southern regions with a focus on rural areas.

Subject Areas: Urban-Rural Differences; Leisure walking; Walking for transport

1.20. Title: Persistent Differences in Walking across the Socioeconomic Spectrum: Variations by Trip Purpose

Author: Mondschein, A.

Abstract: The relationship between socioeconomic status (SES) and walking remains underexamined, and prior research identifies multiple models of walking behavior. This research examines the distribution of walking across SES, using the 2001, 2009, and 2017 National Household Travel Surveys. Statistical models estimate walking rates and likelihoods by trip purpose, controlling for income, education, and other factors. Findings include less walking by middle-SES travelers and specific trip purposes favoring walking by high-SES adults in urban areas. Increases in walking between 2001 and 2017 are broad based, but persistent imbalances suggest the need for a more pluralistic view of walkability.

Subject Areas: Transportation; Walking; Trip Purpose; NHTS; Equity; Socioeconomic Status

https://journals.sagepub.com/doi/abs/10.1177/0739456X18796652
1.21. Title: A Comparison of Bicyclist Attitudes in Two Urban Areas in USA and Italy

Authors: Stamatiadis, N., Cafiso, S. and Pappalardo, G.

Abstract: Over the past 40 years, the number of people using bicycles as their primary means of transportation has increased significantly. Transportation agencies around the world now promote bicycling as a way to reduce pollution and traffic congestion. However, the lack of bicycling infrastructure in many cities could significantly impede the future growth of bicycle usage. This paper used a web survey to evaluate the attitudes and preferences of bicyclists in two cities: Lexington, Kentucky, USA and Catania, Sicily, Italy. The goal of the survey was to document impediments to bicycling in both cities, determine how infrastructure could be improved. Descriptive statistics and test of hypothesis were applied to the survey data to analyze participant responses and their level of agreement. Confirming previous research, respondents in both cities overwhelmingly cited lack of infrastructure as a major obstacle to bicycling more often. Respondents indicated that improving bicycle infrastructure and pavement conditions would result in an increased number of bicycle trips. While the survey findings lend support to the idea that bicyclists around the world harbor similar attitudes about what improvements are needed to increase cycling and enhance their experiences, local conditions and practices also influence perceptions about the relevance of specific issue.

Subject Areas: Bicyclist mobility; Bicyclist preferences; Infrastructure

1.22. Title: Walkability in the Connected and Automated Vehicle Era: A U.S. Perspective on Research Needs

Authors: Shay, E., Khattak, A.J. and Wali, B.

Abstract: Walkability and walking activity are of interest to planners, engineers, and health practitioners for their potential to improve safety, promote environmental and public health, and increase social equity. Connected and automated vehicles (CAVs) will reshape the built environment, mobility, and safety in ways we cannot know with certainty—but which we may anticipate will change the meaning of “walkability.” The CAV era may provide economic, environmental, and social benefits, while potentially disrupting the status quo. This paper considers the concept of walkability in light of the approaching transition to CAVs, considering literature in engineering, information technology, built environment, land use, and public health, to support a discussion on research needs. To add depth, we subject a collection of research papers and technical reports to text analytics.

Subject Areas: Walkability; Walking activity; Connected and automated vehicles (CAVs)

1.23. Title: Metropolis-Hasting based Expanded Path Size Logit Model for Cyclists’ Route Choice using GPS Data

Authors: Sobhani, A., Aliabadi, H.A. and Farooq, B.

Abstract: This study contributes to the field of cycling route choice by adopting the unprecedented combination of the Metropolis-Hastings (MH) path-sampling algorithm and the Expanded Path Size Logit (EPSL) model. The MH sampling approach is used to generate 15 alternative route choice sets for cyclists. The EPSL multivariate route choice framework is utilized to account for the correlation between sampled and non-sampled alternatives (joint MH-EPSL model). The data used in this paper is drawn from GPS data collected by the City of Toronto using a custom-built smartphone application in 2014–2015. The study focuses on non-work-related cycling trips (shopping, leisure, social and others) in downtown Toronto on weekdays. The estimated results indicate that the presence of bicycle lanes and road medians attractions and number of trees along the path have a positive impact on cyclist route choice. In general, cyclists prefer to take shorter routes on lower speed roads with less public transit stops especially during the evening rush hour, and less willing to take one-way streets, local roads, and steep road segments. These findings are useful to policy makers as well as transportation and urban designers when developing a cycling network aiming to attract more cyclists. Finally, our results indicate that the MH-EPSL model performance is an appropriate framework to study cyclists’ route choice decisions.

Subject Areas: Route choice; GPS data; Expanded Path Size Logit; Metropolis-Hastings; Cyclists

1.24. **Title:** Measuring the Wind through your Hair? Unravelling the Positive Utility of Bicycle Travel

**Author:** Krizek, K.J.

**Abstract:** The intrinsic qualities of bicycling in urban areas are oft-asserted and difficult to measure. These benefits may therefore be undervalued. Considering the majority of research of bicycling in cities has captured functional characteristics (e.g., travel time, cost, health), less is known of how bicycling provides intrinsic benefits (e.g., the feeling of wind in one’s hair, social cohesion, stress relief) and how such benefits could be incorporated into travel analysis. I argue how and why access to a destination by bicycling can be more valuable than access to destinations by other modes—largely owing to intrinsic qualities—and point to opportunities and challenges for measurement. Drawing from the idea that travel often times has a positive utility, coupled with the emerging research base that points to how bicycling advances emotional well-being, I extend a framework based on measuring access to destinations and point to future challenges and opportunities in doing so.

**Subject Areas:** Bicycle; Benefits; Positive utility

1.25. Title: User Preferences of Bicycle Infrastructure

Author: Clark, C.

Abstract: Cycling for transportation is experiencing a resurgence in much of the U.S. Consequently, this is becoming a hot topic of research, particularly when it comes to how we can make cycling safe. Still, most research studies bicyclists’ travel behaviors and preferences in areas with strong bicycling cultures. This thesis discusses the findings of focus groups and a survey (N=1221) deployed in six communities in Alabama and Tennessee, where cycling is not (yet) popular and/or widely adopted, a setting that is much more representative of the nation at large. Three of these communities, considered treatment sites, were in the process of adding major cycling facilities to their transportation systems. The other three communities, which were paired up with a treatment site with similar land use and demographic characteristics, were considered control sites, as no such plans were on the immediate horizon, thus creating a setting for a quasi-experimental design. Focus groups were conducted in each of the treatment sites, highlighting a number of issues related to perceived safety and personal comfort in using the new proposed infrastructure. Not surprisingly, the types of infrastructure that limited interaction with automobile through, turning, and parking traffic were found to be perceived as more desirable among cyclists in areas where drivers (and potential cyclists) are not used to heavy cycling adoption. The quantitative analysis includes linear regression models built on respondents’ reactions to images of bicycling infrastructure in terms of comfort, safety, and willingness to try, which confirmed preferences for more separated facilities and the deterrents introduced with adjacent parking. Results from this study provide useful insights into ways to maximize the return on investments, and design bike infrastructure that can attract patronage and be most successful in areas lacking a substantial bicycling population.

Subject Areas: Bicycle; Transportation; Travel behaviors; Infrastructure

https://smartech.gatech.edu/handle/1853/60317
1.26. Title: Help! New Guidance Available on Shared Bikes and Scooters

Author: Herrig, D.

Abstract: Blog

Subject Areas: Transportation; Bikeshare; Bicycle; Scooter; NHTS; FHWA


1.27. Title: Do bike lanes have to be white lanes?

Author: Herrig, D.

Abstract: Blog

Subject Areas: Bikelanes

1.28. Title: Spin cities: Bike- and scooter-sharing startups move forward in fits and starts

Author: O’Brien, K.J.

Abstract: Blog

Subject Areas: Bike-sharing; Scooter-sharing

1.29. **Title:** Novelty of Scooters Poses Serious Challenge to Cars’ Reign

**Author:** Bullard, N.

**Abstract:** Blog

**Subject Areas:** Scooter; Portland; Electric scooter pilot program; Car

1.30. Title: Meeting to focus on walking, biking benefits as you age

Author: Stayner, W.

Abstract: Blog

Subject Areas: Walking; Biking; Health benefits; Older adults

1.31. Title: CalAmp and PWS Expand Access to Personal Micro-Mobility

Author: CalAmp

Abstract: Blog

Subject Areas: Scooter sharing; Micromobility; Vehicle trips

1.32. Title: Mate X raises $10 million for its foldable electric bike

Author: Venturebeat

Abstract: Blog

Subject Areas: Electric bikes

1.33. Title: Car Companies rush to embrace Scooters and Bikes

Author: McFarland, M.

Abstract: Blog

Subject Areas: Car companies; Ford; Scooter; Bike

1.34. Title: Gotcha Unveils New Portfolio of E-Mobility Products

Authors: Romanski, P., White, E., Deniz, Y., McMilan, L. and Abud, C.

Abstract: Blog

Subject Areas: Gotcha; E-mobility; scooter; bike; e-ride share vehicle

Gotcha Unveils New Portfolio of E-Mobility Products
1.35. Title: Re-legalizing Fourplexes Would Also Be Fantastic for Bike Transportation

Author: Anderson, M.

Abstract: Blog

Subject Areas: Bicycle Transportation; Legalizing

2. Energy Consumption

2.1. Title: Modeling and Forecasting Household Energy Consumption and Related CO₂ Emissions Integrating UrbanSim And Transportation Models: An Atlanta Beltline Case Study

Authors: Wang, D. and Yuan, C.

Abstract: Reducing energy consumption and controlling greenhouse gas emissions are key challenges for urban residents. Because urban areas are complex and dynamic, affected by many driving factors in terms of growth, development, and demographics, urban planners and policy makers need a sophisticated understanding of how residential lifestyle, transportation behavior, land-use changes, and land-use policies affect residential energy consumption and associated CO₂ emissions. This study presents an approach to modeling and simulating future household energy consumption and CO₂ emissions over a 30-year planning period, using an energy-consumption regression approach based on the UrbanSim model. Outputs from UrbanSim for a baseline scenario are compared with those from a no-transportation-demand model and an Atlanta BeltLine scenario. The results indicate that incorporation of a travel demand model can make the simulation more reasonable and that the BeltLine project holds potential for curbing energy consumption and CO₂ emissions.

Subject Areas: Energy Consumption; Emissions; Land Use; Travel Demand; UrbanSim; Forecasts; Atlanta Beltline

https://www.tandfonline.com/doi/abs/10.1080/03081060.2018.1453917
2.2. Title: System and Method for Estimating and Predicting Vehicle Trip Energy Consumption

Authors: Trancik, J.E., Needell, Z.A. and McNerney, J.

Abstract: A system for estimating or predicting energy consumption for a trip of a personal includes a user facing portion and a back-end portion. The user facing portion includes a display and a user interface hosting a real-time application configured to receive travel information and present a received energy distribution via the display. The back-end portion includes a back-end database and an energy processor configured to access the back-end database. The energy processor includes a demand model module configured to produce a set of possible velocity histories and a set of possible ambient temperatures. A vehicle model module is configured to receive the velocity histories and ambient temperatures to provide the energy distribution or a probabilistic prediction of future energy consumption to the user facing portion.

Subject Areas: Energy consumption; Vehicle model module

2.3. Title: Relative Economic Competitiveness of Light-Duty Battery Electric and Fuel Cell Electric Vehicles.

Authors: Morrison, G., Stevens, J. and Joseck, F.

Abstract: This paper estimates battery electric (BEV) and hydrogen fuel cell electric vehicle (FCEV) costs from today through 2040 to explore the potential market size of each vehicle type. Two main tasks are performed. First, the total cost of ownership (TCO) – including vehicle purchase, fuel, maintenance, resale, and refueling inconvenience – is estimated for 77 light-duty vehicle (LDV) segments, defined by driving range and size class. Second, data on individual travel behavior is used to estimate the fraction of vehicle owners within each of the 77 segments. In 2020, BEVs are estimated to be the cheaper vehicle option in 79-97 percent of the LDV fleet and have a weighted average cost advantage of $0.41 per mile below FCEVs across all vehicle segments and drivers. However, costs of the two powertrains quickly converge between 2025 and 2030. By 2040, FCEVs are estimated to be less expensive than BEVs per mile in approximately 71-88 percent of the LDV fleet and have notable cost advantages within larger vehicle size classes and for drivers with longer daily driving ranges. This analysis demonstrates a competitive market space for both FCEVs and BEVs to meet the different needs of LDV consumers.

Subject Areas: Electric vehicles; Market segmentation; Fuel cell vehicles; Total cost of ownership; Hydrogen; Greenhouse gas abatement

2.4. Title: GIS-based Probabilistic Modeling of BEV Charging Load for Australia

Authors: Li, M., Lenzen, M., Keck, F., McBain, B., Rey-Lescure, O., Li, B. and Jiang, C.

Abstract: Due to the unknown spatio-temporal distribution of Battery Electric Vehicles (BEVs) charging load, introducing large quantities of BEVs in the transportation sector has drawn growing concerns about its negative impacts on the power grid system. Based on real-world vehicle driving survey data, this paper presents a deterministic and a probabilistic model to quantitatively investigate the spatio-temporal distribution of BEV charging load for Australia. Whilst the trip-chain-related travel parameters for the deterministic model are directly taken from travel survey data, those for the probabilistic model are generated by the k-Nearest-Neighbour (kNN) algorithm. The probabilistic model is validated and applied to simulate the spatio-temporal distribution of BEV load based on GISgridded data for Australia. We are able to distinguish different temporal BEV charging load distributions for weekdays and weekends, and a heavy spatial concentration in capital cities.

Subject Areas: Electric vehicle; GIS; Charging load; kNN model

2.5. Title: Planning for Electric Vehicle Needs by Coupling Charging Profiles with Urban Mobility

Authors: Xu, Y., Çolak, S., Kara, E.C., Moura, S.J. and González, M.C.

Abstract: The rising adoption of plug-in electric vehicles (PEVs) leads to the temporal alignment of their electricity and mobility demands. However, mobility demand has not yet been considered in electricity planning and management. Here, we present a method to estimate individual mobility of PEV drivers at fine temporal and spatial resolution, by integrating three unique datasets of mobile phone activity of 1.39 million Bay Area residents, census data and the PEV drivers survey data. Through coupling the uncovered patterns of PEV mobility with the charging activity of PEVs in 580,000 session profiles obtained in the same region, we recommend changes in PEV charging times of commuters at their work stations and shave the pronounced peak in power demand. Informed by the tariff of electricity, we calculate the monetary gains to incentivize the adoption of the recommendations. These results open avenues for planning for the future of coupled transportation and electricity needs using personalized data.

Subject Areas: Electric vehicle; Transportation; Mobility demands

2.6. Title: The Feasibility of Using V2G to Face the Peak Demand in Warm Countries

Authors: Almansour, I., Gerding, E. and Wills, G.

Abstract: As a result of the very difficult weather in Saudi Arabia during the summer, there is too high power peak demand in the grid and this is expected to increase in the next decade. To fix this problem, power consumers should participate in the power production. Vehicle-to-grid (V2G), one of the efficient sustainable technologies, can offer this opportunity. It is defined as a concept where electric vehicle (EV) provides electric to the grid when parked. This investigation looks at the feasibility of using V2G to mitigate the problem of highest electricity peak demand in the summer period in one of the warmest countries of the world (Saudi Arabia). We conduct a survey in order to serve this issue and we use information from Saudi Arabia electricity authority. We found that, V2G is a promising solution to the peak demand challenge in the summer in Saudi Arabia since there is about 80% of the sample interested in using V2G technology. Moreover, 90% of the participants used their vehicles less than 4 hours daily. Furthermore, in the summer period, most of the participants park their vehicles for the longest time between 13:00 to 18:00, which is the peak demand period.

Subject Areas: V2G; Peak demand

https://eprints.soton.ac.uk/417667/1/VEHITS_2018_9_CR.pdf
2.7. Title: Multi-agent Modeling and Analysis of EV Users’ Travel Willingness based on an integrated Causal/Statistical/Behavioral Model.


Abstract: An electric vehicle (EV) centred ecosystem has not yet been formed, the existing limited statistic data are far from enough for the analysis of EV users’ travel and charge behaviors, which however tends to be affected by many certain and uncertain factors. An experimental economics (EE) based simulation method can be used to analyze the behaviors of key participants in a system. However, it is restricted by the system size, experimental site and the number of qualified human participants. Therefore, this method is hard to be adopted for the behavioral analysis of a large number of human participants. In this paper, a new method combining a questionnaire statistics and the EE-based simulation is proposed. The causal relationship is considered in the design of the questionnaires and data extraction, then a multi-agent modeling integration method is introduced in the EE-based simulation, which enables the integration of causal/statistical/behavioral models into the multi-agent framework to reflect the EV users’ travel willingness statistically. The generated multi-agents are used to replace human participants in the EE-based simulation in order to evaluate EV users’ travel demands in different scenarios, and compare the differences of simulated or measured travel behaviors between potential EV users and internal combustion engine (ICE) vehicle users.

Subject Areas: Travel willingness; Questionnaire design; Multi-agent; Experimental economics; Causal analysis

2.8. Title: Improving Voltage Profile and Optimal Scheduling of Vehicle to Grid Energy based on a New Method

Authors: Nazarloo, A., Feyzi, M.R., Sabahi, M. and Bannae Sharifian, M.B.

Abstract: The electric vehicles (EVs), depending on the charging or discharging modes, can act as flexible loads or as flexible energy sources. Therefore, this paper proposes a method for achieving the following objectives: improvement the voltage profile of the point of common coupling (PCC), control the charging and discharging of EVs in an appropriate scheduling so that at the end of the charging and discharging process all EVs are fully charged, improvement the profiles of active and reactive loads based on the peak shaving and the valley filling, charging rate control and energy management for the economic justification of vehicle to grid (V2G) technology based on the proposed method. Considering that the penetration of EVs and state of charge (SOC) of battery at any time is random, this paper extracts and analyzes the data that is available through national household travel surveys (NHTS). In order to determine the desired parameters, two stochastic algorithms are integrated with Monte Carlo simulations. To prove the performance superiority of the proposed method over conventional methods under high EVs-penetration, an IEEE 14-bus system is used for real-time simulation.

Subject Areas: Electric Vehicles; Vehicle to Grid Energy

2.9. Title: Battery Technologies for Mass Deployment of Electric Vehicles

Authors: Brooker, P., Qin, N., Dubarry, M. and Center, F.S.E.

Abstract: Electric vehicle (EV) batteries have significantly improved since their inception. However, lifetime of these batteries is still strongly dependent on the usage profiles. This report describes aspects of EV battery utilization, and their impact on battery lifetime. Additionally, this report will describe potential future uses of EV batteries, particularly in vehicle-to-grid applications.

Subject Areas: Electric Vehicles; Vehicle to Grid

file:///Users/Apara/Downloads/dot_35686_DS1.pdf
2.10. Title: Voltage-dependent Modelling of Fast Charging Electric Vehicle Load Considering Battery Characteristics

Authors: Shukla, A., Verma, K. and Kumar, R.

Abstract: Electric vehicle (EV) integration into the power grids is increasing rapidly. To analyse the effect of charging of EVs on the distribution system, most of the literature considered EV load as constant power load (CPL) which do not represent the exact behaviour of these uncertain loads. An accurate EV load modelling is developed by determining the relationship between power consumption by EV, grid voltage and state of charges of fast charging EV load. The derived relationship is validated by simulating a realistic fast charging system to obtain a battery charging behaviour characteristics and is curve fitted on standard exponential load model. Further the impact of stochastic 24-h load profile of fast charging EVs considering the exponential load model is investigated on IEEE 123 bus distribution system and is compared with the constant impedance-constant current-constant power (ZIP) load model and CPL model. The stochastic 24-h load is developed using queuing analysis-based method. The results show that the exponential load model is the better representation of fast charging EV load and 10.19% of the reduction in annual energy demand and 11.19% of the reduction in annual energy loss is observed for exponential load model compared to the existing CPL model.

Subject Areas: Electric Vehicle charging; Battery; Power grids; Distribution networks

http://digital-library.theiet.org/content/journals/10.1049/iet-est.2017.0096
2.11. Title: A Charging Pricing Strategy of Electric Vehicle Fast Charging Stations for the Voltage Control of Electricity Distribution Networks


Abstract: With the increasing number of electric vehicles (EVs), the EV fast charging load will significantly affect the voltage quality of electricity distribution networks. On the other hand, EVs have potentials to change the choices of charging locations due to the incentives from the variations of charging prices, which can be considered as a flexible response resource for electricity distribution networks. In this paper, a charging pricing strategy of EV fast charging stations (FCSs) was developed to determine the pricing scheme for the voltage control of electricity distribution networks, which consisted of a simulation model of EV mobility and a double-layer optimization model. Considering the travel characteristics of users, the simulation model of EV mobility was developed to accurately determine the fast charging demand. Taking the total income of FCSs and the users’ response to the pricing scheme into account, the double-layer optimization model was developed to optimize the charging pricing scheme and minimize the total voltage magnitude deviation of distribution networks. A test case was used to verify the proposed strategy. The results show that the spatial distribution of EV fast charging loads was reallocated by the proposed charging pricing scheme. It can also be seen that the proposed strategy can make full use of the response capacity from EVs to improve the voltage profiles without decreasing the income of the FCSs.

Subject Areas: Electric vehicle (EV); Electric vehicle mobility; Charging pricing strategy; Voltage control of electricity distribution networks

2.12. Title: Implication of Replacing the Federal and State Fuel Taxes with a National Vehicle Mile Traveled Tax

Authors: Wang, Y. and Miao, Q.

Abstract: A Vehicle Miles Traveled (VMT) tax is often proposed to replace fuel taxes for financing the nation’s highway and road network. In this paper, we investigate households’ driving response to driving cost changes depending on their vehicle choices. Using the empirical estimates, we simulate the vehicle usage, tax burdens, and total tax revenues generated under a possible nationwide revenue-neutral flat VMT tax. Our results confirm that, compared to the current gasoline tax, a revenue-neutral flat VMT tax can be a more stable tax revenue source. We estimate that a 50 percent increase in average miles per gallon (MPG) would lead to a 28 percent decrease in the total revenues raised by the current gasoline tax, while the same amount of increase in fuel economy would increase the VMT tax revenues by 4.4 percent (all relative to the 2009 baseline). In the meantime, we find no significant difference between the two types of tax in their total revenues, when the pre-tax gasoline prices fluctuate by different magnitudes. A VMT tax would be slightly more regressive than the gasoline tax, but the difference is negligible. Overall, our simulation shows that VMT tax could serve as a viable alternative to gasoline taxes.

Subject Areas: Vehicle miles traveled (VMT); VMT tax; Gasoline tax; Tax equity

2.13. Title: Spatial and Temporal Optimization Strategy for Plug-In Electric Vehicle Charging to Mitigate Impacts on Distribution Network

Authors: Gong, L., Cao, W., Liu, K., Zhao, J. and Li, X.

Abstract: The large deployment of plug-in electric vehicles (PEVs) challenges the operation of the distribution network. Uncoordinated charging of PEVs will cause a heavy load burden at rush hour and lead to increased power loss and voltage fluctuation. To overcome these problems, a novel coordinated charging strategy which considers the moving characteristics of PEVs is proposed in this paper. Firstly, the concept of trip chain is introduced to analyze the spatial and temporal distribution of PEVs. Then, a stochastic optimization model for PEV charging is established to minimize the distribution network power loss (DNPL) and maximal voltage deviation (MVD). After that, the particle swarm optimization (PSO) algorithm with an embedded power flow program is adopted to solve the model, due to its simplicity and practicality. Last, the feasibility and efficiency of the proposed strategy is tested on the IEEE 33 distribution system. Simulation results show that the proposed charging strategy not only reduces power loss and the peak valley difference, but also improves voltage profile greatly.

Subject Areas: Plug-in Electric Vehicles; Coordinated Charging; Distribution Network; Trip Chain; Particle Swarm Optimization; National Household Trip Survey Data


Authors: Kheradmand-Khanekehdani, H. and Gitizadeh, M.

Abstract: Environmental concerns, limitations of fossil fuels and their pollution are among the most important challenges of societies today. To overcome these challenges, the penetration rate of electric vehicles and renewable energy resources has highly increased. But the use of plug-in hybrid electric vehicles with unmanaged charging exerts a negative impact on the electric grid reliability. The current study presents a comprehensive investigation of the reliability of distribution grid based on stochastic behavior of plug-in hybrid electric vehicles and renewable energy resources. Moreover, a new method is introduced for grid well-being management in the presence of plug-in hybrid electric vehicles. The proposed method includes the managed charging and vehicle to grid scenarios and is tested through improved of Roy Billinton test system bus 2. The presented method manages the plug-in hybrid electric vehicles charging and power injection to the grid using system well-being analysis. The simulation results indicate that adequacy of distribution grid is put at risk state in the presence of plug-in hybrid electric vehicles with unmanaged charging, whereas the use of the proposed method not only does not deteriorate the system reliability but also improves well-being criteria and adequacy indices.

Subject Areas: Plug-in hybrid electric vehicle; Managed charging; Vehicle-to-grid’ Well-being assessment; Adequacy evaluation; Monte Carlo simulation

2.15. Title: Alternative Utility Factor Versus the SAE J2841 Standard Method for PHEV and BEV Applications

Authors: Paffumi, E., De Gennaro, M. and Martini, G.

Abstract: This article explores the potential of using real-world driving patterns to derive PHEV and BEV utility factors and evaluates how different travel and recharging behaviours affect the calculation of the standard SAE J2841 utility factor. The study relies on six datasets of driving data collected monitoring 508,607 conventional fuel vehicles in six European areas and a dataset of synthetic data from 700,000 vehicles in a seventh European area. Sources representing the actual driving behaviour of PHEV together with the WLTP European utility factor are adopted as term of comparison. The results show that different datasets of driving data can yield to different estimates of the utility factor. The SAE J2841 standard method results to be representative of a large variety of behaviours of PHEVs and BEVs’ drivers, characterised by a fully-charged battery at the beginning of the trip sequence, thus being representative for fuel economy and emission estimates in the early phase deployment of EVs, charged at home and overnight. However the results show that the SAE J2841 utility factor might need to be revised to account for more complex future scenarios, such as necessity-driven recharge behaviour with less than one recharge per day or a fully deployed recharge infrastructure with more than one recharge per day.

Subject Areas: Utility factor; GPS driving patterns; Databases; Electric vehicles; Plug-in hybrid electric vehicles; SAE J2841

2.16. Title: Clean Vehicles as an enabler for a Clean Electricity Grid

Authors: Coignard, J., Saxena, S., Greenblatt, J. and Wang, D.

Abstract: California has issued ambitious targets to decarbonize transportation through the deployment of electric vehicles (EVs), and to decarbonize the electricity grid through the expansion of both renewable generation and energy storage. These parallel efforts can provide an untapped synergistic opportunity for clean transportation to be an enabler for a clean electricity grid. To quantify this potential, we forecast the hourly system-wide balancing problems arising out to 2025 as more renewables are deployed and load continues to grow. We then quantify the system-wide balancing benefits from EVs modulating the charging or discharging of their batteries to mitigate renewable intermittency, without compromising the mobility needs of drivers. Our results show that with its EV deployment target and with only one-way charging control of EVs, California can achieve much of the same benefit of its Storage Mandate for mitigating renewable intermittency, but at a small fraction of the cost. Moreover, EVs provide many times these benefits if two-way charging control becomes widely available. Thus, EVs support the state’s renewable integration targets while avoiding much of the tremendous capital investment of stationary storage that can instead be applied towards further deployment of clean vehicles.

Subject Areas: Electric Vehicles (EVs); Renewable generation; California

2.17. Title: Landscape Analysis: The Electric Car (Is it a Viable Alternative?)

Authors: Janzen, H., Kancherla, D.Y., Paneerselvam, S., Reddy, S.R. and Daim, T.U.

Abstract: N.A.

Subject Areas: Cleaner air; Renewable energy

https://link.springer.com/chapter/10.1007/978-3-319-68987-6_10
2.18. Title: Changes in Time Use and their Effect on Energy Consumption in the United States

Authors: Sekar, A., Williams, E. and Chen, R.

Abstract: Technological advancements and socio-economic trends are enabling rapid changes in lifestyle that influence energy use. This research tracks lifestyle changes in the United States through changes in times spent on different activities and measures the associated energy effects. We find that Americans are spending more time at home and correspondingly less time traveling and in offices and stores. We find that more time at home implies lower energy consumption due to reduced automobile travel and energy use in non-residential buildings. At the national scale, this research shows that time-based models would improve energy forecasts by capturing behavioral changes that current models fail to capture. Knowledge of such lifestyle trends can help prioritize energy efficiency policies of federal and state governments and utilities. For individuals, the research raises awareness of connections between lifestyle and energy use.

Subject Areas: Energy Consumption; Energy efficiency policies

2.19. Title: Grid Integration of Large-Scale Electric Vehicles: Enabling Support through Power Storage

Authors: Jain, P. and Jain, T.

Abstract: This chapter presents the grid assistance opportunities through charging and discharging of electric vehicles (EV) and explores the technical and operational challenges in integrating the electric vehicle storage, a movable and changeable of its kind, with the power system. The initial step discusses the development of charging load curves of EVs based on mobility attributes and charging protocols. Researchers have also proposed the vehicle-to-grid (V2G) mode of operation of EVs in which a proportion of energy stored in the battery can be injected back into the grid at the peaking periods. Based on this, the second step discusses the evolution of V2G energy profiles with various discharge power levels for a defined mobility pattern. The heterogeneity in the vehicles as well as in the mobility behavior can further be incorporated to determine the grid-to-vehicle (G2V) and V2G power capabilities of the aggregation at different moments under varying penetrations of the electric vehicles.

The coordinated grid connection of EV aggregation can also be employed to provide short-term ancillary services like regulation, thereby increasing the power system reliability and side-by-side forming a revenue stream for the grid-connected vehicles for the contracts made in the competitive services market. Through coordinated charging and discharging of EVs, the controllability of the battery storage can also be utilized to achieve the control over the peak shaving, valley filling, and load leveling functions of the system operator. Finally, this chapter discusses the possible configuration of EV and electric power utility interfacing to manage the centrally dispatched EV aggregation, comprising system operator, vehicle aggregator, power supply equipment, and vehicle owner as the key participants.

Subject Areas: Electric Vehicles (EV); Vehicle-to-grid

2.20. Title: Do Electric Vehicles need Subsidies? Ownership Costs for Conventional, Hybrid, and Electric Vehicles in 14 US Cities

Authors: Breetz, H.L. and Salon, D.

Abstract: Battery electric vehicles (BEVs) are an important pathway for decarbonizing transportation and reducing petroleum dependence. Although one barrier to adoption is the higher purchase price, advocates suggest that fuel and maintenance savings can make BEVs economical over time. To assess this empirically, this paper analyzes the five-year Total Cost of Ownership (TCO) for conventional, hybrid, and electric vehicles in 14 U.S. cities from 2011 to 2015. Results show spatial variation due to differences in state and local policies, fuel prices, insurance and maintenance costs, depreciation rates, and vehicle miles traveled. Yet in nearly all cities, the BEV’s higher purchase price and rapid depreciation outweighed its fuel savings. Extensive sensitivity analyses highlight the impact of key parameters and show that both federal and state incentives were necessary for BEVs to be cost competitive. Future BEV cost competitiveness may improve if innovation and scaling lead to significantly reduced BEV purchase prices, but our analysis suggests that it will be challenging for BEVs to achieve unsubsidized cost competitiveness except in the most optimistic scenarios.

Subject Areas: Total cost of ownership; Battery electric vehicles; Hybrid vehicles; Resale value; Fuel economy

2.21. **Title:** Markov Chain Monte Carlo Simulation of Electric Vehicle Use for Network Integration Studies

**Authors:** Wang, Y. and Infield, D.

**Abstract:** As the penetration of electric vehicles (EVs) increases, their patterns of use need to be well understood for future system planning and operating purposes. Using high resolution data, accurate driving patterns were generated by a Markov Chain Monte Carlo (MCMC) simulation. The simulated driving patterns were then used to undertake an uncertainty analysis on the network impact due to EV charging. Case studies of workplace and domestic uncontrolled charging are investigated. A 99% confidence interval is adopted to represent the associated uncertainty on the following grid operational metrics: network voltage profile and line thermal performance. In the home charging example, the impact of EVs on the network is compared for weekday and weekend cases under different EV penetration levels.

**Subject Areas:** Electric vehicles; Markov Chain; Monte Carlo; Multi-place charging; Uncertainty

2.22. Title: Quantitative Calculation and Optimization of Demand for Electric Vehicle Charging Stations

Authors: Fan, R. and Zhang, W.

Abstract: The rapid development of electric vehicles (EVs) requires a reasonable plan in building charging stations. The number of charging stations should meet the charge demand of all users at least. Firstly, based on the statistics of CAAM, the bass diffusion model and the logistic regression forecast are used to obtain the EVs ownership in China in 2020. Secondly, based on the analysis of user trip data (NHTS), the expectation of the average daily mileage of electric vehicles is obtained, and is calculated as the daily average mileage with high reliability. Finally, analogous to the construction of gas stations and taking into account the user’s travel habits to classify users, taking the charging stations of the State Grid and the BYD E6 model as an example, the number of charging stations that China needs to build in 2020 is calculated in detail. The calculation method is scientific and can provide a scientific theoretical basis for construction.

Subject Areas: Electric vehicles; Charging Demand; Daily mileage

2.23. Title: The Impact of High Occupancy Vehicle (HOV) Lane Access on Hybrid-electric Vehicle Adoption: Evidence from US States

Author: Chen, F.

Abstract: In 2009, nine states in the United States allowed a solo driver in a hybrid vehicle access to high occupancy vehicle (HOV) lanes without restrictions. This policy was designed to be an effective incentive to promote hybrid and electric vehicles consumption. There is little academic research specifically evaluating this policy effect and exploring the relationship between the HOV lane incentives and hybrid vehicle ownership. This paper tries to fill the gap by using the 2009 National Household Travel Survey (NHTS) data and Heckman two-step model to examine the relationship. Controlling for demographic characteristics, household composition, travel pattern, and monetary incentives, this paper finds no evidence of a meaningful relationship between the HOV lane incentive and hybrid vehicle consumption. However, there is a positive and statistically significant association between state financial incentives and hybrid vehicle adoption. Policymakers should be well advised to reexamine the hybrid vehicle purchasing incentive policy based on sound empirical evidence.

Subject Areas: High Occupancy Vehicle (HOV) Lane; Hybrid-electric Vehicle

https://search.proquest.com/openview/b80d8763795cc8ac9b55f3c2e5fc9dfa/1?pq-origsite=gscholar&cbl=18750&diss=y
2.24. Title: Research on an Electric Vehicle Owner-Friendly Charging Strategy Using Photovoltaic Generation at Office Sites in Major Chinese Cities


Abstract: Electric vehicles (EV) and photovoltaic (PV) generation are widely recognized around the world. Most EV owners in the major Chinese cities are forced to charge their EV batteries at the workplace during the daytime due to the limited space near their homes, which will increase the peak load during the daytime. On the other hand, the PV output is most likely to have a peak at around noon, which means, PVs could have a potential capability to compensate the EV charging load. An EV owner-friendly charging strategy based on PV utilization which alleviates both the EV charging constraints and the negative impact of the EV charging load on the grid is proposed. The PV utilization for compensating the unconstrained EV charging load is maximized to derive the maximum number of EVs with unconstrained charging. If the actual number of EVs exceeds the maximum number, a portion of EVs have to be charged only from the grid. Then, the line loss is introduced as the optimization objective in which the charging states are regulated. The case study shows that the proposed strategy can successfully increase the number of EVs with unconstrained charging, and reduce the peak-to-peak of the load curve.

Subject Areas: Electric vehicle; Office sites; Major Chinese cities; PV utilization; EV owner-friendly charging strategy

Title: Charging Electric Vehicles in Smart Cities: An EVI-Pro Analysis of Columbus, Ohio

Author: Wood, E., Rames, C., Muratori, M., Raghavan, S. and Young, S.

Abstract: In June 2016, the City of Columbus, Ohio, won the U.S. Department of Transportation Smart City Challenge, laying the foundation to become a model for future sustainable transportation in the United States and abroad. With the support of the U.S. Department of Energy’s Vehicle Technologies Office, the National Renewable Energy Laboratory worked with the City of Columbus, The Ohio State University, Clean Fuels Ohio, the Mid-Ohio Regional Planning Commission, and American Electric Power to develop a plan for the expansion of the region’s network of charging stations to support increased adoption of plug-in electric vehicles (PEVs) in the local market. Potential sites include multi-unit dwellings to support PEV ownership in urban environments, workplaces to maximize electric vehicle miles, and strategic locations along highway corridors to enable regional travel.

The National Renewable Energy Laboratory’s Electric Vehicle Infrastructure Projection (EVIPro) model was used to generate scenarios of regional charging infrastructure to support consumer PEV adoption based on travel patterns provided by INRIX (a commercial mapping/traffic company) that are used to characterize regional travel in the Columbus area and anticipate future demand for PEV charging. Moreover, charging loads considering different levels of residential and public charging are reported to better inform the impact of PEV adoption on the electric load. This report provides guidance on PEV charging infrastructure to stakeholders in the Columbus area to reduce range anxiety as a barrier to PEV sales and ensure the effective use of private/public investments in PEV charging infrastructure.

Results indicate that approximately 400 Level 2 plugs at multi-unit dwellings and 350 Level 2 plugs at non-residential locations are required to support Columbus’ primary PEV goal of 5,300 PEVs on the road by the end of 2019. This analysis finds that while consumer demand for fast charging is expected to remain low (due to modest anticipated adoption of short-range battery electric vehicles), a minimum level of fast charging coverage across the city is required to ease consumer range anxiety concerns by providing a safety net for unexpected charging events. Sensitivity analyses around some key assumptions have also been performed; of these, consumer preference for PHEV versus BEV and for their electric driving range, ambient conditions, and availability of residential charging at multi-unit dwellings were identified as key determinants of the non-residential PEV charging infrastructure required to support PEV adoption. The results discussed in this report can be leveraged by similar U.S. cities as part of a strategy to accelerate PEV adoption in the light-duty vehicle market.

Subject Areas: Charging stations; Plug-in electric vehicles (PEVs); Electric Vehicle Infrastructure Projection (EVIPro) model


78
States).
https://www.nrel.gov/docs/fy18osti/70367.pdf
2.26. Title: Probabilistic Multi-Objective Optimal Scheduling of Plug-in Hybrid Electric Vehicles in the Distribution System

Author: Pouladi, J. and Abedinzadeh, T.

Abstract: Unlike previous papers that hypothesize specific inputs and present fixed outputs for optimal charging of electric vehicles, this paper offers a multi-objective probabilistic charging algorithm based on the point estimate method (PEM) for aggregation of plug-in hybrid electric vehicles and investigates its impacts on the distribution system. In other words, the uncertainty related to the outputs of different charging algorithms is determined using the PEM. Moreover, from the perspective of an aggregator, simultaneous optimization of the minimum charging cost and minimum charging time is proposed to satisfy the customers. The proposed algorithm is optimized through multi-objective scheduling and applying distribution network constraints. Finally, the proposed method is applied to the IEEE-37 node test feeder, and simulation results are presented to illustrate its performance.

Subject Areas: Plug-in electric vehicles (PEVs); Optimal charging

Title: A Multi-objective Framework for Energy Resource Scheduling in Active Distribution Networks

Author: Shafiee, M., Ghazi, R. and Moeini-Aghtaie, M.

Abstract:
Purpose: The purpose of this paper is to investigate the impacts of electric vehicles’ (EVs) charging/discharging decisions in energy resources scheduling problem of active distribution networks.
Design/methodology/approach: The problem under study is modelled as a two-stage optimisation problem in which the main requirements of EV owners are introduced as an objective function of the first stage. The total energy costs and the emission factor are considered as the main criteria of the second stage. The output generation schedules of distributed generation (DG) technologies together with the charging/discharging schedule of EVs are proposed as decision variables of the energy scheduling problem. Therefore, some effective methods are presented to model the uncertainties associated with these variables.
Findings: The results proved that an efficient compromise can be reached between the emission factor and the energy cost of the system. In addition, it has been emphasised on the importance of such comprehensive energy scheduling frameworks.
Originality/value: This paper contributes by: (a) providing a multi-objective framework for energy scheduling of active distribution networks, (b) extracting the mathematical model of this two-stage problem and (c) employing a linearised optimisation model to reach its global optimal solution.

Subject Areas: Charging/discharging schedule; Distributed generation (DG) technologies; Electric vehicles’ (EVs); Emission


Authors: Zhao, Y., Che, Y., Wang, D., Liu, H., Shi, K. and Yu, D.

Abstract: With the rapid growth of domestic electric vehicle charging loads, the peak-valley gap and power fluctuation rate of power systems increase sharply, which can lead to the increase of network losses and energy efficiency reduction. This paper tries to regulate network loads and reduce power system transmission loss by optimizing domestic electric vehicle charging loads. In this paper, a domestic electric vehicle charging loads model is first developed by analyzing the key factors that can affect users’ charging behavior. Subsequently, the Monte Carlo method is proposed to simulate the power consumption of a cluster of domestic electric vehicles. After that, an optimal electric vehicle charging strategy based on the 0-1 integer programming is presented to regulate network daily loads. Finally, by taking the IEEE33 distributed power system as an example, this paper tries to verify the efficacy of the proposed optimal charging strategy and the necessity for considering seasonal factors when scheduling electric vehicle charging loads. Simulation results show that the proposed 0-1 integer programming method does have good performance in reducing the network peak-valley gap, voltage fluctuation rate, and transmission loss. Moreover, it has some potential to further reduce power system transmission loss when seasonal factors are considered.

Subject Areas: Domestic Electric Vehicles; Charging Strategy; Network Transmission Loss; Seasonal Factor

2.29. **Title:** Evolving Controllers for Electric Vehicle Charging

**Author:** Pilát, M.

**Abstract:** We describe an algorithm to design controllers for the charging of electric vehicles. The controller is represented as a neural network, whose weights are set by an evolutionary algorithm in order to minimize the changes in the overall electrical consumption. The presented algorithm provides de-centralized controllers that also respect the privacy of the owner of electric vehicles, i.e. the controller does not share the information about charging with any third party. The presented controllers also require only a very small amount of memory and computational resources and are thus suitable for implementation in embedded systems.

**Subject Areas:** Electric vehicle charging; Evolutionary algorithm; Neural network


[https://link.springer.com/chapter/10.1007/978-3-319-77538-8_18](https://link.springer.com/chapter/10.1007/978-3-319-77538-8_18)
2.30. Title: Elasticity of Vehicle Miles of Travel to Changes in the Price of Gasoline and the Cost of Driving in Texas.

Authors: Wenzel, T.P. and Fujita, K.S.

Abstract: This report examines the sensitivity of annual vehicle miles of travel (VMT) of light-duty vehicles to the price of gasoline, commonly referred to as the elasticity of demand for VMT to the price of gasoline; the fuel-economy-related rebound effect is generally assumed to be of the same magnitude as the VMT elasticity of gas price or driving cost. We use detailed odometer readings from over 30 million vehicles in four urban areas of Texas, over a six-year period. We account for economic conditions over this period, as well as vehicle age. Following the literature we include fixed effects by vehicle make and individual vehicle, as well as the effect of adding an instrument to predict monthly gasoline price independent of any influences of demand for gasoline on its price.

Subject Areas: Vehicle Miles of Travel (VMT); Gasoline price

https://cloudfront.escholarship.org/dist/prd/content/qt3pr533kp/qt3pr533kp.pdf
2.31. Title: Assessment and Enhancement Frameworks for System Reliability Performance Using Different PEV Charging Models.

Authors: Almutairi, A. and Salama, M.

Abstract: This paper presents a comprehensive reliability framework for incorporating different PEV charging load models into the evaluation of generation adequacy. The proposed framework comprises special treatment and innovative models to achieve an accurate determination of the impact of PEV load models on reliability. First, a goodness-of-fit statistical model determines the probability distribution functions (PDFs) that best reflect the main characteristics of driver behavior. Second, robust and detailed stochastic methods are developed for modeling different charging scenarios (uncontrolled charging and charging based on TOU pricing). These models are based on the use of a Monte Carlo simulation in conjunction with the fitted PDFs to generate and assess a large number of possible scenarios while handling the uncertainties associated with driver behavior, penetration levels, charging levels, battery capacities, and customer response to TOU pricing. Also proposed is a novel reliability-based framework for the application of dynamic response to critical events programs for use with PEV charging loads. The effectiveness of the proposed framework with respect to improving system reliability is demonstrated using several case studies applied on the IEEE Reliability Test System (RTS).

Subject Areas: Reliability; Power system reliability; Load modeling; Biological system modeling; Batteries; Uncertainty; Pricing


2.32. Title: A Method for Determining The Optimal Delivered Hydrogen Pressure for Fuel Cell Electric Vehicles

Authors: Lin, Z., Ou, S., Elgowainy, A., Reddi, K., Veenstra, M. and Verduzco, L.

Abstract: Fuel cell electric vehicles (FCEVs) are considered an important part of a portfolio of options to address challenges in the transportation sector, including energy security and pollution reduction. The market success of FCEVs depends on standardization of key vehicle and infrastructure parameters, including the delivered hydrogen pressure (DHP). This study developed and utilized the Hydrogen Optimal Pressure (HOP) model to systematically identify the optimal DHP among 350, 500, and 700?bar toward the lowest total consumer cost and analyze how the optimal DHP may be affected by attributes of drivers, vehicles, and hydrogen refueling stations. The DHP of 700?bar is robustly better choice than 350?bar or 500?bar for Region Strategy, regardless of fuel availability, FCEV adoption, driver types, time values, and fuel economies. A DHP of 300 or 500?bar can be the winner in Cluster Strategy if combined with certain assumptions of driving patterns and time value. The optimal pressure is found to be very sensitive to fuel availability, fuel economy, driving pattern and time value. The appeal of a higher DHP such as 700?bar (or even higher) is more obvious during the early market stages, when the number of hydrogen stations is limited and early FCEV consumers likely have higher time value, and thus may be willing to pay more for the increased range with higher DHP. Future research on mixed DHPs within a station and across stations is suggested.

Subject Areas: Fuel cell electric vehicle; Hydrogen refueling station; On-board storage; Optimization; Driving range; Hydrogen fueling pressure

2.33. Title: Range-extending Zinc-air Battery for Electric Vehicle


Abstract: A vehicle model is used to evaluate a novel powertrain that is comprised of a dual energy storage system (Dual ESS). The system includes two battery packs with different chemistries and the necessary electronic controls to facilitate their coordination and optimization. Here, a lithium-ion battery pack is used as the primary pack and a Zinc-air battery as the secondary or range-extending pack. Zinc-air batteries are usually considered unsuitable for use in vehicles due to their poor cycle life, but the model demonstrates the feasibility of this technology with an appropriate control strategy, with limited cycling of the range extender pack. The battery pack sizes and the battery control strategy are configured to optimize range, cost and longevity. In simulation the vehicle performance compares favourably to a similar vehicle with a single energy storage system (Single ESS) powertrain, travelling up to 75 km further under test conditions. The simulation demonstrates that the Zinc-air battery pack need only cycle 100 times to enjoy a ten-year lifespan. The Zinc-air battery model is based on leading Zinc-air battery research from literature, with some assumptions regarding achievable improvements. Having such a model clarifies the performance requirements of Zinc-air cells and improves the research community’s ability to set performance targets for Zinc-air cells.

Subject Areas: Range Extender; Zinc-Air Battery; Dual Energy Storage System; Vehicle Model; Metal-Air Battery; Single Energy Storage System; Driving Profile; Vehicle Use Pattern

http://www.aimspress.com/fileOther/PDF/energy/energy-06-00121.pdf
2.34. Title: Multicriterion Optimal Electric Drive Vehicle Selection based on Lifecycle Emission and Lifecycle Cost

Authors: Ahmadi, P., Cai, X.M. and Khanna, M.

Abstract: This research paper examines the optimal choice among conventional gasoline vehicles, hybrid electric vehicles (HEVs), plug-in HEVs (PHEVs), and full-battery EVs taking into account the different characteristics of these vehicles, such as cost, emissions per mile, and vehicle miles to be traveled between refueling and acceleration time. The existing challenges for wide-spread deployment of EVs are availability of charging infrastructure, higher cost, long time for charging, and lower travel millage compared with conventional vehicles. Statistical data are considered for determining the spatially varying average daily vehicle miles traveled (VMT) across the United States, which, together with charging behavior, can influence the optimal choice among EV with different travel ranges. Two alternative cases for charging are examined: (1) home-only charging and (2) home plus work charging. The motivation of this work is to select the optimal EV among their types when lifecycle cost and lifecycle emission are considered. The optimization model seeks to minimize total lifecycle cost and emissions for each level of VMT per day. It is found that when lifecycle cost is the sole objective, HEV is usually the best choice, especially for higher VMT levels. When lifecycle greenhouse gas emission is the sole objective, PHEV1 (PHEV with 1 charging station) is the optimal solution over a wide range of VMTs. The outcome of this provides a roadmap for the selection of EVs based on their annual VMT to reduce both lifecycle emission and lifecycle cost.

Subject Areas: Electric Vehicles; Charging; Lifecycle emission

2.35. Title: Probabilistic-possibilistic Model for a Parking Lot in the Smart Distribution Network Expansion Planning

Authors: Nasri, A., Abdollahi, A., Rashidinejad, M. and Amini, M.H.

Abstract: Conventional distribution network departs to the smart grid. The parking lot will have an important role in the smart grid as a distributed generation. Due to the output power of parking lots is uncertain, More accurate modeling of parking lot output power is necessary for the future of distribution network studies such as Distribution Network Expansion Planning (DNEP). In this paper, a systematic method based on the Z-number concept is utilized to represent the uncertainty of Vehicle to Grid’s (V2G’s) presence. In order to investigate the impact of V2Gs uncertainty on the DNEP, we proposed a Probabilistic-Possibilistic DNEP in the presence of V2Gs referred to as P-PDNEPV2G. If the V2Gs historical data is incomplete, the proposed structure can significantly consider the effects of V2G on the DNEP. In P-PDNEPV2G, parking lots output power is described as a probabilistic-possibilistic variable by Z-number method. The optimization of P-PDNEPV2G is executed by the Non-Dominated Sorting Genetic Algorithm (NSGA-II). A 24-bus test system and the real 20?kV distribution network of Ghale-Ganj city of Kerman province in Iran are used to demonstrate the effectiveness of the proposed methodology. Eventually, several analyses are conducted to investigate the impact of probabilistic-possibilistic V2G model on the DNEP problem.

Subject Areas: Power distribution planning; Probability; Distributed power generation; possibility theory; Smart power grids

2.36. Title: Ancillary Services Participation for Electric Vehicle Fleets

Author: Shin, S.

Abstract: Amid growing concerns of global climate disruption, a diverse set of stakeholders are advocating for deep decarbonization efforts in sectors such as electrical power generation and transportation. This Master’s Project (MP) will explore the potential scenarios when these two sectors begin to merge. As the electrification of vehicles becomes commonplace, benefits and limitations will become evident across the U.S. electric grid. The impact of fleet-scale adoption of electric vehicles (EVs) and vehicle-to-grid (V2G) implementation will be discussed. An EV fleet managed by a central entity has the possibility of aggregating their stored power for a grid service through a specialized charger that allows for bi-directional electric flow. The communication software and ability to transfer power from grid to vehicle is called vehicle-to-grid implementation, or V2G. V2G is a broad term with multiple applications. The focus of this MP will be on EV fleets’ ability to provide ancillary services. The ancillary services market represents an array of services that provide general grid support, rather than outright electrical power capacity. Ancillary services include services such as frequency regulation and voltage control.

Subject Areas: V2G; EV Fleet(s); Ancillary Services; Frequency Regulation

2.37. Title: A Pattern Analysis of Daily Electric Vehicle Charging Profiles: Operational Efficiency and Environmental Impacts

Author: Desai, R.R., Chen, R.B. and Armington, W.

Abstract: Plug-in Electric Vehicles (PEVs) are considered one solution to reducing GHG emissions from private transport. Additionally, PEV adopters often have free access to public charging facilities. Through a pattern analysis, this study identifies five distinct clusters of daily PEV charging profiles observed at the public charging stations. Empirically observed patterns indicate a significant amount of operational inefficiency, where 54% of the total parking duration PEVs do not consume electricity, preventing other users from charging. This study identifies the opportunity cost in terms of GHG emissions savings if gasoline vehicles are replaced with potential PEV adopters. The time spent in parking without charging by current PEV users can be used by these potential PEV users to charge their PEVs and replace the use of gasoline. The results suggest that reducing inefficient station use leads to significant reductions in emissions. Overall, there is significant variability in outcomes depending on the specific cluster membership.

Subject Areas: Plug-in Electric Vehicles (PEVs); GHG emissions; Charging; Parking

2.38. Title: Multiobjective Scheduling of Microgrids to Harvest Higher Photovoltaic Energy

Author: Hamidi, A., Nazarpour, D. and Golshannavaz, S.

Abstract: Photovoltaics (PVs) and plug-in electric vehicles (PEVs) could instigate voltage violation issues, if not controlled properly. Besides, these components highly contribute to economic efficiency of microgrids (MGs). Being motivated to enhance technical and economic issues, this study develops an energy management system that is able to coordinate voltage control devices, say under-load tap changers (ULTC), PVs, PEV aggregators, and dispatchable distributed generations (DDGs). Active and reactive power provisions of PEVs and DDGs along with voltage control of ULTC lessen the plausible violations. So, higher renewable energy is contributed by PVs and extra monetary saving is reflected. In this manner, augmented Epsilon-constraint method followed with fuzzy decision making is applied to operation cost and voltage deviation minimizations. The proposed approach is formulated as a mixed-integer nonlinear multiobjective problem and tested on a modified IEEE 33-bus medium-voltage MG. Results are discussed in depth.

Subject Areas: Energy management system (EMS); Microgrid (MG); Multiobjective approach; Photovoltaics (PVs); Plug-in electric vehicles (PEVs)

2.39. Title: Enhancing Electric Vehicle Sustainability through Battery Life Optimal Charging

Authors: Schoch, J., Gaerttner, J., Schuller, A. and Setzer, T.

Abstract: In this article, we investigate the potential for battery life prolongation through optimized charging under consideration of individual mobility requirements. Based on a comprehensive battery aging model we introduce a continuous quadratic programming model to derive battery life optimal charging (OPT). The strategy indicates when and how much to charge to maximize the potential range throughout the battery life. We find that OPT has the potential to more than double the expected battery life compared to simple and often abundant recharging activities as observable today. The degree of battery life prolongation strongly depends on the operating temperature. Since optimal charging would require deterministic knowledge of future trips and corresponding charging levels we investigate a more convenient charging heuristic derived from “As-Late-As-Possible” (ALAP) charging. ALAP charging considers range buffers between 5% and 60% over the range required until the next re-charging opportunity. We analyze the trade-off between (long-term) battery life and (short-term) range flexibility. We find that for decreasing temperatures the trade-off between battery life and flexibility is solved with increasing range buffers. From our results battery degradation aware charging heuristics can be easily derived and applied in real-world settings.

Subject Areas: Battery aging; Optimal charging behavior; Range anxiety; Battery electric vehicle

2.40. Title: Electrified Vehicles Continue to see Slow Growth and Less Use than Conventional Vehicles

Author: Stone, D.

Abstract: Blog

Subject Areas: Diesel; Electricity; Gasoline; Liquid Fuels; Transportation; Vehicles

Title: Is gasoline price elasticity in the United States increasing? Evidence from the 2009 and 2017 national household travel surveys.

Authors: Goetzke, F. and Vance, C.

Abstract: Drawing on the 2009 and 2017 waves of the National Household Transportation Survey, this paper models the determinants of vehicle miles traveled, with the aim of parameterizing the magnitude of the fuel price elasticity. To capture changes in this magnitude over the two years of the survey, our specification interacts the logged fuel price with a dummy indicating the 2017 survey year. We find a small but statistically significant mean elasticity of about -0.05 for the year 2009, which increases over fourfold to -0.23 by the year 2017. We explore the robustness of this result to different model specifications and estimation techniques, including instrumental variable estimation to account for the possible endogeneity of fuel prices, as well as quantile regression to account for heterogeneity according to driving intensity. A similar pattern of substantially increasing elasticity emerges across all these models. We speculate that one possible source of this pattern is economic duress from the 2008 financial crisis, which the data suggests reoriented mode choice patterns.

Subject Areas: Fuel price elasticity; Household VMT; Heterogeneity

2.42. Title: A Methodology to derive Land Use specific Auto-trip Emission Footprints from Household Travel Survey Data.

Authors: Venigalla, M., Dixit, S. and Pulugurtha, S.

Abstract: Regional travel-demand forecasting models are complex and cumbersome to use. Furthermore, they are also not sensitive to neighborhood level sustainable land use policies such as transit-oriented developments (TOD). There is a need for developing simple sketch planning tools and methodologies for taking measurements on the impacts of land use policies on mobility and environment. The primary objective of this research is to develop a methodology for deriving household-level emission footprints of auto travel from household travel survey data. The methodology was demonstrated by comparing and contrasting emission footprints for TOD and Non-TOD land uses in the Washington DC metropolitan area. A TOD is defined as the area encircling stations along line-haul Metrorail service. Statistical analyses indicated that Non-TOD emission footprints are significantly higher than the TOD footprints. Differences amongst pairs of TODs showed no statistical significance. Some exceptions to this generalized observation were also noted. The utility of the methodology was also demonstrated by comparing aggregate emission footprints at county level. The methodology can also be used for deriving emission footprints for any logical aggregate group of traffic analysis zones (TAZ). Thus, this research advances the utility of travel surveys to establishing baselines on emission footprints for select geographies.

Subject Areas: Sustainable land use; Emission Footprints; Transit Oriented Developments (TOD); Deriving emissions from travel survey data; Land use and transportation

https://rsa.tandfonline.com/doi/abs/10.1080/21650020.2018.1555055#.XC0D8BNKj-Y
2.43. Title: Comments to NHTSA and US EPA on the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021 – 2026: Passenger Cars and Light Trucks.

Authors: Linn, J., Krupnick, A., Leard, B. and McConnell, V.

Abstract: Public Comments Report

Subject Areas: Fuel-efficient vehicles; Passenger cars; Light trucks

2.44. Title: Impacts of Fuel Economy Improvements on the distribution of Income in the U.S.

Authors: Greene, D.L. and Welch, J.G.

Abstract: We estimate the impacts of passenger car and light truck fuel economy improvements in the U.S. since 1975 on the real monetary incomes of U.S. households by income quintile over the period 1980 – 2014. We limit our analysis to the direct monetary impacts (fuel savings minus increased vehicle costs) and do not attempt a full welfare analysis. We include all vehicle purchases, new and used. Household fuel expenditures come from the U.S. Consumer Expenditures Surveys (CES). Costs of increased new passenger car and light truck fuel economy were obtained from four National Research Council (NRC) studies plus a literature review of earlier estimates. The NRC cost functions provide a unique time series of technology supply functions constructed by balanced expert panels and comprised of specific technologies proven to increase fuel economy. Effects of fuel economy improvements on used vehicle prices are based on an analysis of the CES data. Retrospective analysis indicates that all income quintiles received net savings and that the effect on the distribution of income was progressive. A prospective analysis of future fuel economy improvements produced similar results. Sensitivity analysis indicates that these findings are relatively robust.

Subject Areas: Income effects; Fuel economy

2.45. Title: Well-to-wheel Water Footprints of Conventional Versus Electric Vehicles in the United States: A State-based Comparative Analysis

Authors: Onat, N.C., Kucukvar, M. and Tatari, O.

Abstract: Today, increasing levels of water demand become a particularly serious challenge for many countries, especially since water is an essential element for production of transportation fuels. Unfortunately, no research efforts as of now have been directed specifically toward understanding the fundamental relationship between the adoption of electric vehicles (EVs) and water demand. This research aims to fill this knowledge gap by analyzing the water consumption and withdrawal impacts resulting from the increased usage of alternative vehicle technologies in the United States. 5 vehicle types - Internal Combustion Vehicles (ICVs), Hybrid Electric Vehicles (HEVs), Plug-in Hybrid Electric Vehicles (PHEV20, PHEV40) and Battery Electric Vehicles (BEVs) - are analyzed across 50 U.S. states with 3 different electricity generation mix profiles: the state-based average electricity generation mix, the state-based marginal electricity generation mix, and a hypothetical electricity generation mix consisting entirely of solar-powered charging stations. The well-to-wheel (WTW) life cycle analysis is used for the water footprint calculations. In worst case, BEVs may consume up to 70 times more water than ICVs. BEVs with solar charging have the lowest levels of water consumption and withdrawal and can reduce transportation water footprint by up to 97%. In most of the states, the marginal electricity generation mix has higher water consumption and withdrawal values than those of the average electricity generation mix. In particular, the authors suggest the use of BEVs with solar charging for states with the highest water-stressed areas (California (CA), Arizona (AZ), Nevada (NV), Florida (FL), etc.), and recommend the inclusion of incentives by federal and state governments for these states.

Subject Areas: Water footprint; Life cycle assessment; Well-to-Wheel; Electric vehicle; Energy policy; United States

2.46. Title: Vehicle Fuel Economy and Vehicle Miles Traveled: An Empirical Investigation of Jevon’s Paradox

Authors: Munyon, V.V., Bowen, W.M. and Holcombe, J.

Abstract: There has been, in recent decades, a concerted effort to promote energy efficiency as a means to reduce energy consumption. The general thesis is that, ceteris paribus, an increase in energy efficiency leads to a decrease in the consumption of the good or service rendered efficient. This is in opposition to Jevons’ Paradox which states that “It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth?” This study examines whether Jevons’ Paradox holds when all available factors that could affect consumption of an efficient good/service are controlled for. Using vehicle fuel economy as a measure of energy efficiency and vehicle miles travelled (VMT) as a measure of consumption, the study examines whether, other things being held equal, a more fuel efficient vehicle accrues greater Vehicle Miles Traveled. The findings indicate that in this case Jevons’ Paradox does hold true; a 1% increase in fuel efficiency was associated with a 1.2% increase in VMT.

Subject Areas: Vehicle fuel efficiency; Fuel economy; Vehicle miles travelled (VMT); Jevons’ Paradox

2.47. Title: How Much Are Electric Vehicles Driven?

Author: Davis, L.W.

Abstract: The prospect for electric vehicles as a climate change solution hinges on their ability to reduce gasoline consumption. But this depends on how many miles electric vehicles are driven and on how many miles would have otherwise been driven in gasoline-powered vehicles. Using newly-available U.S. nationally representative data, this paper finds that electric vehicles are driven considerably fewer miles per year on average than gasoline-powered vehicles. The difference is highly statistically significant and holds for both all-electric and plug-in hybrid vehicles, for both single- and multiple-vehicle households, and both inside and outside California. The paper discusses potential explanations and policy implications. Overall, the evidence suggests that today’s electric vehicles imply smaller environmental benefits than previously believed.

Subject Areas: Electric Vehicles; Plug-in Hybrids; Vehicle Miles Traveled, Rebound Effect

http://faculty.haas.berkeley.edu/ldavis/Davis%20VMT%202018.pdf

Authors: Yang, F., Xie, Y., Deng, Y. and Yuan, C.

Abstract: Electric vehicles (EVs) are widely promoted as clean alternatives to conventional vehicles for reducing greenhouse gas (GHG) emissions from ground transportation. However, the battery undergoes a sophisticated degradation process during EV operations and its effects on EV energy consumption and GHG emissions are unknown. Here we show on a typical 24 kWh lithium-manganese-oxide-graphite battery pack that the degradation of EV battery can be mathematically modeled to predict battery life and to study its effects on energy consumption and GHG emissions from EV operations. We found that under US state-level average driving conditions, the battery life is ranging between 5.2 years in Florida and 13.3 years in Alaska under 30% battery degradation limit. The battery degradation will cause a 11.5–16.2% increase in energy consumption and GHG emissions per km driven at 30% capacity loss. This study provides a robust analytical approach and results for supporting policy making in prioritizing EV deployment in the U.S.

Subject Areas: Electric Vehicles (EVs); Greenhouse gas (GHG) emissions; Battery life; Energy consumption

Title: The Impact of Daily and Annual Driving on Fuel Economy and CO₂ Emissions of Plug-in Hybrid Electric Vehicles

Authors: Plötz, P., Funke, S.Á. and Jochem, P.

Abstract: The potential of plug-in hybrid electric vehicles (PHEV) to reduce greenhouse gas emissions highly depends on vehicle usage and electricity source. The electric driving share, i.e. the share of kilometres driven electrically, is specific to PHEV and a key factor for its fuel economy. Altogether, a detailed understanding of all factors influencing PHEV fuel economy is missing, especially with regard to driving distances. We analyse the influence of driving behaviour on fuel economy and more precisely the influences on the electric driving share based on mobility data. We applied a regression with mobility data of 780 vehicles to identify the main factors explaining this variation. Our results indicate that real-world fuel economy of PHEV differs widely among users. The resulting factors that explain up to 80% of the fuel economy are the all-electric range, the annual mileage, the regularity of daily driving, and the likelihood of long-distance trips. In our empirical analysis, the average electric driving share of N=1,831 Chevrolet Volt in real-world driving is 78%. When the electricity for charging comes from renewable energy sources the resulting real-world well-to-wheel CO₂ emissions of these PHEV are 37 gCO₂/km. However, even with the current US electricity mix, the annual CO₂ savings of all registered Chevrolet Volts in the U.S. amount to about 57 kt CO₂ in comparison to conventional cars. Furthermore, a full charge per day is necessary for high fuel economy and any necessary recharging during the day increases the share of electric driving and lowers the consumption of conventional fuel. Current test-cycle fuel economy ratings neglect these factors. Although fuel economy ratings are good estimates for average usage patterns, they fail to account for the high variation in individual driving behaviour. This should be taken into account by future test-cycles and policies should incentivise high electric driving shares.

Subject Areas: Electric Vehicles (EVs); Plug-in hybrid electric vehicles; Fuel economy; Utility factor

2.50. Title: Battery Electric Vehicles: What is the Minimum Range Required?

Authors: Shi, X., Pan, J., Wang, H. and Cai, H.

Abstract: Identifying the battery range needs at the individual level is critical to enhance our understanding of the environmental benefits and electricity grid load impacts from large-scale battery electric vehicle (BEV) adoption, and inform policy decision making for charging infrastructure development and BEV system deployment. However, two research gaps exist in existing research: neglecting the use of public charging stations and lacking a model to identify the minimum battery ranges required to fulfill all the travel demands of a vehicle at the individual level. This study fills these gaps by developing an optimization model to identify the minimum required BEV battery ranges at the individual level, using real world vehicle travel data and charging station location information. Based on our case study of taxis and private vehicles in Beijing, China, the results show that: 1) with home charging and the existing public charging infrastructure, it is feasible to use existing BEV models to replace a significant portion of gasoline vehicles without sacrificing individual mobility needs; 2) battery technologies are unlikely to be the major bottleneck to BEV adoption; and 3) increase the service range of charging infrastructures can reduce the minimum required battery ranges, but function substitutions will need to be considered.

Subject Areas: Electric Vehicles (EVs); Battery range; Individual travel pattern; Taxis; Private vehicle; Public charging

2.51. Title: Vehicle Choice and Utilization: Improving Estimation with Partially Observed Choices and Hybrid Pairs

Authors: Lloro, A. and Brownstone, D.

Abstract: This paper exploits differences in fuel efficiency between hybrid vehicles and their gasoline counterparts to investigate two key questions relating to fuel economy standards: whether consumers properly value fuel economy (the energy paradox) and whether improved fuel efficiency increases travel (the rebound effect). Several vehicles, such as the Honda Civic, are available in both hybrid and gasoline versions. Such vehicles share many of the same attributes, with the main difference being fuel efficiency, and provide a unique setting to examine these issues. We emphasize methodological and data issues that typically have not been a focus in prior studies, such as partial observability, endogeneity, and measurement error. Estimates of the rebound effect and consumer valuation of fuel economy remain imprecise despite the use of the detailed household level data and sound methodology to handle limitations with these data. The inability to precisely estimate these important policy questions suggests it is useful to obtain reliable, detailed data on household vehicles, paired with rich household- and person-level survey data.

Subject Areas: Hybrid vehicles; Fuel efficiency; Gasoline; Vehicle Choice; Utilization

2.52. Title: Economic Scheduling of Plug-In Hybrid Electric Vehicle considering Various Travel Patterns

Authors: Preethi, A.A., Nesamalar, J.J.D., Suganya, S. and Raja, S.C.

Abstract: Due to the wide usage of fossil fuels, global warming has become a major threat in recent years. Hence, Plug-in Hybrid Electric Vehicles (PHEVs) usage has become an alternative solution due to the depletion of resources and the increasing price of fossil fuels. In this work, the driving pattern of the vehicles is calculated using probability density function. A Fuzzy Logic based method is used to correlate the arrival and departure time of the vehicle with the daily mileage as they are independent in nature. The total operating cost minimization is the main objective of the work by adopting controlled charging strategy. The controlled charging strategy comprises of three different modes: charging, discharging and idle mode. Thus, the economic scheduling of PHEVs using the controlled charging strategy is implemented considering two different test cases namely residential and commercial area, each with a parking lot for charging the vehicles. Finally, the scheduling of PHEV is performed using MATLAB and the results of the two different cases were analyzed under different charging levels and three All Electric Range (AER)-30, 40 and 60 ranges of PHEVs.

Subject Areas: Batteries; State of charge; Probability density function; Fuzzy logic; Probability distribution; Power engineering; Plug-in hybrid electric vehicles


106
2.53. Title: Goodness of Fit Statistical Analysis for Different Variables of PEV Driver Behaviour

Authors: Almutairi, A., Alotaibi, M. and Salama, M.M.A.

Abstract: Modelling plug-in electric vehicles (PEVs) charging load for use in many power system applications requires reliable estimates of a number of random variables that characterize the PEV charging process. Among these variables are the variables relevant to the driver’s behaviour (e.g., arrival and departure times and daily mileage). Determining reliable estimates of these variables is challenging, since no currently sufficient real data can be relied upon for precise descriptions of these variables. The alternative is to use sample data for each variable from the available transportation mobility data, and to estimate a proper probability distribution function (PDF) that can preserve the random characteristics of each variable and generate the desired synthetic data. This paper presents a statistical evaluation study for different collections of PDFs in order to find the best model to precisely reflect the random characteristics of each driver behaviour variable. The most commonly used PDFs, along with some advanced PDFs, have been verified against the observed sample data based on consideration of a well-known goodness of fit statistical test.

Subject Areas: Driver Behavior; Goodness of Fit Test; Probability Distribution Function

2.54. **Title:** Distribution System V1G PEV Charging Impacts Report

**Authors:** Pratt, R.M. and Bernal, L.E.

**Abstract:** Plug-in Electric Vehicles (PEVs) are a clean form of transportation that will require a new control paradigm between the energy supply and the transportation sectors as PEV adoption continues to grow. Meeting the projected PEV energy demands will require implementing PEV / grid integration methods beyond charging PEVs at incentivized times. MATLAB was used to simulate the daily vehicle trip demands and charging processes of hundreds of PEVs. The National Household Travel Survey (NHTS) data was used as the source of vehicle travel data, and EV Project provided measured PEV charging data to calibrate the PEV population models. GridLAB-D analyses used a prototypical feeder and PEV population models to evaluate residential PEV V1G (unidirectional) charging in multiple locations, V1G PEV distribution feeder impacts, Time-Of-Use (TOU) rate effects on PEV charging, and charging control methods. The key findings were: optimized charging using California TOU rates could result in savings of over $20 per month for non-TOU program participants; non-TOU participants consume 30-40% of PEV charging energy; about 50% of PEV drivers have their transportation fuel bill reduced by $50 per month; 6.6kW charging will cause distribution transformer power limits to be exceeded on prototypical feeders if the household PEV adoption rate reaches 0.75 PEVs per home; distribution feeder loading is proportional to PEV charging rate; a method was devised to remotely identify when residential transformer overloads occur using changes in PEV charging rate; and the low-cost TOU period is composed of a distribution of PEVs needing small, medium and larger energy needs that can be more effectively shifted as groups to mitigate the TOU peak power and enable a higher PEV adoption rate per household without overloading distribution transformers.

**Subject Areas:** Plug-in Electric Vehicles (PEVs); Charging; Grid

2.55. Title: Continuous-time Model Predictive Control for Real-time Flexibility Scheduling of Plugin Electric Vehicles

Authors: Khatami, R., Parvania, M. and Bagherinezhad, A.

Abstract: This paper proposes a continuous-time model predictive control (MPC) for co-optimizing the charging flexibility of plugin electric vehicles (PEVs) and generation schedule of generating units in real-time power systems operation. A continuous-time queuing model is developed to aggregate and cluster a large population of PEVs, which represents their aggregate flexibility to the power system operator. The proposed model integrates the most recent information about the system load and PEV arrival, and utilizes the flexibility of PEVs and generating units to supply the ramping requirements of load, while ensuring the delay-based and deadline-based service quality constraints of PEVs. The proposed model is implemented on the IEEE Reliability Test System, using PEV and load data of California. The simulation results demonstrate effectiveness of the proposed model to utilize the flexibility of PEVs in real-time power systems operation, which considerably reduces ramping requirements from conventional generating units.

Subject Areas: Continuous-time model predictive control; Queuing model; Plugin electric vehicles

2.56. Title: Flexibility Provisions from a Fast Charging Facility Equipped with DERs for Wind Integrated Grids

Authors: Alharbi, W. and Bhattacharya, K.

Abstract: This paper presents a new mathematical model to design a fast charging facility (FCF) equipped with distributed energy resources (DERs) to provide flexibility services in wind integrated power grids. Two different ownership structures of the FCF and wind generation facility (WGF) are considered. The DER options considered for FCF design are solar photovoltaic (PV) units and battery energy storage systems (BESS). The effects of wind power uncertainty on power system operations are mitigated through the designed FCF with DERs via the upward and downward flexibility provisions. Monte Carlo simulations are used to simulate the uncertainties in PV and wind generation, and market price. Studies considering an 18 MW WGF and the National Household Travel Survey (NHTS) 2009 data are presented to demonstrate the effectiveness of the flexibility provisions from the proposed design of FCF with DERs.

Subject Areas: Battery energy storage systems; Fast charging facility; Distributed energy resources; Flexibility; Investment; Wind integration

2.57. Title: Optimal Scheduling of Hybrid Energy Resources for a Smart Home

Authors: Rafique, M., Haider, Z., Mehmood, K., Saeed Uz Zaman, M., Irfan, M., Khan, S. and Kim, C.H.

Abstract: The present environmental and economic conditions call for the increased use of hybrid energy resources and, concurrently, recent developments in combined heat and power (CHP) systems enable their use at a domestic level. In this work, the optimal scheduling of electric and gas energy resources is achieved for a smart home (SH) which is equipped with a fuel cell-based micro-CHP system. The SH energy system has thermal and electrical loops that contain an auxiliary boiler, a battery energy storage system, and an electrical vehicle besides other typical loads. The optimal operational cost of the SH is achieved using the real coded genetic algorithm (RCGA) under various scenarios of utility tariff and availability of hybrid energy resources. The results compare different scenarios and point-out the conditions for economic operation of micro-CHP and hybrid energy systems for an SH.

Subject Areas: Battery energy storage systems; Electric vehicle (EV); Fuel cell (FC); Micro combined heat and power (micro-CHP) system; Real coded genetic algorithm (RCGA); Smart home (SH)

2.58. Title: A Spatial-temporal Charging Load Forecasting Modelling of Electric Vehicles Considering Urban Traffic Network

Authors: Li, H., Du, Z., Chen, L. and Zhou, B.

Abstract: With development of electric vehicles (EVs), the grid is gradually facing additional pressure on peak load. Therefore, it is necessary to have accurate charging load forecasting as users behavior is full of uncertainty influenced by the traffic network and trip chains. In this paper, a novel charging load forecasting model is proposed to maintain the spatial-temporal characteristic of EVs considering different trip chains and traffic network, where Logit delay function is applied to calculate the road resistance. The normal distribution is used to fit the departure time of each stroke, and the improved Dijkstra algorithm is adopted to select the shortest time-consuming driving path. Finally, the efficiency of proposed model and method is assessed in the road network of test urban area.

Subject Areas: Electric vehicles; Charging load forecasting; Traffic road network; Spatial-temporal characteristic

2.59. Title: Optimal Temporal-spatial Electric Vehicle Charging Demand Scheduling Considering Transportation-Power Grid Couplings

Authors: Sun, S., Yang, Q. and Yan, W.

Abstract: This paper proposed a holistic temporal-spatial scheduling approach for charging demand (both fast charging and normal charging) of plug-in electric vehicles (PEVs). The proposed solution aims to optimally schedule the PEV charging actions based on PEV operational states with minimized charging costs and travel time, whilst meets the constraints of both transportation and power distribution networks. The power utility can also participate in the scheduling strategy by adopting real-time pricing (RTP) to increase the utilization efficiency of distributed generation (DG) and optimize the profiles of power distribution networks. The proposed solution was assessed through a set of case studies and the numerical results clearly demonstrated the effectiveness of the proposed strategy.

Subject Areas: Charging stations; Real-time systems; Roads; Schedules; Pricing

2.60. Title: Capacity Configuration of Electric Vehicle Charging Facilities Based on User Behavior Prediction

Authors: Yang, S., Shi, K., Cao, X., Wang, H. and Yu, Z.

Abstract: By analyzing the behavior of electric vehicle users, this paper predicts the driving and charging activities of electric vehicles in the area and simulates the total charging load of electric vehicle charging load in a charging station in a certain area. Finally, taking a city as an example, this method is used to calculate the specific configuration scheme of the city’s public charging network, and further studies the impact of user charging habits and vehicle differences on the configuration results. The results show that the proposed capacity allocation method is effective and feasible.

Subject Areas: Electric Vehicle; Charging Facilities; Public Charging Network; User Behavior

2.61. Title: Ownership Cost Comparison of Battery Electric and Non-Plugin Hybrid Vehicles: A Consumer Perspective

Author: Fulton, L.

Abstract: This study evaluates eight-year ownership costs for battery electric vehicles (BEV) versus non-plugin hybrid vehicles, using forecasting to estimate future electricity and conventional gasoline prices and incorporating these in a multiple design of experiments simulation. Results suggest that while electric vehicles are statistically dominant in terms of variable costs over an 8-year life-span, high-performance hybrid non-plugins achieve variable fuel costs nearly as good as low-performing electric vehicles (those attaining only 3 miles per kilowatt hour) and that these hybrid acquisition costs are (on average) lower, yet the vehicles retain higher residual values. In general, the six smallest ownership costs are split evenly between hybrid and electric vehicles; however, inflation for conventional regular gasoline is estimated to outstrip inflation per kilowatt hour. Thus, non-plugin hybrid cars are likely to require considerably more advanced engineering to keep pace.

Subject Areas: BEV; Ownership cost analysis; Design of experiments; Forecasting; Monte Carlo simulation

2.62. Title: Ownership Cost Comparison of Battery Electric and Non-Plugin Hybrid Vehicles: A Consumer Perspective

Author: Fulton, L.

Abstract: This study evaluates eight-year ownership costs for battery electric vehicles (BEV) versus non-plugin hybrid vehicles, using forecasting to estimate future electricity and conventional gasoline prices and incorporating these in a multiple design of experiments simulation. Results suggest that while electric vehicles are statistically dominant in terms of variable costs over an 8-year life-span, high-performance hybrid non-plugins achieve variable fuel costs nearly as good as low-performing electric vehicles (those attaining only 3 miles per kilowatt hour) and that these hybrid acquisition costs are (on average) lower, yet the vehicles retain higher residual values. In general, the six smallest ownership costs are split evenly between hybrid and electric vehicles; however, inflation for conventional regular gasoline is estimated to outstrip inflation per kilowatt hour. Thus, non-plugin hybrid cars are likely to require considerably more advanced engineering to keep pace.

Subject Areas: BEV; Ownership cost analysis; Design of experiments; Forecasting; Monte carlo simulation

2.63. Title: How Do US Passenger Vehicle Fuel Economy Standards Affect Purchases of New and Used Vehicles?

Authors: Linn, J. and Dou, X.

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

Subject Areas: Passenger Vehicles; Fuel Tax; Fuel Economy Standard; Greenhouse Gas Emissions Standard; Consumer Demand; Vintage Differentiated Regulation; Used Vehicles

Title: Smart Deregulated Grid Frequency Control in Presence of Renewable Energy Resources by EVs Charging Control

Authors: Aliabadi, S.F., Taher, S.A. and Shahidehpour, M.

Abstract: Nowadays, due to the increasing price of fossil fuels and its decreasing resources on the one hand and environmental pollutions on the other hand, use of electric vehicles (EVs) has been increased. Charging EVs has imposed new loads on power systems. These new and major loads along with the deregulation of power systems, which introduces new uncertainties to grid, have caused new challenges for the frequency control and stability of power systems. Use of EVs as moving batteries is one of the ways for dealing with this problem. In this method, EV charging is controlled and, when necessary, EV battery is discharged in grid. This concept is so-called vehicle to grid (V2G). V2G concept is employed in this paper for the control of a smart deregulated grid frequency. For this purpose, an optimized fuzzy controller is used to control EVs. Using the proposed method, charging or discharging batteries is carried out with respect to grid frequency and battery state of charge. To investigate the proposed approach, a modified IEEE 39-bus system in the presence of renewable energy resources is assumed. Then, this system is converted into a three area system in order for the frequency analysis. Investigating the performance of the proposed method for the charging of EVs is done in another part of paper. Simulations are carried out in MATLAB/SIMULINK environment and their results illustrate good performance of the proposed method in the frequency control of deregulated system and EV charging.

Subject Areas: Smart grid; Deregulated grid; Vehicle to grid; Fuzzy control; Renewable energy

2.65. Title: The Impact of Electric Vehicle Penetration and Charging Patterns on the Management of Energy Hub—A Multi-agent System Simulation

Authors: Lin, H., Liu, Y., Sun, Q., Xiong, R., Li, H. and Wennersten, R.

Abstract: In this paper, a multi-agent system (MAS) was developed to simulate the operation of an energy hub (EH) with different penetration rates (PRs) and various charging patterns of electric vehicle (EV). Three charging patterns, namely uncontrolled charging pattern (UCP), rapid charging pattern (RCP) and smart charging pattern (SCP), together with vehicle to grid (V2G), were simulated in the MAS. The EV penetration rates (EV-PRs), from 10% to 90% with a step of 20%, are considered in this study. Under the UCP, the peak load increases by 3.4–17.1% compared to the case without EVs, which is the reference case in this study. A main part of the increased electricity demand can be supplied by the gas turbine (GT) when the PR is lower, i.e. 71.7% under 10% PR and 37.4% under 50% PR. Under the SCP, the charging load of EVs is shifted to the valley period and thus the energy dispatch of the EH at 07:00–23:00 remain the same as that in the reference case. When V2G is considered, the electricity demand from the grid becomes the largest in all of the cases, e.g. the demand with 50% PR doubles the electricity demand in the reference case. However, the GT output decreases by 2.9–15.7% at 07:00–23:00 due to the effect of V2G. The variations in the EH’s operation further raise the changes in energy cost, i.e. the electricity and cooling prices are lowered by 18.3% and 33.8% due to the availability of V2G and the heating and cooling prices increase by 3.5% and 4.3% under the UCP with the PR of 50%. Regarding the V2G capacity, near 39% of the EVs’ battery capacity can be discharged via V2G. In addition, the paper also produced a V2G potential line, which is an effective tool to provide the maximum potential of the EVs for peak shaving at any specific time.

Subject Areas: Multi-agent system; Electric vehicle; Charging pattern; Penetration rate; Energy hub

Title: Comparing the Emissions Benefits of Centralized vs. Decentralized Electric Vehicle Smart Charging Approaches: A Case Study of the Year 2030 California Electric Grid

Authors: Cheng, A.J., Tarroja, B., Shaffer, B. and Samuelsen, S.

Abstract: Grid communicative “smart” charging of electric vehicles can provide significant benefits for maximizing the emission reductions provided by the large-scale use of these vehicles. While decentralized approaches to smart charging can be practical to implement in real systems, it is unclear whether these provide the same benefits for the electric grid as those identified by centralized approaches in the literature. This study compares the CO$_2$ and NO$_x$ reduction benefits, and cost and grid capacity benefits, achieved by decentralized and centralized electric vehicle smart charging by modeling two different smart charging algorithms in battery electric vehicles and characterizing their effect on the operation and dispatch of electric grid resources and subsequently electric grid CO$_2$ and NO$_x$ emissions. Decentralized approaches were found to provide the same CO$_2$ emissions benefits and within 2% of the NO$_x$ emissions benefits achieved with centralized approaches, but only if the frequency of communication between vehicles and the electric grid is sufficiently high (less than 60min). The difference in NO$_x$ emission is associated with the increased load variability caused by less frequent communication in decentralized smart charging resulting in higher power plant startup events. Finally, costs and grid capacity needs are increased without frequent grid communication.

Subject Areas: Electric vehicle; Smart charging; Centralized; Decentralized; Electric grid; Emissions

2.67. Title: Design of Residential Plug-in Electric Vehicle Charging Station with Time of Use Tariff and IoT Technology

Authors: Divyapriya, S. and Vijayakumar, R.

Abstract: Electric vehicles (EVs) pull in around the globe because it has a benefit of energy saving and environmental protection. High Penetration of Electric Vehicles in the world makes an additional demand on the power system at peak time. To overcome this problem, Smart Charging Station is designed for residential. At peak time the power required to charge Electric Vehicles is effectively handled by Grid connected PV generation and also Electric Vehicles acted as an Uninterrupted Power Supply (UPS) based on Time of Use (TOU) Tariff. All control functions are done by the Raspberry Pi controller. The whole process monitored and controlled by using Internet of Things (IoT). The proposed control system and their control functions are done in MATLAB/SIMULINK.

Subject Areas: Batteries; Electric vehicles; Load modeling; Charging stations; Internet of Things; Plugs; Mathematical model

2.68. Title: Quantifying the Flexibility of Hydrogen Production Systems to Support Large-Scale Renewable Energy Integration

Authors: Wang, D., Muratori, M., Eichman, J., Wei, M., Saxena, S. and Zhang, C.

Abstract: Hydrogen is a flexible energy carrier that can be produced in various ways and support a variety of applications including industrial processes, energy storage and electricity production, and can serve as an alternative transportation fuel. Hydrogen can be integrated in multiple energy sectors and has the potential to increase overall energy system flexibility, improve energy security, and reduce environmental impact. In this paper, the interactions between fuel cell electric vehicles (FCEVs), hydrogen production facilities, and the electric power grid are explored. The flexibility of hydrogen production systems can create synergistic opportunities to better integrate renewable sources into the electricity system. To quantify this potential, we project the hourly system-wide balancing challenges in California out to 2025 as more renewables are deployed and electricity demand continues to grow. Passenger FCEV adoption and refueling behavior are modeled in detail to spatially and temporally resolve the hydrogen demand. We then quantify the system-wide balancing benefits of controlling hydrogen production from water electrolysis to mitigate renewable intermittency, without compromising the mobility needs of FCEV drivers. Finally, a control algorithm that can achieve different objectives, including peak shaving, valley filling, and ramping mitigation is proposed. Our results show that oversizing electrolyzers can provide considerable benefits to mitigate renewable intermittency, while also supporting the deployment of hydrogen vehicles to help decarbonize the transportation sector.

Subject Areas: Grid integration; Hydrogen; Fuel cell electric vehicle; Renewable energy; Electric power system; Duck curve

2.69. **Title:** The Development and Key Technologies of Smart Distribution Network Planning Converging High Penetration Level of EVs

**Authors:** Han, J., Hu, S., Shao, H., An, J., Yang, Y., Zhai, G. and Liu, X.

**Abstract:** As an effective way to solve energy problems and achieve sustainable development, electric vehicles (EVs) present broad application prospects. Without the help of effective distribution network planning and design methods, the development of EVs is impossible. However, due to the massive access of EVs, the planning and design of distribution network is quite different from the traditional power system. This paper presents the key steps of smart distribution network planning converging high penetration level of EVs on the technique side, reviews latest developments in the field of modelling methods, solving algorithms and evaluation methods, and emphatically discusses the coupling between the EVs charging behavior and the planning of distribution network, as well as the main comprehensive evaluation methods. The future research direction of smart distribution network with high-penetration level of EVs is proposed.

**Subject Areas:** Planning; Batteries; Load forecasting; Public transportation; Load modeling; Electric vehicle charging; Predictive models

2.70. Title: Fuel Consumption and Gasoline Prices: The Role of Assortative Matching between Households and Automobiles

Authors: Banzhaf, H.S. and Kasim, M.T.

Abstract: Analyses of policies to reduce gasoline consumption have focused on two effects, a compositional effect on the fuel economy of the automotive fleet and a utilization effect on how much people drive. However, the literature has missed a third effect: a matching effect, in which policies change how high-utilization households are matched to fuel-efficient vehicles in equilibrium. We show that higher gas prices should lead to stronger assortative matching. Empirical estimates using US micro-level data are consistent with this hypothesis. We find a $0.50 increase in the gas tax would reduce US gas consumption by 0.8% through the matching effect alone, bringing annual environmental benefits of about $1.7 billion.

Subject Areas: Energy; Gasoline demand; Automobiles

2.71. Title: Consumer Willingness to Pay for Vehicle Attributes: What do we Know?

Authors: Greene, D., Hossain, A., Hofmann, J., Helfand, G. and Beach, R.

Abstract: As standards for vehicle greenhouse gas emissions and fuel economy have become more stringent, concerns have arisen that the incorporation of fuel-saving technologies may entail tradeoffs with other vehicle attributes important to consumers such as acceleration performance. Assessing the effects of these tradeoffs on consumer welfare requires estimates of both the degree of the tradeoffs, and consumer willingness to pay (WTP) for the foregone benefits. This paper has two objectives. The first is to review recent literature that presents, or can be used to calculate, marginal WTP (MWTP) for vehicle attributes to describe the attributes that have been studied and the estimated MWTP values. We found 52 U.S.-focused papers with sufficient data to calculate WTP values for 142 different vehicle attributes, which we organized into 15 general groups of comfort, fuel availability, fuel costs, fuel type, incentives, model availability, non-fuel operating costs, performance, pollution, prestige, range, reliability, safety, size, and vehicle type. Measures of dispersion around central MWTP values typically show large variation in MWTP values for attributes. We explore factors that may contribute to this large variation via analysis of variance (ANOVA) and find that, although most have statistically significant effects, they account for only about one third of the observed variation. Case studies of papers that provide estimates from a variety of model formulations and estimation methods suggest that decisions made by researchers can strongly influence MWTP estimates. The paper’s second objective is to seek consensus estimates for WTP for fuel cost reduction and increased acceleration performance. Meta-analysis of MWTP for reduced fuel cost indicates that estimates based on revealed vs. stated preference data differ, as do estimates from models that account for endogeneity and those that do not. We find greater consistency in estimates of MWTP for acceleration despite substantial uncertainty about the overall mean. We conclude with recommendations for improving the understanding of consumers’ MWTP for vehicle attributes.

Subject Areas: Vehicle choice; Fuel efficiency; Vehicle attribute; Willingness to pay

Title: Stochastic Residential Energy Management System with Vehicle-to-Home and Photovoltaic Penetration

Authors: Wang, S., Dong, Z.Y., Luo, F., Ranzi, G. and Qiao, Y.

Abstract: This paper proposes a residential energy resource (RER) management system based on stochastic programming technique. The proposed system aims to minimize the home electricity cost while fully considering the user’s life convenience and solar photovoltaic uncertainty. The system optimally schedules plug-in electric vehicle and household shiftable appliances (SAs) in the presence of roof solar photovoltaic. Wasserstein distance metric and K-medoids based scenario generation & reduction techniques are used to tackle the renewable uncertainty. A waiting cost model is applied to measure the user’s preference on the household appliance operation. Simulation studies are conducted to validate the proposed method.

Subject Areas: Home energy management system; Demand side management; Demand response; Home automation

2.73. Title: Stochastic Modeling of the Charging Behavior of Electromobility

Authors: Sokorai, P., Fleischhacker, A., Lettner, G. and Auer, H.

Abstract: As electric vehicle market penetration grows steadily and charging demand along with it, the analysis of daily usage gains in significance. We propose in this paper a simple yet powerful tool based on a Markov chain that can model the stochastic nature of day to day usage of a charging station if adequate datasets on travel patterns are available. The model is generic and therefore can be tailored to different locations with different features. Within this work, we conducted a case study with the aim to verify the algorithm. By an additional sensitivity analysis, impacts of the made assumptions are considered. With a final analysis of two charging tariff designs the model provides valuable stochastic information about electricity consumption and annual revenues at a location of interest.

Subject Areas: Electromobility; Electric Vehicle; Fast Charging Station; Stochastic Model; Markov Chain; Charging Pattern

2.74. Title: Optimal sizing of PEV fast charging stations with Markovian demand characterization

Authors: Yang, Q., Sun, S., Deng, S., Zhao, Q. and Zhou, M.

Abstract: Fast charging stations are critical infrastructures to enable high penetration of plug-in electric vehicles (PEVs) into future distribution networks. They need to be carefully planned to ensure meeting charging demand as well as economic benefits. Accurate estimation of PEV charging demand is the prerequisite of such planning, but a non-trivial task. This paper addresses the sizing (number of chargers and waiting spaces) problem of fast charging stations and presents an optimal planning solution based on an explicit temporal-SoC characterization of PEV fast charging demand. The characteristics of PEV charging demand are derived through the vehicle travel behavior analysis using available statistics. The PEV dynamics in charging stations is modelled with a Markov chain and queuing theory. As a result, the optimal number of chargers and waiting spaces in fast charging stations can be jointly determined so as to maximize the expected operator profits, considering profit of charging service, penalty of waiting and rejection, as well as maintenance cost of idle facilities. The proposed solution is validated through a case study with mathematical justifications and numerical results from simulation.

Subject Areas: Plug-in electric vehicle (PEV); State of charge (SoC); Monte Carlo simulation; Markov model; Queuing theory; Charging station planning.


2.75. Title: Aggregated Electric Vehicle Resource Modelling for Regulation Services Commitment in Power Grid

Authors: Jain, P., Das, A. and Jain, T.

Abstract: The objective of this paper is to present a mechanism to determine the two-way energy storage capacity of a large pool of electric vehicles (EV) which can be contracted in ancillary services market on a long-term basis to provide the regulation up (RU) and regulation down (RD) to the grid. The proposed mechanism uses a scheme which delivers the schedule of power supplied to or drawn from the grid by treating the mobility attributes dependent electrical parameters. Two operational places, the workplace, and the home were identified as per driving pattern of customers for the provision of regulation ancillary service. An illustrative model considering a fleet of representative battery electric vehicle (BEV) is presented based on the mechanism, to obtain the minute-wise storage capacity that can be contracted in the market to provide frequency regulation to the grid. Results demonstrate that two major mobility traits namely, driven distance and arrival pattern, as well as the charging and discharging power standards directly influences the regulation schedule. Further, it has been realized that even though the charging cost is associated with energy consumption, the regulation provision will yield a notable revenue stream on a long-term capacity commitment basis. This supplements the concept of EVs participation in power markets by virtue of their high ramp up ramp down speed capabilities.

Subject Areas: Electric vehicle; Vehicle-to-grid (V2G); Grid-to-vehicle (G2V); Ancillary services; Regulation capacity; Charging-discharging power; Power scheduling

2.76. Title: Bi-Level Planning Model of Charging Stations Considering the Coupling Relationship between Charging Stations and Travel Route

Authors: Zang, H., Fu, Y., Chen, M., Shen, H., Miao, L., Zhang, S., Wei, Z. and Sun, G

Abstract: The major factors affecting the popularization of electric vehicles (EV) are the limited travel range and the lack of charging infrastructure. Therefore, to further promote the penetration of EVs, it is of great importance to plan and construct more fast charging stations rationally. In this study, first we establish a travel pattern model based on the Monte Carlo simulation (MCS). Then, with the traveling data of EVs, we build a bi-level planning model of charging stations. For the upper model, with an aim to maximize the travel success ratio, we consider the influence of the placement of charging stations on the user’s travel route. We adopt a hybrid method based on queuing theory and the greedy algorithm to determine the capacity of charging stations, and we utilize the total social cost and satisfaction index as two indicators to evaluate the optimal solutions obtained from the upper model. Additionally, the impact of the increase of EV ownership and slow charger coverage in the public parking lot on the fast charging demands and travel pattern of EV users are also studied. The example verifies the feasibility of the proposed method.

Subject Areas: Electric Vehicle; Fast Charging Station; Slow Charging; Bi-Planning Model; Travel Success Ratio

2.77. Title: Environmental Attributes of Electric Vehicle Ownership and Commuting Behavior in Maryland: Public Policy and Equity Considerations

Authors: Farkas, Z.A., Shin, H.S. and Nickkar, A.

Abstract: This research investigated the socio-demographic attributes that contribute to electric vehicle (EV) ownership and EV owners' commuting behavior based on different types of developed human settlements such as city, suburb, and rural area. EVs still are pricier than internal combustion engine vehicles (ICEVs). The objective of this study was to suggest public policies and recommendations to decision makers to prompt EV ownership equitably by identifying socio-demographic factors that influence the purchasing/leasing decision. The State of Maryland promotes EV ownership by subsidizing EV purchases and deploying charging facilities at transit rail stations. The other objective was to determine mode choice by EV owner commuters. An online survey of EV (non-fleets) owners registered in Maryland was conducted from July 1, 2016, to August 19, 2016. In total, 1,257 EV owners completed the survey. After assessing data quality, the survey data were tabulated and visualized to observe general trends that helped construct appropriate hypotheses and statistical models. Multinomial logistic regression models (MNL) were constructed to examine the associations between EV owner characteristics and their reasons for purchasing/leasing the EV. The findings revealed five key points. First, socioeconomic attributes such as age, education, income, household size, marital status, number of vehicles in a household, and political affiliation significantly affected EV owners' preference when making purchasing/leasing decisions. Second, environmental concerns were the main reason for purchasing and driving an EV; vehicle price was the third most important factor. Third, very few EV owners used rail transit for the commute to work prior to EV purchase, and even fewer after purchase. Fourth, EV owners who had longer commuting trips were more concerned about price and operating costs and efficiency and performance of the EV than those with shorter commuting trips. Fifth, some significant similarities and differences are found in the travel patterns of both EV and ICEV owners.

Subject Areas: Electric vehicle; EV incentive programs; Equity; Willingness-to-adopt; Maryland

Title: A Prediction Method of Electric Vehicle Charging Load Considering Traffic Network and Travel Rules


Abstract: Predicting the electric vehicle (EV) charging load is important to the power grid security. Current literature that researches EV charging load prediction rarely considers the specific traffic network and the trip characteristics of the drivers. This paper proposes a prediction method of electric vehicle charging load considering traffic network and travel rules. First, considering the travel rules of taxis and private cars, the travel information is obtained through the Monte Carlo simulation. Then, based on the road topology modeling and the cellular automata driving rules, we can simulate the driving process of the vehicle on the road. This paper mainly focuses on electricity consumption caused by the different speed and the use of air conditioner. The charging decision is determined by specific circumstances. Finally, by analyzing the charging information, we can predict the space-time distribution of the EV charging load.

Subject Areas: Electric vehicle; EV; Traffic network; Cellular automata; Charging load prediction

2.79. Title: Quantifying Vehicle Waste Heat: A Case Study of Phoenix, Arizona

Author: Hoehne, C.G.

Abstract: NA

Subject Areas: Vehicle waste heat; Arizona

https://repository.asu.edu/attachments/193507/content/20180115_hoehne_vehicle_waste_heat.pdf
2.80. Title: Real-time Optimal Energy Management Controller for Electric Vehicle Integration in Workplace Microgrid

Authors: Lakshminarayanan, V., Chemudupati, V.G.S., Pramanick, S. and Rajashekara, K.

Abstract: Electric vehicles (EV) that are connected to the charging station of a parking lot in a workplace can be considered as potential power sources. These EVs can be operated in both grid-to-vehicle (G2V) and vehicle-to-grid (V2G) modes of power transfer. However, an intelligent energy management (EM) controller is required for providing optimal schedule for V2G and G2V modes of operation. This paper proposes a real-time optimal EM controller for EV to grid integration for workplace microgrid system. In this proposed EM scheme, charging and discharging of EV battery is scheduled by forecasting the EV travel pattern using Random Forest methodology. In addition, the EM scheme is designed as optimization problem that utilizes this predicted EV travel data to minimize the cost energy consumption at the workplace. The EM scheme is developed by considering economic benefits to both the EV owner and the workplace. The EM controller is developed using Java Agent Development framework (JADE) and it is tested with real-world data in real-time simulation testbed. The real-time testbed is developed by interfacing two Typhoon HIL units emulating two electric vehicle batteries, and RTDS emulating the grid side power network.

Subject Areas: Electric vehicle (EV); Energy Management; EV forecasting; Microgrid; Multi-Agent System (MAS)

2.81. Title: Energy-saving Benefits from Plug-in Hybrid Electric Vehicles: Perspectives Based on Real-World Measurements

Authors: Zhou, B., Zhang, S., Wu, Y., Ke, W., He, X. and Hao, J.

Abstract: Promoting plug-in hybrid vehicles (PHEV) is one important option to mitigate greenhouse gas emissions and air pollutants for road transportation sector. In 2015, more than 220,000 new PHEVs were registered across the world, indicating a 25-fold growth during 2011–2015. However, more criticizes have been put forward against the current energy efficiency regulations for vehicles that are mostly depended on laboratory measurements. To better understand the real-world energy-saving and emission mitigation benefits from PHEVs, we conducted on-road testing experiments under various operating conditions for two in-use PHEVs in Beijing, China. Our results indicate that air condition usage, congested traffic conditions, and higher loading mass could significantly increase energy consumption and shorten actual all-electric distance for PHEVs. For example, the worst case (14.1 km) would occur under harshest usage conditions, which is lower by at least 35% than the claimed range over 20 km. In charge sustaining (CS) mode, real-world fuel consumption also presents a large range from 3.5 L/100 km to 6.3 L/100 km because of varying usage conditions. Furthermore, various vehicle users have significantly different travel profiles, which would lead to large heterogeneity of emission mitigation benefits among individual PHEV adopters. Therefore, this study suggests that the global policy makers should use real-world energy efficiency of emerging electrified powertrain techniques as criteria to formulate relevant regulations and supportive policies.

Subject Areas: Plug-in hybrid electric vehicle; On-road test; Energy consumption; Driving condition; Utility factor

2.82. Title: Distributionally Robust Distributed Generation Hosting Capacity Assessment in Distribution Systems

Authors: Seydali Seyf Abad, M., Ma, J., Ahmadyar, A. and Marzooghi, H.

Abstract: Uncertainties associated with the loads and the output power of distributed generations create challenges in quantifying the integration limits of distributed generations in distribution networks, i.e., hosting capacity. To address this, we propose a distributionally robust optimization-based method to determine the hosting capacity considering the voltage rise, thermal capacity of the feeders and short circuit level constraints. In the proposed method, the uncertain variables are modeled as stochastic variables following ambiguous distributions defined based on the historical data. The distributionally robust optimization model guarantees that the probability of the constraint violation does not exceed a given risk level, which can control robustness of the solution. To solve the distributionally robust optimization model of the hosting capacity, we reformulated it as a joint chance constrained problem, which is solved using the sample average approximation technique. To demonstrate the efficacy of the proposed method, a modified IEEE 33-bus distribution system is used as the test-bed. Simulation results demonstrate how the sample size of historical data affects the hosting capacity. Furthermore, using the proposed method, the impact of electric vehicles aggregated demand and charging stations are investigated on the hosting capacity of different distributed generation technologies.

Subject Areas: Distributed generation; Distributionally robust optimization; Electric vehicles; Hosting capacity; Over-voltage; Radial distribution systems; Thermal capacity limits

2.83. Title: Reliability Modeling of Electric Vehicles and Its Impact on Distribution Network

Authors: Wu, H., Li, S. and Ren, Y.

Abstract: The integration of high penetration electric vehicles (EVs) into a power grid challenges distribution system operations. This has increased the need to study the reliability of distribution networks integrated with EVs. By considering the spatial-temporal characteristics of the EVs, a dispatchable EV time distribution model, a spatial distribution model, a battery state of charge (SOC) model, and an output factor model of EVs are developed in this paper. Advanced dispatch strategies coordinated EVs and wind turbine generators (WTGs) are proposed for system reliability assessment under both normal and fault states. The sequential Monte Carlo simulation method is applied to evaluate distribution network reliability. By using the IEEE RBTS 6-Bus system, the proposed models and strategies are analyzed and verified. A numerical case study demonstrated that the EVs and WTGs coordinated dispatch is beneficial for improving the distribution network reliability.

Subject Areas: Distribution network; Electric vehicle; Coordinated dispatching; Reliability evaluation

2.84. Title: Assessment of Plug-in Electric Vehicles Charging Impacts on Residential Low Voltage Distribution Grid in Hungary

Authors: Ramadan, H., Ali, A. and Farkas, C.

Abstract: The growing concerns over greenhouse gas emissions coupled with the improvement of electric vehicle technology have encouraged the electrification of the transportation sector. Plugin electric vehicles (PEVs) are becoming an alternative to vehicles powered by an internal combustion engine. This leads to environmental benefits, but these PEVs represent new challenges facing the power grid. Therefore, the power grid must be prepared for these challenges. This paper provides a comprehensive study of PEVs charging impact on the low voltage distribution grid. For this purpose, a typical Hungarian low voltage grid was modeled in DIgSILENT Power Factory. Two charging scenarios have been studied, uncoordinated charging and delayed charging. Three penetration levels of PEVs are considered in this paper as follows, 20%, 40%, and 60% Time sweep analysis is used to investigate transformer loading, feeders loading, voltage deviation and system total losses. The results show that at 60% penetration level with uncoordinated charging, both the distribution transformer and feeders thermal loading violation is experienced. On the contrast, with the delayed charging, all the grid components function at their normal rating at all penetration levels and no network upgrade is required.

Subject Areas: Plug-in electric vehicles (PEVs); Low voltage distribution grid; Time sweep analysis; Uncoordinated charging; Delayed charging

2.85. Title: A Stochastic Programming Approach for Electric Vehicle Charging Network Design

Authors: Faridimehr, S., Venkatachalam, S. and Chinnam, R.B.

Abstract: The advantages of electric vehicles (EVs) include reduction of greenhouse gas and other emissions, energy security, and fuel economy. The societal benefits of large-scale adoption of EVs cannot be realized without adequate deployment of publicly accessible charging stations. We propose a two-stage stochastic programming model to determine the optimal network of charging stations for a community, considering uncertainties in the arrival and dwell times of vehicles, the state of charge of arriving vehicles’ batteries, drivers’ walking ranges and charging preferences, demand during weekdays and weekends, and the community’s rate of EV adoption. We conducted studies using the sample average approximation method, which asymptotically converges to an optimal solution for a two-stage stochastic problem. However, this method is computationally expensive for large-scale instances. Therefore, we also developed a heuristic to produce nearly optimal solutions quickly for our data instances. We conducted computational experiments using various publicly available data sources and evaluated the benefits of the solutions for a given community, both quantitatively and qualitatively.

Subject Areas: Two-stage stochastic programming; Electric vehicle; Charging network; Sample average approximation.

2.86. Title: Application of V2G and G2V Coordination of Aggregated Electric Vehicle Resource in Load Levelling

Authors: Jain, P. and Jain, T.

Abstract: This paper proposes a distinct vehicle-to-grid (V2G) and grid-to-vehicle (G2V) coordination model to utilize the controllability of electric vehicle (EV) battery storage system during the charging and discharging phases for load levelling. The aspect of the vehicles of changeable locations is taken as the basis to obtain a defined mobility pattern, with home and work being selected as the operational places to perform G2V and V2G activities. The presented approach assisted in achieving peak shaving and valley filling (MW) of a typical two-peak daily load curve of a real system to a considerable extent, thereby levelling the load and reducing the complexities associated with the forecasting and dispatch of the oscillating load. The reduction in the ramp up and ramp down energy and reserve requirements (MW), as well as the cost savings associated with reduced generation ramping commitments, as seen from system operator’s perspective, is quantified with the proposed schemes. Results demonstrate that the proposed approach is capable of flattening a realistic amount of load. The associated cost savings with reduced ramping requirements from traditional sources can be allocated to participating vehicles for providing the grid services. The benefits derived can encourage their adoption which is contained due to its expensiveness in the current market scenario, apart from increasing the grid reliability.

Subject Areas: Vehicle-to-grid (V2G); Grid-to-vehicle (G2V); Load levelling; Peak shaving; Valley filling

2.87. **Title:** Pricing of Flexibility Provisions from a Reinforced Electric Vehicle Charging Facility with DERs

**Authors:** Alharbi, W. and Bhattacharya, K.

**Abstract:** A novel flexibility pricing model (FPM) is proposed in this paper to determine the service price of flexibility provided to the main grid, by an electric vehicle charging facility (EVCF) optimally reinforced with distributed energy resources (DERs). The proposed FPM seeks to achieve a targeted profit of an investor. A flexibility index is introduced to calculate the flexibility in the EVCF load, and hence determine the extent to which the EVCF is flexible, when equipped with DERs. The DER options considered for reinforcement of the EVCF are energy storage systems (ESS) and rooftop photovoltaic (PV) generation. Case studies considering a 33 bus distribution system are presented and discussed to validate the proposed model.

**Subject Areas:** Distributed energy resources; Electric vehicle charging facility; Flexibility pricing

2.88. Title: The Impact of PHEVs Charging and Network Topology Optimization on Bulk Power System Reliability

Authors: Li, Y., Xie, K., Wang, L. and Xiang, Y.

Abstract: Exhausting fossil fuels and increasing environmental pollutions call for the wider deployment of plug-in hybrid electric vehicles (PHEVs), which enable the interactions of transportation and electric sectors. The extra loads for charging massive PHEVs could compromise the power system reliability and impose considerable stress on the power system. Transmission line congestions and generation capacity inadequacy could be caused under this circumstance. However, there is little literature which comprehensively studies the impact of large-scale PHEVs on the bulk power system reliability when smart grid technologies are incorporated including smart charging and flexible transmission topology control technologies. This work studies the impacts of different charging strategies and transmission network operation strategies on the bulk power system reliability with high PHEVs integration. An evolution strategy particle swarm optimization (ESPSO) algorithm is applied to optimize the charging load of PHEVs and shave the peak load. A network topology optimization (NTO) operation strategy is employed to lessen the transmission congestions and reduce the load curtailment. Based on the sequential Monte Carlo simulation method, these technologies are integrated into the reliability evaluation process. Numerical studies and sensitivity analysis are conducted on modified IEEE RTS-79 systems. The results verify the effectiveness of the technologies to realize the potential of existing power system infrastructures so as to relieve the stress caused by the PHEVs load, increase the available penetration of PHEVs and promote the bulk power system reliability which is meaningful for power system planning and risk management.

Subject Areas: Plug-in electric vehicles; Charging strategy; Evolution strategy particle swarm optimization; Network topology optimization; Power system reliability

Title: Technical and Economic Impact of PV-BESS Charging Station on Transformer Life: A Case Study

Authors: Affonso, C.M. and Kezunovic, M.

Abstract: The uncoordinated charging of several plug-in electric vehicles in a parking garage can potentially overload distribution transformer reducing its lifetime. Attempting to mitigate this issue, this paper proposes a smart charging method to minimize electricity consumption costs and avoid transformer overloading, considering a charging station integrated with photovoltaic (PV) generation and battery energy storage system (BESS). The optimal coordination among all these elements is investigated assessing transformer hottest-spot temperature and loss-of-life, considering a case study with time-of-use rate and meteorological data from Texas, USA. In addition, an economic analysis is developed to evaluate the viability of the project, with a sensitivity study considering different charging fees and variation in the daily number of vehicles parked in the garage. The results show the proposed approach is feasible, yields tangible financial benefits and can preserve distribution transformer life.

Subject Areas: Batteries; Electric vehicle charging; Buildings; Aging; Photovoltaic systems

https://ieeexplore.ieee.org/abstract/document/8444729
2.90. Title: Modeling and Solving Method for Supporting ‘Vehicle-to-Anything’ EV Charging Mode

Authors: Mao, T., Zhang, X. and Zhou, B.

Abstract: Electric vehicles (EVs) are an attractive solution to make traditional transportation energy-efficient and environmentally friendly. EVs are also considered an important element to bring new opportunities for power grids. In addition to the role of a pure load, along with the development of discharging technology for batteries, EVs can deliver energy back to power grids or another power consumption entity or community, performing various discharging activities such as vehicle-to-home (V2H), vehicle-to-building (V2B), vehicle-to-vehicle (V2V), vehicle-to-grid (V2G), etc. These charging scenarios can be uniformly named the ‘Vehicle-to-anything’ (V2A) charging mode. The paradigm of this charging mode has already been given; however, the modeling and solving approaches are still insufficient. Therefore, the analysis and modeling of V2A are investigated herein. The aim is to propose a generic model suitable for different applications of V2A in different places. The characteristics of the V2A charging mode are given and analyzed first. Then a model that can adapt to the V2A scenario is illustrated. The optimization problem is transformed and solved as an INLP (integer nonlinear programming) problem. The effectiveness of the approach is verified with simulation results. The outcome also indicates that V2A applications have great potential for lowering power consumption costs; for instance, a reduction of 4.37% in energy expense can be achieved in a case study with EV discharging enabled for a household.

Subject Areas: Electric vehicles (EVs); Vehicle-to-home (V2H); Vehicle-to-building (V2B); Vehicle-to-vehicle (V2V); Vehicle-to-grid (V2G)

2.91. Title: Effects of V2H Integration on Optimal Sizing of Renewable Resources in Smart Home Based on Monte Carlo Simulations

Authors: Naghibi, B., Masoum, M.A. and Deilami, S.

Abstract: This paper investigates optimal sizing of rooftop PV, wind turbine (WT), and battery storage system (BSS) in smart home (SH) with a plug-in electric vehicle (PEV) considering vehicle-to-home (V2H) and home-to-grid operations. The proposed idea is to use a rule-based home energy management system (HEMS) along with the Monte Carlo simulations and particle swarm optimization to find the optimal sizes of renewable resources and BSS by minimizing the annual cost of household electricity. The probabilistic behaviors of wind speed, irradiance, temperature, load and electricity rate, as well as the availability of PEV are considered for the input data generation. Detailed simulations and sensitivity analyses are performed to investigate the impacts of shiftable loads, V2H integration, battery charge/discharge rates, designated maximum daily export energy and maximum PV, and WT and battery capacity limits on the annual and levelized costs of electricity. Our analyses reveal the possibility of eliminating BSS altogether in SH with PEV with some reduction in annual electricity cost.

Subject Areas: Batteries; Wind speed; State of charge; Smart homes; Erbium; Discharges (electric); Monte Carlo methods

2.92. Title: Stochastic Model Predictive Control Based Scheduling Optimization of Multi-Energy System Considering Hybrid CHPs and Evs

Authors: Guo, X., Bao, Z. and Yan, W.

Abstract: Recently, the increasing integration of electric vehicles (EVs) has drawn great interest due to its flexible utilization; moreover, environmental concerns have caused an increase in the application of combined heat and power (CHP) units in multi-energy systems (MES). This paper develops an approach to coordinated scheduling of MES considering CHPs, uncertain EVs and battery degradation based on model predictive control (MPC), aimed at achieving the most economic energy scheduling. After exploiting the pattern of the drivers’ commuting behavior, the stochastic characteristics of available charging/discharging electric power of aggregated EVs in office or residential buildings are analyzed and represented by the scenarios with the help of scenario generation and reduction techniques. At each step of MPC optimization, the solution of a finite-horizon optimal control is achieved in which a suitable number of available EVs scenarios is considered, while the economic objective and operational constraints are included. The simulation results obtained are encouraging and indicate both the feasibility and the effectiveness of the proposed approach.

Subject Areas: Combined Heat and Power (CHP); Electric Vehicles (EVs); Model Predictive Control (MPC); Multi-energy system (MES); Optimization; Stochastic

2.93. Title: Stackelberg Game Approach on Modeling of Supply Demand Behavior Considering BEV Uncertainty

Authors: Azimian, B., Fijani, R.F., Ghotbi, E. and Wang, X.

Abstract: Based on sophisticated metering infrastructure (AMI), one can use big data to provide demand-response (DR) solutions. There is a need to develop optimized cost structures for consumers. In this paper, Stackelberg game approaches are utilized, and residential loads are considered including battery electric vehicles (BEVs) equipped with BEV communication controllers and vehicle-to-grid (V2G) technologies. Efficient and effective optimized algorithms are developed for users (followers) based on time dependent pricing schemes. In the “games,” besides the followers, other participant is an electricity retailer company (leader), with a two-way bilateral communication procedure accepted and established by all participants. The user side of the games is related to the demand side management (DSM). Real-time pricing (RTP) from time-of-use (TOU) companies is used to achieve better results. Monte Carlo simulations (MCS) represent uncertain behaviors of BEV drivers. Results indicate that customers’ demands can be met while reaching the best efficiency.

Subject Areas: Companies; Load modeling; Batteries; Pricing; Vehicle-to-grid; Game theory; Games

2.94. Title: A Coordinated Charging Strategy for Electric Vehicles Based on Hierarchical Optimization

Authors: Jin-Yong, S.H.I., Hui-Min, K.E., Chong, L.I. and Jun-Jun, S.H.A.O.

Abstract: There are many electric vehicles charging stations in distribution network. Uncoordinated charging electric vehicles load is large and changes quickly, it brings risk to the operation of power grid. If taking each station as an independent unit, which will reduce the practicability of the proposed strategy because of the small consideration scope and incomplete information acquisition. Taking all electric vehicles in the distribution network as an object to study will lack the consideration about the differentiation of a single charging stations. Also, controlling all electric vehicles directly through the control center has high demand on reliability. And it is difficult to implement. Given this, the paper used the hierarchical control method to control the electric vehicles in the charging stations and studied charging strategy based on hierarchical optimization. The upper layer used the distribution system load variance as an objective function to establish a model and peak load shifting. The lower level model took the actual charging power deviation and load variance of the charging station into account to reduce the load fluctuation of the charging station. The paper used function fmincon to solve the upper level model and used CPLEX to solve the lower layer model. Finally, using a modified IEEE 33-bus system with 3 EVAs to verify the feasibility of the model and method, which reduced frequency between the control center and electric vehicles. Also, it cuts peak load and reduces load fluctuations of charging stations.

Subject Areas: Electric vehicles; Hierarchical optimization; Peak load shifting; Load fluctuation

https://www.atlantis-press.com/proceedings/edep-18/25903020
2.95. Title: Influence of the Electric vehicle battery size and EV penetration rate on the potential capacity of Vehicle-to-grid

Authors: Liu, Y., Lin, H., Yu, W., Luyao, L., Sun, Q. and Wennersten, R.

Abstract: The idea that electric vehicles can connect to grid to serve as energy storage energy devices is compelling, especially in situations where traditional forms of storage, back-up energy supply is unavailable or expensive, or considering the volatility of frequency. So far, the viability and reliability of vehicle-to-grid(V2G) has become a very popular research topic. Previous studies mainly focused on the maximum potential of V2G capacity, which, however, is usually unrealistic to achieve. The potential capacity of V2G is relevant to the size of batteries and the penetration rates of electric vehicle. This article developed an agent-based model to estimate the real amount of electricity that vehicles can discharge to the grid. Three battery sizes under the penetration rate of 90% and the penetration rate from 10% to 90% were investigated. The results show that the increase of battery capacity led to an increase of V2G potential capacity from 1650.2 kW to 1868.5 kW and that increase from 10% to 90% in penetration rate could account for V2G potential capacity change from 162.8 kW to 1650.2 kW.

Subject Areas: Electric vehicles; Hierarchical optimization; Peak load shifting; Load fluctuation

2.96. Title: Microgrid Feasibility Study for Future Smart Communities: A Case Study for London, Ontario

Authors: Rezai, E.A., Stevens, G. and El-Saadany, E.F.

Abstract: Given the international focus on microgrids, smart communities and smart city developments, this paper presents the first large-scale fully integrated net-zero energy (NZE) smart community under development in Canada, which creates a showcase for sustainable design and draws society to participate; with the overall goal of developing a new community with minimal impact on the environment. The conceptual microgrid design considerations are illustrated along with discussions and analyses of feasibility indicators such as energy efficiency, system flexibility, renewables penetration, and GHG emission reduction.

Subject Areas: Electric vehicle; Energy storage; Net-zero energy buildings; PVenergy; Smart communities

2.97. Title: Online Modeling and Identification of Plug-in Electric Vehicles Sharing a Residential Station

Authors: Danté, A.W., Agbossou, K., Kelouwani, S., Cardenas, A. and Bouchard, J.

Abstract: In this paper, a novel plug-in electric vehicle (PEV) modeling approach is proposed for residential charging stations. This methodology can be used in the design of autonomous energy management systems (EMS) with the purpose of providing the charging schedules using minimum input measured data. The proposed method is composed of two main steps. In the first step, unlike other similar works, online PEV recognition is performed by means of an artificial neural network as a supervised classification method. The required feature space for classification is provided using the power spectral density estimation and the statistical analysis of individual PEVs charging current. The second step deals with the statistical modeling of the charging habits to facilitate the scheduling by predicting the charging demand using the current measurements on the grid side. In this respect, each PEV charging habit is modeled based on the correlation among the plug-in time, departure time, required energy, and weekdays using kernel density estimation. The performance of the suggested method is validated using real data collected from a charging station. The final results confirm the applicability of the proposed methodology with a satisfactory precision. The effectiveness of the method is demonstrated using a comparative analysis in terms of the recognition performance.

Subject Areas: Plug-in electric vehicles; Battery charging profile; Neural network; Support vector machines; Pattern classification; Statistical modeling; Smart grid; Feature selection

2.98. **Title:** Dynamic Modeling of California Grid-Scale Hydrogen Energy Storage

**Authors:** Heydarzadeh, Z., McVay, D., Flores, R., Thai, C. and Brouwer, J.

**Abstract:** The dynamics of hydrogen energy storage (HES) integrated with large-scale renewable power (119.5 GW) using the capabilities of the existing California natural gas infrastructure were investigated. The dynamics associated with the grid demand, renewable power, pressure, and HES capacity for one week each of November and August were analyzed in detail while a higher level analysis of the entire state for the whole year was simulated in MATLAB/Simulink. It was found that the existing natural gas storage facilities may be converted to hydrogen storage facilities to store otherwise curtailed renewable energy through solid oxide electrolysis (SOE). Moreover, Solid Oxide Fuel Cell (SOFC) systems can also be used to dispatch the hydrogen back to the grid as power. The analysis in this paper shows that the dynamics of California natural gas underground storages associated with pressure and mass flow rate for achieving HES to support 100% renewable gas use are reasonable.

**Subject Areas:** Hydrogen energy storage (HES); California; Natural gas

[http://ecst.ecsd1.org/content/86/13/245.short](http://ecst.ecsd1.org/content/86/13/245.short)
2.99. Title: Evaluating the Impacts of Centralized and Decentralized Electric Vehicle Smart Charging Algorithms on the Electric Grid

Authors: Cheng, A.J.W.

Abstract: Plug-in electric vehicles (PEVs) are considered one of the leading solutions in reducing greenhouse gas emissions since they remove carbon emissions from the tailpipe. However, as their penetration in the vehicle market increases, so will their impact on the electric grid. To minimize the impact that PEVs have on the electric grid, “smart” charging protocols are necessary to manage PEV charging. This study evaluates how two smart charging architectures, a centralized and decentralized architecture, impact both small and large-scale electric grids through real deployment of the algorithms as well as MATLAB simulations.

The “field-deployable” decentralized charging algorithm uses a telematics-based approach to create charging schedules for 10 PEVs deployed on the University of California, Irvine’s (UCI) microgrid. The results reveal that a barrier associated with this approach is the need to retrieve the vehicles’ status, referred to as “polling.” Polling affects how the algorithm creates charging schedules. To determine the effect of polling, simulations are performed on different buildings on the UCI campus using National Household Travel Survey data to simulate vehicle travel patterns. The results show that, if polling occurs frequently (e.g., once every 10 minutes), the charging schedules are not significantly altered. To determine whether or not the decentralized algorithm can provide the same emissions benefits as an ideal centralized algorithm on large-scale systems, both algorithms are simulated on the California electric grid for the year 2030. The results reveal that the decentralized algorithm provides the same emissions benefits as the centralized algorithm, but only if communication between the grid and vehicles is sufficiently frequent (e.g., 60 minutes or less).

Subject Areas: Plug-in electric vehicles (PEVs); Smart charging; Centralized; Decentralized; Electric grid; Algorithm

2.100. Title: Apartments Rarely come with Access to Charging Stations. But Electric Vehicles Need Them

Authors: Davis, L.

Abstract: Blog

Subject Areas: Electric vehicles; Charging stations

2.101. Title: In the US, rental property is one of the biggest barriers to electric vehicle take up

Author: Davis, L.

Abstract: Blog

Subject Areas: Electric vehicles; Homeowners; Renters

Availability: Davis, L., 2018. In the US, rental property is one of the biggest barriers to electric vehicle take up. Transport, CityMetric. https://www.citymetric.com/transport/us-rental-property-one-biggest-barriers-electric-vehicle-take-4112
2.102. Title: All Charged Up, No Place to Go

Author: Davis, L.

Abstract: Blog

Subject Areas: Electric vehicles; Homeowners; Renters

2.103. Title: Plug-in Hybrids shouldn’t just be California Compliance Cars

Author: Halvorson, B.

Abstract: Blog

Subject Areas: Plug-in Hybrids; Urban environments; California

2.104. Title: A Cluster Based Model to Enhance Acceptance of New Energy Driven Technologies

Author: Asudegi, M.A.

Abstract: Resistance against new innovative technologies by customers has been studied in many publications to improve prediction of behavior. Econometrics models, the Technology Acceptance Model by Fred D. Davis (1989), and market research models are the most widely used modeling techniques to predict and understand customer behaviors. The proposed methodology in this paper advances current models by relaxing many of their assumptions and increasing prediction accuracy. A case study in predicting hybrid car buyer behaviors is performed to illustrate and validate the suggested modeling method named as the Energy Efficiency Technology Acceptance Model.

Subject Areas: Energy Efficiency Technology Acceptance Model; Market research models


Author: Rastegar, M.

Abstract: Residential energy management (REM) systems facilitate the application of residential demand response programs to manage the increasing demand of electricity in power systems. The load curtailment at high price periods and the load shift from high-price to low-price periods are the main results of REM implementation, which may improve the technical and economical operation of the distribution systems. Customers’ satisfaction should be considered in the REM procedure to motivate the customers to respond to the received price signals. This paper proposes an optimization-based REM to minimize not only the customer’s energy cost but also customer dissatisfaction, which is modeled as a function of load curtailment. In addition, the impact of broad application of REM in bus 6 of RBTS is studied on the reliability of a distribution system. To this end, two different methods for reliability evaluation are used to show the effect of load shift and load curtailment on the energy not supplied by the distribution system. The results verify the validity and effectiveness of the proposed REM approach and show the impact of application of REM programs with different penetration levels on the reliability of the distribution system.

Subject Areas: Demand response; Power system reliability; Load modeling; Home appliances; Energy consumption; Customer satisfaction; Energy management

2.106. Title: Solar Electric Vehicles: State-of-the-art and Perspectives

Authors: Conti, S., Di Mauro, S., Raciti, A., Rizzo, S.A., Susinni, G., Musumeci, S. and Tenconi, A.

Abstract: The progressive reduction of global oil reserves and the issues related to the emission of air pollutions have spotlighted the urgent need for the production of vehicles enabling the reduction of both the fuel consumption and pollution. Nowadays, the hybrid electric vehicles are a viable option to guarantee reduction of both oil consumption and emissions. In the last decade, it is also appearing the diffusion of vehicles having photovoltaic (PV) panels: the hybrid solar vehicle (HSV). This survey deepens and reviews the actual state-of-the-art of the HSV, the improvements and the issues related to them, the latest development in the related technologies and the future trend. Finally, the outlook of the main themes of research, useful for a wider diffusion of HSV, are highlighted. From the review, it come to light a lack of a depth studies of HSVs considering the interaction and impact on the grid and the need for high efficiency PV panels.

Subject Areas: Investment; Energy management; Batteries; Electric vehicles; Photovoltaic systems; Economics

3. Environment

3.1. Title: Mapping The Influence of Food Waste in Food Packaging Environmental Performance Assessments.

Authors: Heller, M.C., Selke, S.E. and Keoleian, G.A

Abstract: Scrutiny of food packaging environmental impacts has led to a variety of sustainability directives, but has largely focused on the direct impacts of materials. A growing awareness of the impacts of food waste warrants a recalibration of packaging environmental assessment to include the indirect effects due to influences on food waste. In this study, we model 13 food products and their typical packaging formats through a consistent life cycle assessment framework in order to demonstrate the effect of food waste on overall system greenhouse gas (GHG) emissions and cumulative energy demand (CED). Starting with food waste rate estimates from the U.S. Department of Agriculture, we calculate the effect on GHG emissions and CED of a hypothetical 10% decrease in food waste rate. This defines a limit for increases in packaging impacts from innovative packaging solutions that will still lead to net system environmental benefits. The ratio of food production to packaging production environmental impact provides a guide to predicting food waste effects on system performance. Based on a survey of the food LCA literature, this ratio for GHG emissions ranges from 0.06 (wine example) to 780 (beef example). High ratios with foods such as cereals, dairy, seafood, and meats suggest greater opportunity for net impact reductions through packaging-based food waste reduction innovations. While this study is not intended to provide definitive LCAs for the product/package systems modeled, it does illustrate both the importance of considering food waste when comparing packaging alternatives, and the potential for using packaging to reduce overall system impacts by reducing food waste.

Subject Areas: Food Packaging; Food waste; GHG emissions; Industrial ecology; Life Cycle Assessment (LCA)

3.2. Title: Carbon Footprint Planning: Quantifying Local and State Mitigation Opportunities for 700 California Cities

Authors: Jones, C.M., Wheeler, S.M. and Kammen, D.M.

Abstract: Consumption-based greenhouse gas (GHG) emissions inventories have emerged to describe full life cycle contributions of households to climate change at country, state and increasingly city scales. Using this approach, how much carbon footprint abatement potential is within the control of local governments, and which policies hold the most potential to reduce emissions? This study quantifies the potential of local policies and programs to meet aggressive GHG reduction targets using a consumption-based, high geospatial resolution planning model for the state of California. We find that roughly 35% of all carbon footprint abatement potential statewide is from activities at least partially within the control of local governments. The study shows large variation in the size and composition of carbon footprints and abatement opportunities by ~23,000 Census block groups (i.e., neighborhood-scale within cities), 717 cities and 58 counties across the state. These data and companion online tools can help cities better understand priorities to reduce GHGs from a comprehensive, consumption-based perspective, with potential application to the full United States and internationally.

Subject Areas: Carbon footprint; Climate action plans; Climate change; Consumption; Emissions inventory; Greenhouse gas

3.3. **Title:** Estimating Individualized Exposure Impacts from Ambient Ozone Levels:
A Synthetic Information Approach

**Authors:** Pires, B., Korkmaz, G., Ensor, K., Higdon, D., Keller, S., Lewis, B. and Schroeder, A.

**Abstract:** There is ample evidence that short-term ozone exposure is associated with increased respiratory symptoms. Many studies, however, aggregate the population, activities, or concentration levels of the pollutant across space and/or time, failing to capture critical variations in the exposure levels. We couple spatiotemporal air quality estimates of ozone with a synthetic information model of the Houston Metropolitan Area, allowing us to attach exposure levels to individuals based on exact times, geo-locations, and microenvironments of activities. Several scenarios of the model are run at different levels of resolution. When we maintain the spatiotemporal resolution of the data, the proportion of the population that experiences sharp increases in short-term exposure increases substantially. This can be particularly important if experienced by sensitive populations given the increased risk for adverse health effects. We find that individuals in the same zip code, neighborhood, and even household have varying levels of exposure.

**Subject Areas:** Synthetic populations; Air quality; Ozone; Microenvironment; Personal exposure

3.4. Title: The Influence of the Built Environment of Neighborhoods on Residents’ Low-Carbon Travel Mode

Authors: Qian, C., Zhou, Y., Ji, Z. and Feng, Q.

Abstract: Motor vehicle travel is one of the causes of aggravation of CO2 emission, environmental issues and urban problems. The advocacy of low-carbon travel is necessary for the achievement of low-carbon city construction and sustainable development in the future. Many studies have shown that built environment tends to influence residents’ travel behavior, and most studies are demonstrated from the macro level of metropolis. However, from the perspective of neighborhoods, much less attention has been paid, especially in developing countries including China. This study chooses 15 neighborhoods in the main districts of Nanjing in China, taking the location of neighborhoods and residents’ socio-economic attributes into consideration, to examine the effects of residential built environment on residents’ mode choice of different travel types, and to propose the recommended values for the most significant variables. The residential built environment attributes are from three dimensions of land use, road network system and transit facilities. The method of this study is three-step and successive. Primarily, a correlation analysis model is applied to initially examine the role that residents’ socio-economic attributes and residential built environment attributes play on residents’ low-carbon travel of three different travel types respectively. Primary significant attributes from these two aspects are preliminarily screened out for the re-screening in the next step. In addition, the study uses multivariate logit regression modeling approach, with significant socio-economic attributes as concomitant variables, to further re-screen out the key variables of built environment. Furthermore, a unary linear regression model is applied to propose the recommended values for the key built environment variables.

Subject Areas: Neighborhood; Built environment; Low carbon travel; Correlation analysis model; Multivariate Logit regression model; Unary linear regression model

3.5. Title: A Life Cycle Assessment of the Environmental Impacts of A Beef System in the USA

Authors: Asem-Hiablie, S., Battaglie, T., Stackhouse-Lawson, K.R. and Rotz, C.A.

Abstract: The need to assess the sustainability attributes of the United States beef industry is underscored by its importance to food security locally and globally. A life cycle assessment (LCA) of the US beef value chain was conducted to develop baseline information on the environmental impacts of the industry including metrics of the cradle-to-farm gate (feed production, cow-calf, and feedlot operations) and post-farm gate (packing, case-ready, retail, restaurant, and consumer) segments.

Subject Areas: Beef footprints; Beef production emissions; Beef sustainability; Beef value chain

3.6. Title: Future of Mobility White Paper

Authors: Shaheen, S., Totte, H., and Stocker, A.

Abstract: Transportation is arguably experiencing its most transformative revolution since the introduction of the automobile. Concerns over climate change and equity are converging with dramatic technological advances. Although these changes – including shared mobility and automation – are rapidly altering the mobility landscape, predictions about the future of transportation are complex, nuanced, and widely debated. California is required by law to renew the California Transportation Plan (CTP), updating its models and policy considerations to reflect industry changes every five years. This document is envisioned as a reference for modelers and decision makers. We aggregate current information and research on the state of key trends and emerging technologies/services, documented impacts on California’s transportation ecosystem, and future growth projections (as appropriate). During 2017, we reviewed an expanded list of 20 topics by referencing state agency publications, peer-reviewed journal articles, and forecast reports from consulting firms and think tanks. We followed transportation newsletters and media sources to track industry developments, and interviewed six experts to explore their opinions on the future of transportation. We consulted an advisory committee of over 50 representatives from local and state transportation agencies, who provided input throughout the project’s evolution. We also obtained feedback on our draft report from a panel of U.S. experts.

Subject Areas: Transportation; Climate Change; Technological advances

3.7. Title: Optimizing One-day Driving Restriction using Mathematical Programming

Authors: Silva, C.G. and Kim, M.K.

Abstract: A one-day driving restriction prohibits drivers from operating their vehicles on a given weekday in an attempt to reduce traffic congestion and air pollution. A restricted weekday is assigned based on vehicles’ license number, which is somewhat random. The one-day driving restriction has been popular in developing countries due to the low cost of implementation. However, it has not been effective in reducing air pollution in the long run. Many studies have pointed out that there is an incentive for the household to purchase an old used vehicle, which might have high emission potential, to circumvent the restriction. In addition, as shown in this paper, households drive more on non-restricted weekdays to compensate for lost driving time, creating a substitution effect which may lead to increased emissions. We propose a one-day driving restriction based on mathematically assigned household vehicle registrations rather than a randomly assigned license plate number. This is valuable in overcoming flaws of the current one-day driving restriction to increase opportunity cost of cheating as such, the new one-day driving restriction will increase the cost of buying the second vehicle. Furthermore, the mathematical programming model is utilized to assign the restricted weekday to each household, while also optimizing the distribution of high and low emission vehicles on the road to reduce air pollution effectively. The numerical simulation illustrates that the goal of driving restriction is achieved.

Subject Areas: Traffic congestion; Air pollution

3.8. Title: Optimal Energy Taxation in Cities

Authors: Borck, R. and Brueckner, J.K.

Abstract: This paper presents the first investigation of the effects of optimal energy taxation in an urban spatial setting, where emissions are produced both by residences and commuting. When levying an optimal direct tax on energy or carbon use is not feasible, the analysis shows that exactly the same adjustments in resource allocation can be generated by the combination of a land tax, a housing tax, and a commuting tax. We then analyze the effects of these taxes on urban spatial structure, showing that they reduce the extent of commuting and the level of housing consumption while increasing building heights, generating a more-compact city with a lower level of emissions per capita.

Subject Areas: Environmental taxes; Greenhouse gases; Monocentric city

3.9. Title: Energy Use and Life Cycle Greenhouse Gas Emissions of Drones for Commercial Package Delivery


Abstract: The use of automated, unmanned aerial vehicles (drones) to deliver commercial packages is poised to become a new industry, significantly shifting energy use in the freight sector. Here we find the current practical range of multi-copters to be about 4km with current battery technology, requiring a new network of urban warehouses or waystations as support. We show that, although drones consume less energy per package-km than delivery trucks, the additional warehouse energy required and the longer distances traveled by drones per package greatly increase the life-cycle impacts. Still, in most cases examined, the impacts of package delivery by small drone are lower than ground-based delivery. Results suggest that, if carefully deployed, drone-based delivery could reduce greenhouse gas emissions and energy use in the freight sector. To realize the environmental benefits of drone delivery, regulators and firms should focus on minimizing extra warehousing and limiting the size of drones.

Subject Areas: Greenhouse gas emissions; Environmental; Freight; Drones

https://www.nature.com/articles/s41467-017-02411-5
Title: Appraising the Environmental Benefits of Ride-sharing: The Paris Region Case Study

Authors: Yin, B., Liu, L., Coulombel, N. and Viguie, V.

Abstract: This paper investigates the environmental benefits of ride-sharing through its CO₂ emission mitigation potential. Ride-sharing is expected to substantially decrease CO₂ emissions by raising vehicle occupancy, thus mechanically reducing the number of vehicles on the road. Yet, as ride-sharing entails both a decrease in travel (monetary) costs and in travel times (inasmuch as it reduces road congestion), it is likely to make the car more attractive ultimately. This could result in mode switching in the short run (as travelers forsake public transport or active modes for car), as well as in longer distances travelled in the medium run. In the long run, people could even take advantage of the easier travel conditions to relocate further within the metropolitan area. To account for these rebound effects, we develop an integrated land-use transport model. This intends to capture the effects of ride-sharing on the whole household decision process regarding transport and residential location. The model is applied to the Paris region, with several ride-sharing scenarios for year 2030. While ride-sharing does indeed strongly reduce CO₂ emissions, we find substantial rebound mechanisms. In contrast to the (naive) expectation that raising vehicle occupancy by 50% would reduce CO₂ emissions by 33%, the various rebound effects end up dividing the CO₂ emission savings by a factor ranging from 2 to 3 depending on the day period considered (i.e. the morning or evening peak period). The rebound mechanisms - the mode switching, distance and relocation effects - should therefore be heeded. Some policy recommendations are provided to develop ride-sharing while curbing these unintended effects.

Subject Areas: Ride-sharing; CO₂ emissions; Transport; Land-use; Behavioral change

3.11. Title: Multiagent Spatial Simulation of Autonomous Taxis for Urban Commute: Travel Economics and Environmental Impacts

Authors: Lu, M., Taiebat, M., Xu, M. and Hsu, S.C.

Abstract: With the likelihood of autonomous vehicle technologies in public transport and taxi systems increasing, their impact on commuting in real-world road networks is insufficiently studied. In this study, an agent-based model is developed to simulate how commuters travel by autonomous taxis (aTaxis) in real-world road networks. The model evaluates the travel costs and environmental implications of substituting conventional personal vehicle travel with aTaxi travel. The proposed model is applied to the city of Ann Arbor, Michigan, to demonstrate the effectiveness of aTaxis. The results indicate that to meet daily commute demand with wait times less than 3 min, the optimized autonomous taxi fleet size is only 20% of the conventional solo-commuting personal car fleet. Commuting cost decreases by 38%, and daily vehicle utilization increases from 14 to 92 min. When using internal combustion engine aTaxis, energy consumption, greenhouse gas (GHG) emissions, and SO₂ emissions are respectively 16, 25, and 10% higher than conventional solo commuting, mainly because of unoccupied repositioning between trips. Given the emission intensity of the local electricity grid, the environmental impacts of electric aTaxis do not show significant improvement over conventional vehicles.

Subject Areas: Autonomous taxis; Environmental impact; Greenhouse Gas (GHG) emissions

3.12. Title: Travel Effects and Associated Greenhouse Gas Emissions of Automated Vehicles

Author: Rodier, C.J.

Abstract: In much the same way that the automobile disrupted horse and cart transportation in the 20th century, automated vehicles (AVs) hold the potential to disrupt our current system of transportation and the fabric of our built environment in the 21st century. Experts predict that vehicles could be fully automated by as early as 2025 or as late as 2035. The public sector is just beginning to understand AV technology and to grapple with how to accommodate it in our current transportation system. Research on AVs is extremely important because AVs may significantly disrupt our transportation system with potentially profound effects, both positive and negative, on our society and our environment. However, this research is very hard to do because fully AVs have yet to travel on our roads. As a result, AV research is largely conducted by extrapolating effects from current observed behavior and drawing on theory and models. Both the magnitude of the mechanism of change and secondary effects are often uncertain. Moreover, the potential for improved safety in AVs drive the mechanisms by which vehicle miles traveled (VMT), energy, and greenhouse gas (GHG) emissions may change. We really don’t know whether AVs will achieve the level of safety that will allow for completely driverless cars, very short headways, smaller vehicles, lower fuel use, and/or reduce insurance cost. We don’t know whether AV fleets will be harmonized to reduce energy and GHG emissions.

In this white paper, the available evidence on the travel and environmental effects of AVs is critically reviewed to understand the potential magnitude and likelihood of estimated effects. The author outlines the mechanisms by which AVs may change travel demand and review the available evidence on their significance and size. These mechanisms include increased roadway capacity, reduced travel time burden, change in monetary costs, parking and relocation travel, induced travel demand, new traveler groups, and energy effects. They then describe the results of scenario modeling studies. Scenarios commonly include fleets of personal AVs and automated taxis with and without sharing. Travel and/or land use models are used to simulate the cumulative effects of scenarios. These models typically use travel activity data and detailed transportation networks to replicate current and predict future land use, traffic behavior, and/or vehicle activity in a real or hypothetical city or region.

Subject Areas: Automated Vehicles; Greenhouse Gas Emissions; Environment;

https://escholarship.org/uc/item/9g12v6r0
3.13. Title: Carbon Mitigation in Domains of High Consumer Lock-in

Authors: Ivanova, D., Vita, G., Wood, R., Lausselet, C., Dumitru, A., Krause, K., Macsinga, I. and Hertwich, E.G.

Abstract: As climate policy needs to address all feasible ways to reduce carbon emissions, there is an increasing focus on demand-side solutions. Studies of household carbon footprints have allocated emissions during production to the consumption of the produced goods, and provided an understanding of what products and consumer actions cause significant emissions. Social scientists have investigated how attitudes, social norms, and structural factors shape salient behavior. Yet, there is often a disconnect as emission reductions through individual actions in the important domains of housing and mobility are challenging to attain due to lock-ins and structural constraints. Furthermore, most behavioral research focuses on actions that are easy to trace but of limited consequence as a share of total emissions. Here we study specific alternative consumption patterns seeking both to understand the behavioral and structural factors that determine those patterns and to quantify their effect on carbon footprints. We do so utilizing a survey on consumer behavioral, attitudinal, contextual and socio-demographic factors in four different regions in the EU. Some differences occur in terms of the driving forces behind behaviors and their carbon intensities. Based on observed differences in mobility carbon footprints across households, we find that the key determining element to reduced emissions is settlement density, while car ownership, rising income and long distances are associated with higher mobility footprints. For housing, our results indicate that changes in dwelling standards and larger household sizes may reduce energy needs and the reliance on fossil fuels. However, there remains a strong need for incentives to reduce the carbon intensity of heating and air travel. We discuss combined effects and the role of policy in overcoming structural barriers in domains where consumers as individuals have limited agency.

Subject Areas: Climate change mitigation; Lock-In; Consumer behavior; Carbon intensity; Determinants; Policy measures

3.14. Title: Cities’ Role in Mitigating United States Food System Greenhouse Gas Emissions

Authors: Mohareb, E.A., Heller, M.C. and Guthrie, P.M.

Abstract: Current trends of urbanization, population growth, and economic development have made cities a focal point for mitigating global greenhouse gas (GHG) emissions. The substantial contribution of food consumption to climate change necessitates urban action to reduce the carbon intensity of the food system. While food system GHG mitigation strategies often focus on production, we argue that urban influence dominates this sector’s emissions and that consumers in cities must be the primary drivers of mitigation. We quantify life cycle GHG emissions of the United States food system through data collected from literature and government sources producing an estimated total of 3800 kg CO₂e/capita in 2010, with cities directly influencing approximately two-thirds of food sector GHG emissions. We then assess the potential for cities to reduce emissions through selected measures; examples include up-scaling urban agriculture and home delivery of grocery options, which each may achieve emissions reductions on the order of 0.4 and ~ 1% of this total, respectively. Meanwhile, changes in waste management practices and reduction of postdistribution food waste by 50% reduce total food sector emissions by 5 and 11%, respectively. Consideration of the scale of benefits achievable through policy goals can enable cities to formulate strategies that will assist in achieving deep long-term GHG emissions targets.

Subject Areas: Greenhouse Gas Emissions; Climate Change; Food System

3.15. Title: Research on the Effect of Large-scale Electric Vehicle based on Smart Wearable Equipment Access to Grid

Authors: Cai, L., Hu, P. and Tan, Z.

Abstract: The development of electric vehicles is getting faster and faster. Large-scale electric vehicle access to grid will have a series of effects on the grid. This paper analyzes the current situation of electric vehicle and power grid, introduces the concept and application of power big data, and then puts forward a probability model of electric vehicle access to grid. The paper obtained the big data of the Chinese electric vehicle by experiment, then analyzed it and got the effect to stability of power grid and demand response model with strong uncertainty of large-scale electric vehicle access to grid. This paper proposes a way to collect parameters of electric vehicles using intelligent wearable devices. Finally, a reasonable way to use electric vehicles as energy storage resources is put forward. It can prevent the unstable operation of power grid after the large number of access to electric vehicle charging piles, and improve the reliability and robustness of the power grid system.

Subject Areas: Greenhouse Gas Emissions; Climate Change; Food System

3.16. Title: A Review on Energy, Environmental, and Sustainability Implications of
Connected and Automated Vehicles

Authors: Taiebat, M., Brown, A.L., Safford, H.R., Qu, S. and Xu, M.

Abstract: Connected and automated vehicles (CAVs) are poised to reshape transportation and mobility by replacing humans as the driver and service provider. While the primary stated motivation for vehicle automation is to improve safety and convenience of road mobility, this transformation also provides a valuable opportunity to improve vehicle energy efficiency and reduce emissions in the transportation sector. Progress in vehicle efficiency and functionality, however, does not necessarily translate to net positive environmental outcomes. Here, we examine the interactions between CAV technology and the environment at four levels of increasing complexity: vehicle, transportation system, urban system, and society. We find that environmental impacts come from CAV-facilitated transformations at all four levels, rather than from CAV technology directly. We anticipate net positive environmental impacts at the vehicle, transportation system, and urban system levels, but expect greater vehicle utilization and shifts in travel patterns at the society level to offset some of these benefits. Focusing on the vehicle-level improvements associated with CAV technology is likely to yield excessively optimistic estimates of environmental benefits. Future research and policy efforts should strive to clarify the extent and possible synergetic effects from a systems level to envisage and address concerns regarding the short- and long-term sustainable adoption of CAV technology.

Subject Areas: Connected and automated vehicles (CAVs); Emissions; Environmental impacts

Title: Developing Commute Optimization System to Minimize Negative Environmental Impacts and Time of Business Commuters

Authors: Abdallah, M., Tawfik, A.M., Monghasemi, S., Clevenger, C.M. and Adame, B.A.

Abstract: The objective of this research is to develop a novel and innovative system, called Business+ Commute Optimization System (B+COS) that is capable of identifying the optimal selection of individualized commute alternatives of employees in a business to minimize their greenhouse gas (GHG) emissions, air pollution, and commute time. B+COS is designed to identify the optimal travel behavior for each commuter (e.g., drive car, carpool, use public transit, bike or walk) while maintaining convenience and incentivizing commuters using monetary incentives. The system consists of a geographical information system (GIS) and a multi-objective optimization model. The GIS is designed to measure and quantify business commute attributes such as emissions, commute cost, and time of each commute option. The multi-objective optimization model is designed to generate optimal trade-offs among two optimization objectives (1) minimizing equivalent social cost of GHG emissions and air pollution, and (2) minimizing total commute time of business commuters. Performance of the system is evaluated and verified using a case study of 21 commuters. Results show the capabilities of the new system in identifying Pareto-optimal solutions of the two optimization objectives for various tolerances of commute time increase ranging from 5 to 25?min. The promising results highlight the effectiveness of such an innovative system to minimize transportation-related emissions and commute time for businesses.

Subject Areas: Incentivized emission reduction; Selection of commute alternatives; Multi-objective optimization; Minimizing commute time

3.18. Title: Understanding Our Future

Authors: Bassett, L., Kristina, C., Richards, R. and Krishnamoorthi, D.

Abstract: Blog

Subject Areas: Climate and energy data; Climate change

3.19. Title: Achieving Public Health and Climate Change Goals: What do we Need to Know about the Transportation System?

Author: Tayarani, M.

Abstract: The overall aim of this dissertation is evaluating what new knowledge can be gained about the environmental and public health outcomes of regional transportation planning strategies by implementing a suite of more spatially and temporally detailed transportation and air quality models. This new knowledge can be used to better understand the potential health effects of emissions exposure while also guiding the development of new transportation and land-use plans, and related policies that have the potential to achieve large reductions in pollution exposure and green house gas emissions at local and regional level.

Subject Areas: Air quality; Vehicle Emissions Exposure; Particulate Matter; Greenhouse Gas Emissions; Transportation planning; Land Use; Smart Growth; Health; Environmental Justice

4. Health

4.1. Title: Understanding Temporal Change of Spatial Accessibility To Healthcare: An Analytic Framework For Local Factor Impacts.

Authors: Yang, J. and Mao, L.

Abstract: Population demand, health service supply, and the linkages between them (e.g., transport infrastructure) are important factors that determine spatial accessibility to healthcare at a place. These three factors vary differently over time and location, leading to temporal changes and spatial disparities in access to healthcare. Few analytic methods have been developed to measure local impacts of these factors on healthcare accessibility over time, which are essential to alleviating health disparities and evaluating intervention programs. We propose a spatially explicit analytic framework to measure local factor impacts over time by adopting a chain substitution method from economics. The analysis is illustrated by a case study of spatial accessibility to physicians in Florida, USA, from 1990 to 2010. For each census block group, the results show the impact of local population change, physician relocation, and road-network expansion on the loss and gain of healthcare accessibility over time. The leading impact factor are identified for each census block group through comparison, and spatial clusters of factor impacts are discovered. To the literature of healthcare accessibility, this article presents a promising start of factor impact analysis and offers new perspectives in exploring spatial processes underlying people’s access to healthcare.

Subject Areas: Access to healthcare; Spatial disparities; Temporal changes; Factor impact analysis; GIS

https://trid.trb.org/view.aspx?id=1439632
4.2. Title: Dietary and Physical Activity Interventions for Colorectal Cancer Survivors: A Randomized Controlled Trial


Abstract: There has been evidence on the protective effects of diets high in fiber and low in red and processed meat (RPM), and physical activity (PA) against colorectal cancer (CRC) development, but that against CRC recurrence has been limited. This study evaluated the efficacy of a behavioral program comprising dietary and PA interventions in improving Chinese CRC survivors’ lifestyle. A 2x2 factorial randomized controlled trial of 223 CRC patients (82 females, mean age 65), randomly assigned to receive dietary, PA or both interventions, or usual care for 12 months, and assessed every 6 months for 24 months. Primary outcomes included two dietary and two PA targets. Secondary outcomes included changes in dietary consumptions and PA levels. Dietary interventions significantly increased the odds of achieving the targets of consuming less RPM at all time-points (OR 3.22–4.57, all p<0.01) and refined grain (RG) at months 6 (OR 3.13, p=0.002) and 24 (OR 2.19, p=0.039), and reduced RPM (2.49–3.48 servings/week, all p<0.01) and RG (0.31–0.5 servings/day, all p<0.01) consumptions. Patients receiving PA interventions potentially spent more time on moderate-to-vigorous PA. This study demonstrated the efficacy of a behavioral program in improving dietary habits of Chinese CRC survivors.

Subject Areas: Physical Activity Interventions; High fiber diet; Colorectal Cancer

https://www.nature.com/articles/s41598-018-24042-6
4.3. Title: CTASS: An Intelligent Framework for Personalized Travel Behaviour Advice to Cardiac Patients

Authors: Batool, T., Vanrompay, Y., Neven, A., Janssens, D. and Wets, G.

Abstract: Current cardiac rehabilitation programs intending to increase physical activity of patients suffer from a lack of knowledge about effective patient’s activity profiles and their associated behavior. This leads to the fact that therapies are not completely tailored to the patient, causing non-adherence to the proposed treatment schedule. An important potential for increasing the physical activity level of patients is available in their daily travel behaviour that can be made more active. To validate this potential, we propose a Cardiac Travel Advice Support System (CTASS) digital framework for personalized travel behaviour advice to cardiac patients. The travel behaviour of the group of patients whose actual physical activity level is expected to be too low is monitored by a smartphone application that objectifies their daily activity schedules. The data from the schedules is analysed semi-automatically by the CTASS. Based on this analysis, the doctor can provide a treatment that is personalized to the specific contexts of the patient. In this way, we try to optimize their travel-related physical activity. Moreover, we predict the risk of non-adherence to the therapy taking into account the derived characteristics of the patient.

Subject Areas: Active travel behaviour; Smart cardiovascular rehabilitation; Physical activity level; Behaviour prediction

4.4. Title: VA Using Telemedicine to Provide Therapy to Rural Veterans With PTSD

**Author:** Rubin, R.

**Abstract:** The Department of Veterans Affairs (VA) recently launched a pilot telehealth program to provide psychotherapy and related services by telephone and interactive video for rural veterans with posttraumatic stress disorder (PTSD). As of mid-March, more than 500 rural veterans had enrolled in the telehealth study. Participants may choose between the 2 main types of trauma-focused psychotherapy used in the VA: cognitive processing therapy and prolonged exposure therapy. Study participants receive psychotherapy via interactive video at any of 12 of the VA's community-based outpatient clinics across the country or in their home.

**Subject Areas:** Veterans; Health; Drivers

https://jamanetwork.com/journals/jama/article-abstract/2679260
4.5. Title: Is promoting public transit an effective intervention for obesity?: A longitudinal study of the relation between public transit usage and obesity

Authors: She, Z., King, D.M. and Jacobson, S.H.

Abstract: There is increasing evidence on the association between public transit usage and obesity. To further understand the causal impact of changes in county public transit usage on county obesity rates, this paper presents a longitudinal study on this topic. Annual health data from the Behavioral Risk Factor Surveillance System (BRFSS) and transportation data from the National Household Travel Survey (NHTS) were aggregated and matched at the county level, to create a panel data set with 227 counties from 45 states across two time periods, 2001 and 2009. Annual public transit funding, obtained from the National Transit Database (NTD), is chosen as an instrumental variable to simulate changes in public transit usage caused by exogenous changes in public policies. Possible confounding variables such as amount of leisure time physical activity, health care coverage and distribution of income are explicitly controlled. All time-invariant county level heterogeneities are implicitly controlled using first difference estimators. This study shows that promoting public transit in a county can effectively decrease the county obesity rate. Specifically, a one percentage point increase of frequent public transit riders in a county population is estimated to decrease the county population obesity rate by 0.473% points. This result supports findings in previous research that the extra amount of physical activity involved in public transit usage can have a statistically significant impact on obesity. In addition, this study also provides empirical evidence for the effectiveness of encouraging public transit usage as a public health intervention for obesity.

Subject Areas: Public transit; Health; Obesity

4.6. Title: Actions to Improve Physical Activity Surveillance in the United States

Authors: Pate, R.R., Berrigan, D. and Buchner, D.M.

Abstract: Physical activity, which has been defined as “any bodily movement produced by skeletal muscles that results in energy expenditure”, provides important health benefits across the lifespan. However, a large percentage of Americans fail to meet current physical activity guidelines, and this deficiency accounts for a sizeable population health burden.

A core function of public health, “surveillance” refers to “ongoing, systematic collection, analysis, and interpretation of outcome-specific data for use in the planning, implementation, and evaluation of public health practice”. There are many different forms of physical activity, and physical activity is performed at varying intensities, in numerous settings, and for multiple reasons. Physical activity behavior is known to be influenced by personal, social, physical, environmental, institutional, community, and societal factors. Because physical activity is a complex behavior, physical activity surveillance is a complex, multicomponent process. In the U.S., the existing system for surveillance of physical activity includes some important resources, but it also includes many gaps, catalyzing the need to develop a more robust physical activity surveillance system in the United States—a priority identified in the 2016 National Physical Activity Plan.

Subject Areas: Physical activity; Health benefits; Public health; Surveillance;

4.7. Title: A Multi-modal Relative Spatial Access Assessment Approach to Measure Spatial Accessibility to Primary Care Providers

Authors: Lin, Y., Wan, N., Sheets, S., Gong, X. and Davies, A.

Abstract: Two-step floating catchment area (2SFCA) methods that account for multiple transportation modes provide more realistic accessibility representation than single-mode methods. However, the use of the impedance coefficient in an impedance function (e.g., Gaussian function) introduces uncertainty to 2SFCA results. This paper proposes an enhancement to the multi-modal 2SFCA methods through incorporating the concept of a spatial access ratio (SPAR) for spatial access measurement. SPAR is the ratio of a given place’s access score to the mean of all access scores in the study area. An empirical study on spatial access to primary care physicians (PCPs) in the city of Albuquerque, NM, USA was conducted to evaluate the effectiveness of SPAR in addressing uncertainty introduced by the choice of the impedance coefficient in the classic Gaussian impedance function. We used ESRI StreetMap Premium and General Transit Specification Feed (GTFS) data to calculate the travel time to PCPs by car and bus. We first generated two spatial access scores—using different catchment sizes for car and bus, respectively—for each demanding population location: an accessibility score for car drivers and an accessibility score for bus riders. We then computed three corresponding spatial access ratios of the above scores for each population location. Sensitivity analysis results suggest that the spatial access scores vary significantly when using different impedance coefficients (p<0.05); while SPAR remains stable (p=1). Results from this paper suggest that a spatial access ratio can significantly reduce impedance coefficient-related uncertainties in multi-modal 2SFCA methods.

Subject Areas: 2SFCA; E2SFCA; Multi-modal; Gaussian function; Spatial access; Primary care

4.8. Title: Behavior Model Calibration for Epidemic Simulations

Authors: Singh, M., Marathe, A., Marathe, M.V. and Swarup, S.

Abstract: Computational epidemiologists frequently employ large-scale agent-based simulations of human populations to study disease outbreaks and assess intervention strategies. The agents used in such simulations rarely capture the real-world decision-making of human beings. An absence of realistic agent behavior can undermine the reliability of insights generated by such simulations and might make them ill-suited for informing public health policies. In this paper, we address this problem by developing a methodology to create and calibrate an agent decision making model for a large multi-agent simulation, using survey data. Our method optimizes a cost vector associated with the various behaviors to match the behavior distributions observed in a detailed survey of human behaviors during influenza outbreaks. Our approach is a data-driven way of incorporating decision making for agents in large-scale epidemic simulations.

Subject Areas: Disease outbreaks; Epidemic Simulations; Public health

4.9. Title: Facility Location Model for Free Clinics to Address Healthcare Disparities in Portland, OR

Author: Sample, M.

Abstract: Americans are consistently spending more time and money on their healthcare. The increase in spending is not consistent across all demographics. Minority and lower-income individuals are often spending the most. The locations of healthcare facilities are a key contributor to this discrepancy. The distance an individual must travel for healthcare leads to their exclusion from accessing that facility if the distance is too great. Engineers work to remedy this disparity in access using facility location models. The work presented herein uses one such model to address healthcare disparities in Portland, Oregon. The formulation is a maximal covering location model that uses mixed integer programming parameters. The objective is to maximize medical coverage for the targeted demographics through the strategic opening of free of cost satellite medical facilities.

Subject Areas: Medically uninsured persons; Medical care, Health services accessibility; Oregon; Portland, Clinics; Location; Analysis

4.10. Title: Getting There: There are more places to park than you probably think

Author: Deshais, N.

Abstract: Blog

Subject Areas: Parking; Citycore

4.11. Title: During a Flu Epidemic, Dispensing Flu Vaccines at Pharmacies Could Save Lives and Costs

Authors: Bartsch et al

Abstract: Blog

Subject Areas: Pharmacies; Locations

5. Policy and Mobility

5.1. Title: Development of a Multi-modal Travel Demand Module for the Regional Strategic Planning Model

Author: Yang, H.

Abstract: Presentation

Subject Areas: Multi-modal Travel; Travel Demand Model; Regional Planning

5.2. Title: An Overview of Transportation Data

Author: Texas, A & M University

Abstract: Transportation data is the foundation for informed policy decision making. Transportation data is collected and managed as an asset. These data provide insight into many different aspects of the transportation system, including: 1. Transportation system assets and their physical condition. 2. Safety, system operation, and performance. 3. Travel behavior, demography, and modal data. 4. Transportation economics, finance, and programming. 5. Freight movement, volumes, and modes. 6. Project planning and development. 7. Public opinion data (to reflect attitudes and awareness).

Subject Areas: Automatic Data Collection Systems; Data Collection; Data Processing; Geographic Information Systems; Information Systems; Management Information Systems; Transportation; Transportation Data; Transportation Operations

5.3. Title: Evolution of Transportation Policy and Economics

Author: McMullen, B.S.

Abstract: This chapter discusses the shift in the focus of transportation policy from questions regarding transportation industries or carriers needed to conduct policy in a regulated environment, to issues regarding the finance and pricing of the transportation system and investment decisions on infrastructure. Policymakers are faced with the classic economic problem of allocating scarce resources in a manner that will maximize social welfare and to do so requires the expertise and advice of economists. A vehicle miles travelled (VMT) tax has been proposed as a first step in providing sustainable highway finance and correcting distortions caused by historic underpricing of roads in the United States. Several empirical studies examining the distributional Impact of a VMT tax are reviewed here as policymakers grapple with practical solutions to the finance problem. Issues regarding transit investment and subsidies as well as economic factors to consider when making multimodal investment decisions for freight are discussed. The role of transportation economists in these policy decisions is particularly critical if policies are to achieve desired objectives.

Subject Areas: Deregulation; Highway Trust Fund (HTF); Multimodal investment; Optimal road pricing; Transit; Transportation infrastructure; Regulation; Vehicle miles travelled (VMT)

Title: Devolution of Transportation: Reducing Big-Government Involvement in Transportation Decision Making

Author: Pozdena, R., B.S.

Abstract: This chapter examines the role that federal, state, and local governments play in the funding and provision of transportation infrastructure and services. We build the case for dramatic devolution of authority that is presently asserted by the federal government to states, localities, or the private sector. Although the issues vary somewhat by the specific mode of transport, the general findings are the same. First, the current systems of pricing, decision making, and funding give too much authority to high levels of government. Despite the fact that the vast majority of passenger and goods movements involve short distances, high-level government decisions and funding processes dominate the transportation sector. Second, the pricing and funding mechanisms used do not create a nexus between those who need transportation services and the financing of those services. Rather, funding flows through processes that invoke pooling of revenues, subsidies, and cross-subsidies, and archaic, noneconomic allocation processes. Third, the result is that it is hard for market participants to serve the mostly localized needs of passengers and shippers. The misallocations and distortions are most marked in the case of highway-based transportation and urban transit, resulting in congested and overused highways, and transit systems that provide high-cost service with little accountability to passengers. The issues are less pressing in the case of air and water transport, but we question the need for public ownership of airports and seaports, since we find that other countries successfully privatize both ports and air traffic control systems. Finally, the chapter also concludes that pipelines, like the rail network before them, face sufficient competition to benefit from the near-complete deregulation that rail has enjoyed for over 30 years.

The chapter begins with a conceptual review of the economic bases for allocating authority and setting prices, and the determinants of the appropriate scale of government or private entities. The chapter then examines, mode by mode, the travel and shipment propensities of users of transport services. The implications of this analysis are then used to evaluate the propriety and necessity of current institutional arrangements. To provide illustrative state and local issues, the author uses observations from his home state of Oregon—a state with a unique cross-section of ocean, river, rail, pipeline, and highway facilities. Additionally, Oregon has aggressively sought to develop transit facilities. The chapter concludes that, in general, current hierarchies of authority and methods of pricing are ossified remnants of historical circumstances and technological constraints. Although we are not optimistic that major reform will come quickly, there is no longer a good case to be made for current practices, especially in the highway and transit modes. It is hoped that the technological revolution currently under way will apply sufficient pressure by users to erode out-of-date arrangements.

Subject Areas: Trip length; Transportation regulation; Role of government; Road pricing

Regulation (pp. 207-250).
https://www.sciencedirect.com/science/article/pii/B9780128126202000109
Title: Not so Fast? Examining Neighborhood-Level Effects of Traffic Congestion on Job Access.

Authors: Thomas, T., Mondschein, A., Osman, T. and Taylor, B.D.

Abstract: Traffic congestion powerfully influences urban transportation policy, particularly in regional planning where transportation projects are often prioritized and funded based on expected congestion relief benefits. Congestion is universally unpopular, and it is a short, intuitive leap from frustration with traffic to the belief that congestion is a major drag on connectivity to jobs and other opportunities and, in turn, economic vitality. While much work has focused on evaluating and relieving bottlenecks and project-level traffic delays, relatively little research has quantified the precise role of congestion in limiting access to destinations more broadly, with access defined here in terms of the travel time needed to reach potential destinations. Accordingly, this study (1) captures the precise trade-offs between peak-hour travel speed and job accessibility, and (2) estimates the greatest level of accessibility benefits that congestion relief could be expected to achieve. Using two different measures of employment access for the nine-county San Francisco Bay Area, we find that travel speeds play a surprisingly small role in determining the time it takes to access job sites. One’s location vis-à-vis these job sites, by contrast, plays a much larger role in determining access. In other words, the most densely developed places typically offer the highest levels of access, despite typically higher levels of congestion. We also compare these rush hour job access metrics for the Bay Area with hypothetical congestion-free peak hour conditions and find that such a dramatic transformation would result in only modest increases in employment accessibility in much of the Bay Area. Although some housing-rich, job-poor suburbs would benefit disproportionately from the complete absence of peak-hour traffic, we conclude that (1) while congestion does impede regional accessibility, it does so to a far smaller degree than is commonly thought, and (2) while dense development is associated with slower adjacent peak-hour travel speeds, capping development and limiting densities in order to maintain or increase travel speeds may have deeply counterproductive effects on overall accessibility in regions.

Subject Areas: Congestion; Job accessibility; Urban form; Travel speed; Urban transportation policy

5.6. Title: Mobility and Congestion in Urban India

Authors: Akbar, P.A., Couture, V., Duranton, G., Ghani, E. and Storeygard, A.

Abstract: Using a popular web mapping and transportation service, we generate information for more than 22 million counterfactual trip instances in 154 large Indian cities. We then use this information to estimate a several indices of mobility for these cities. We first show that our measurements are robust to a wide variety of methodological choices. Second, we decompose overall mobility into uncongested mobility and the congestion delays caused by traffic. Finally, we examine correlates of mobility, uncongested mobility, and traffic delays.

Subject Areas: Urban transportation; Roads; traffic; Determinants of travel speed; Cities

5.7. Title: The Road to Inequality: How the Federal Highway Program Polarized America and Undermined Cities

Author: Nall, C

Abstract: NA

Subject Areas: Policy

Availability: Nall, C., 2018. The Road to Inequality: How the Federal Highway Program Polarized America and Undermined Cities. Cambridge University Press. https://books.google.com/books?hl=en&lr=&id=1I5LDwAAQBAJ&oi=fnd&pg=PR8dq=%27NHTS%27and+%27National+Household+Travel+Survey%27&ots=QX0fVTXSW-&sig=OZdpMnuBPK1c-mj53wHME9pIrrA#v=onepage&q='NHTS%20and%20'National%20Household%20Travel%20Survey'&f=false
5.8. Title: Developing Policy for Urban Autonomous Vehicles: Impact on Congestion

Author: Metz, D.,

Abstract: An important problem for surface transport is road traffic congestion, which is ubiquitous and difficult to mitigate. Accordingly, a question for policymakers is the possible impact on congestion of autonomous vehicles. It seems likely that the main impact of vehicle automation will not be seen until driverless vehicles are sufficiently safe for use amid general traffic on urban streets. Shared use driverless vehicles could reduce the cost of taxis and a wider range of public transport vehicles could be economic. Individually owned autonomous vehicles would have the ability to travel unoccupied and may need to be regulated where this might add to congestion. It is possible that autonomous vehicles could provide mobility services at lower cost and wider scope, such that private car use in urban areas could decline and congestion reduce. City authorities should be alert to these possibilities in developing transport policy.

Subject Areas: Road traffic congestion; Autonomous vehicles; Taxis; Cities; Urban

5.9. Title: An Agent-Based Simulation Model for Shared Autonomous Taxi System

Author: Liu, Z., Miwa, T., Zeng, W. and Morikawa, T

Abstract: The shared autonomous taxis system (SATS) has been regarded as a promising traffic mode for improving travel flexibility and reducing travel costs. This study aims to examine the potential benefits of replacing all taxis with ride-sharing autonomous vehicles (AVs). Specifically, two sharing strategies are discussed: nondetour sharing, in which a subsequent customer is picked up only if no detour is required, and detour sharing, where the detour may cause a delay for the first customer. An agent-based simulation is developed to demonstrate the advantage of the SATS. Results show that the nondetour and detour sharing strategies can respectively reduce fleet size by 19% and 27%, reduce waiting time by 62% and 82%, reduce operational costs by 16% and 24%, and reduce CO2 emissions by 17% and 19% in comparison with a nonsharing strategy.

Subject Areas: Highways; Operations and Traffic Management; Planning and Forecasting; Travel costs; Mobility

5.10. Title: The Geography of Poverty and Nutrition: Food Deserts and Food Choices across the United States

Authors: Allcott, H., Diamond, R. and Dubé,, J.P.

Abstract: We study the causes of “nutritional inequality”: why the wealthy tend to eat more healthfully than the poor in the U.S. Using event study designs exploiting supermarket entry and households’ moves to healthier neighborhoods, we reject that neighborhood environments have meaningful effects on healthy eating. Using a structural demand model, we find that exposing low-income households to the same availability and prices experienced by high-income households reduces nutritional inequality by only 9%, while the remaining 91% is driven by differences in demand. These findings contrast with discussions of nutritional inequality that emphasize supply-side factors such as food deserts.

Subject Areas: Food desert; Travel to shop; Lowincome

5.11. Title: The Housing Crisis isn't just about Affordability – It's about Economic Mobility, too

Author: Sisson, P.

Abstract: Blog

Subject Areas: Mobility; Housing Cost; Economic background

5.12. Title: The Future of the Micro-Mobility Industry

Author: Lambe, S.

Abstract: Blog

Subject Areas: Mobility; Bike; Walk; Transit; Trips

Title: Developing a Spatial Transferability Platform to Analyze National-Level Impacts of Connected Automated Vehicles

Authors: Shabanpour, R., Golshani, N., Stephens, T.S., Auld, J. and Mohammadian, A.

Abstract: A recent application of the spatial transferability approach is to assess the potential impacts of the emerging connected automated mobility technology on people’s travel behavior at the national level. While there are a few transportation simulation frameworks which can account for potential impacts of this technology in a simulated geographical context, there is yet to be any literature documenting disaggregated estimates of large-scale impacts of connected automated vehicles (CAVs) on travel behavior at the national level. Therefore, in order to provide a platform to assess national-level impacts of CAVs, this study develops a methodological framework based on transferability techniques, which uses data and models from a smaller geographical area — the POLARIS simulation results for the CAVs scenario in the Chicago metropolitan area — to generate disaggregate travel data at the national level. Comparison of the distributions of the transferred variables at the regional and the national contexts indicates that the platform is capable of transferring travel behavior indices to the national level with high level of accuracy.

Subject Areas: Spatial transferability; Connected automated vehicles; Population clustering; Neural networks; POLARIS

5.14. Title: Capturing the Built Environment-travel Interaction for Strategic Planning: Development of a Multimodal Travel Module for the Regional Strategic Planning Model (RSPM)

Authors: Wang, L., Gregor, B., Yang, H., Weidner, T. and Knudson, T.

Abstract: Integrated land use and transportation models have evolved along a spectrum from simple sketch planning models to complex microsimulation models. While each has its niche, they are largely unable to balance the flexibility and realism of microsimulation and the speed and interactivity of simple models. The Regional Strategic Planning Model (RSPM) aims to fill this gap by taking a microsimulation approach while making other simplifications in order to model first-order effects quickly. It enables planners to consider the robustness of prospective policies in the face of future uncertainties by accepting a broad range of inputs and allowing rapid simulations of many scenarios. This paper introduces the RSPM and shows how new land use and multimodal transportation sensitivities have been incorporated through the conversion to the new VisionEval open-source framework. Land use and transportation interactions in the RSPM are reviewed, and the development of a new multimodal travel demand module with improved land use sensitivities is highlighted. The use of a unique nationwide dataset combining the 2009 NHTS, EPA’s Smart Location Database, and metropolitan transit and roadway data is explained. The paper concludes with the results of validation and sensitivity tests, and a discussion of future work.

Subject Areas: Land use; Transportation models; Policies; Regional Strategic Planning Model (RSPM); Multimodal travel

5.15. Title: The Effect of Competition of Transport Modes on Mobility

Author: Yan, J.

Abstract: Despite the ever-increasing demand, controversies have been surrounding the ride-hailing industry since the day of its rise. Tighter government regulation or even banning is called around the world. In this paper, we address the issue by designing a quasi-experiment and estimate how much Uber benefits consumers in a creative way. Using three datasets created before and after Uber service availability, and dividing San Francisco the studied area into grids of $4\text{km}^2$ each, we are able to investigate consumer commuting behavior at an individual level and find out Uber brings out at least $0.76$ gains per commuter per trip and generates an annual consumer surplus of $100$ million in San Francisco.

The three datasets include the National Household Travel Survey Data from 2008 to 2009 when Uber service was not yet available, the origin-destination level Uber itinerary data and Google map data of 2017. We first use NHTS data to identify consumer preference in 2008 under a discrete choice framework. We then construct counterfactual scenarios in which Uber becomes an option with Uber and Google data, and find out the consumer surplus changes Uber brought.

Subject Areas: Ride-hailing; Mobility; Uber; San Francisco

Availability: Yan, J., 2018. The Effect of Competition of Transport Modes on Mobility. (No. Project ID: 2017 Project 10, Center for Advanced Multimodal Mobility Solutions and Education. 
Title: Bridging the Gap between Mobility Haves and Have-Nots

Authors: Brown, A. and Taylor, B.D.

Abstract: Grace is a single mom with two kids living in Koreatown in Los Angeles. High housing costs have put car ownership out of reach for Grace, so she regularly suffers through a long, complicated morning and afternoon travel grind. Each weekday, she rises at 5:30 a.m. to dress and feed her children and walk them four blocks to her cousin Lydia’s apartment; Lydia then walks Grace’s daughter to daycare and her son to elementary school while Grace makes a seventy-five-minute, two-bus trek from Koreatown to her job as a teacher’s aide in Westchester. The trip home in the afternoon is just as lengthy and complex, and Grace struggles to get dinner on the table for her children by 7:00 p.m. each evening.

Subject Areas: Mobility; Haves and Have-Nots

5.17. Title: Network influences on the development and implementation of active transportation policies in six U.S. cities

Authors: Zwald, M.L., Eyler, A.A., Haire-Joshu, D., Handy, S.L., Harris, J.K., Moreland-Russell, S. and Brownson, R.C.

Abstract: Many communities have prioritized policy and built environment changes to promote active transportation (AT). However, limited information exists on the partnerships and processes necessary to develop and implement such policy and environmental changes, particularly among organizations in non-health sectors. Within the transportation sector, metropolitan planning organizations (MPOs) are increasingly recognized as organizations that can support AT policies. This study examined inter-organizational relationships among MPOs and their partners working to advance AT policies in six U.S. cities.

In fall 2015, an average of 22 organizations in each city participated in an online survey about partnerships with MPOs and other organizations developing and implementing AT policies. Measures included organizational characteristics and relational attributes including: level of AT policy collaboration, information transmission, resource sharing, and perceived decisional power. Descriptive network analysis and exponential random graph modeling were used to examine organizational attributes and relational predictors associated with inter-organizational collaboration in each network.

MPOs served as collaborative intermediaries, connecting other organizations around AT policies, in half of the cities examined. Organizations in each city were more likely to collaborate around AT policies when partners communicated at least quarterly. In half of the cities, the probability of AT policy collaboration was higher when two agencies exchanged resources and when organizations had perceived decisional authority.

Network analysis helped identify factors likely to improve partnerships around AT policies. Results may contribute to best practices for collaboration among researchers, practitioners, policymakers, and advocates across diverse sectors seeking to promote population-level physical activity.

Subject Areas: Network analysis; Metropolitan planning organizations; Active transportation; Walking; Bicycling; Physical activity; Collaboration; Policy

5.18. Title: The Impact of Anti-Congestion Policies and the Role of Labor-supply Margins

Authors: Hirte, G. and Tscharaktschiew, S.

Abstract: Transportation economists apply different labor supply models when studying anti-congestion policy: (i) endogenous working hours; (ii) endogenous workdays but given daily working hours; (iii) labor supply as a residual. We study whether the outcome of anti-congestion policies that change the relative cost of labor supply margins, and, thus, may affect decisions on working hours and working days, is robust against the model applied. In particular, we focus on welfare implications in the presence of other taxes when there is a congestion externality. We find surprisingly strong differences in quantity and sign. Further, we develop a clear recommendation for future research on issues that include decisions on commuting trips. Researchers shall apply both a model of endogenous working hours that provides an upper limit and a model of endogenous workdays that provide a lower limit of results for welfare changes, optimal policies and two optimal tax components (Pigouvian and Ramsey terms).

Subject Areas: Transport Policy; Congestions; Labor Supply; Urban Economics; Spatial Modeling; CGE

5.19. **Title:** Shared Mobility: The Potential of Ridehailing and Pooling

**Author:** Shaheen, S.

**Abstract:** Ridesharing is older than horse-and-buggy travel, and recent innovations make sharing easier, more convenient, and more efficient than ever before. Innovative mobility services premised on pooling can lower travel costs, mitigate congestion, and reduce greenhouse gas emissions. They also offer travelers more mobility choices beyond the traditional bookends of auto ownership and public transit. While the realm of shared mobility is vast, including shared bikes, scooters, and cars, the focus of this chapter is on pooled services—placing more people in a single vehicle. Doing so unlocks huge economic, social, and environmental benefits.

**Subject Areas:** Rideshare; Mobility; Travel costs

6. Special Population Groups

6.1. Title: Examining the Possible Impact of Daily Transport on Depression Among Older Adults Using an Agent-Based Model

Authors: Yang Y., Langellier B.A., Stankov I., Purtle J., Nelson K.L. and Diez Roux A.V.

Abstract:
Objectives: Daily transport may impact depression risk among older adults through several pathways including facilitating the ability to meet basic needs, enabling and promoting contact with other people and nature, and promoting physical activity (e.g. through active transportation such as walking or walking to public transit). Both daily transport and depression are influenced by the neighborhood environment. To provide insights into how transport interventions may affect depression in older adults, we developed a pilot agent-based model to explore the contribution of daily transport and neighborhood environment to older adults’ depression in urban areas.
Method: The model includes about 18,500 older adults (i.e. agents) between the ages of 65 and 85 years old, living in a hypothetical city. The city has a grid space with a number of neighborhoods and locations. Key dynamic processes in the model include aging, daily transport use and feedbacks, and the development of depression. Key parameters were derived from US data sources. The model was validated using empirical studies.
Results: An intervention that combines a decrease in bus fares, shorter bus waiting times, and more bus lines and stations is most effective at reducing depression. Lower income groups are likely to be more sensitive to the public transit-oriented intervention.
Conclusion: Preliminary results suggest that promoting public transit use may be a promising strategy to increase daily transport and decrease depression. Our results may have implications for transportation policies and interventions to prevent depression in older adults.

Subject Areas: Depression; Older Adults; Agent-Based Model; Daily Transport; Aging

6.2. Title: Do Not Forget About Public Transportation: Analysis of the Association of Active Transportation to School Among Washington, DC Area Children With Parental Perceived Built Environment Measures

Authors: Roberts J.D., Rodkey L., Ray R. and Saelens B.E

Abstract: Although the active transportation (AT) indicator received an F grade on the 2016 US Report Card on Physical Activity for Children and Youth, this AT assessment excluded public transportation. An objective of the Built Environment and Active Play Study was to assess youth AT, including public transportation, among Washington, DC area children in relation to parental perceptions of neighborhood built environment (BE) variables. Methods: Questionnaires were mailed to 2000 parents of children aged 7-12 years. AT to school (ATS) was assessed with the question: “In an average school week, how many days does your child use each of the following ways to get to and from school? (a) Walk; (b) Bike; (c) Car; (d) Bus or Metro.” Parental perceived BE data were obtained through questionnaire items, and logistic regression was conducted to determine if BE variables were associated with youth ATS. Results: The sample included 144 children (50% female; average age 9.7 years; 56.3% white; 23.7% African American; 10.4% Asian American). Over 30% used ATS-public transportation 5 days per week, and nearly 13% used ATS-walking daily. Parental perceived BE variables significantly predicted youth ATS-walking and ATS-public transportation. Conclusions: ATS-public transportation is common among Washington, DC area youth, and parental perceptions of BE can significantly predict ATS.

Subject Areas: BEAP Study; Cross-Sectional Study; Sociodemographics; Sample Diversity; United States


6.3. Title: Active Travel, Public Transportation Use, and Daily Transport Among Older Adults: The Association of Built Environment

Authors: Yang, Y., Xu, Y., Rodriguez, D.A., Michael, Y. and Zhang, H.

Abstract:
Objectives: To examine active travel and public transportation use among U.S. older adults and the built environment characteristics associated with them.
Methods: Total active travel, public transportation trips, travel purpose diversity, total and maximum distance traveled for older adults (≥ 65 years) relative to middle age adults (45-64 years) as reported in the 2009 National Household Travel Survey (NHTS) were compared using linear regression models and logistic regression models.
Results: Overall, adults over 65 years of age had 3.3 trips and total travel distance of 20.6 miles per day. Active travel and daily transport trips declined from younger to older age groups. Among the older adults, the daily transport varied by a number of characteristics. The association of built environment on older adults’ transport differed by the specific environmental characteristics and travel modes.
Discussion: Existing transportation facilities and policies need to be adjusted to meet the challenge. Our study has a potential to contribute to the design of effective interventions that enhance health and quality of life for the burgeoning aging population in the U.S.

Subject Areas: Older Adults; Active Travel; Public Transportation; Physical Activity; Built Environment

6.4. Title: Residence in Unsafe Neighborhoods is associated with Active Transportation among Poor Women: Geographic Research on Wellbeing (GROW) Study

Authors: Lee, R.E., Kim, Y. and Cubbin, C.

Abstract: This study investigated associations of neighborhood context with active transportation among women with children after controlling for sociodemographic variables. We used data from the Geographic Research on Wellbeing study (GROW). In 2012 – 2013, GROW surveyed mothers who participated in California’s Maternal and Infant Health Assessment. The dependent variable was active vs. inactive transportation. Mothers were coded as doing active transportation if they responded that they “walked,” “walked and took public transportation,” or “rode a bike,” to most places they went in the previous 7 days, and were coded as doing inactive transportation if they responded that they “drove” any kind of vehicle or “got rides from someone else.” The independent variables were neighborhood-level (census tract) poverty, income inequality, and perceived neighborhood safety. Using a stratified sample of poor or near-poor (≤200% of the federal poverty level, N = 1231) and non-poor mothers (201+% of the federal poverty level, N = 1465), weighted logistic regression was conducted to estimate associations between neighborhood-level factors with active transportation after controlling for age, race/ethnicity, marital status, number of children, car ownership, education, family income, and population density. One in seven mothers reported active transportation with mothers in poor/near-poor families having a higher proportion of active transportation than mothers in higher income families (24% vs. 3%). In adjusted models, poor/near-poor mothers had twice the odds of using active transportation in very or somewhat unsafe neighborhoods compared with those in very safe neighborhoods. Neighborhood-level poverty and income inequality were not statistically significant. Results suggest that individual poverty is a primary driver of active transportation among mothers. Poor and near-poor mothers who perceived their neighborhoods as unsafe had higher odds of using active transportation. Policy and community resources should be allocated to provide safe routes in very unsafe areas where poor women live and where active transport is most likely to occur.

Subject Areas: Active transportation; Exercise; Mothers; Poverty’ Safety’ Minority health

6.5. Title: How Do Stressed Workers Make Travel Mode Choices That Are Good For Their Health, Safety, and Productivity?

Authors: Yang, L.Q., Wipfli, B., Cyr, L., Currans, K.M. and Wang, L.

Abstract: It is well recognized in transportation and psychology research that commuting stress has consequences for commuters’ travel safety, home environment, and work performance. Little research has addressed questions involving the possible interdependence between work stress, family stress, and commuting stress: Do workers having many demands from work and family life get more stressed out from a stressful commute? Or do stressed workers try to cope with work and non-work stress by choosing more relaxing travel modes? This proposal integrates the perspectives from transportation, psychology, and health science by focusing on the relations between commuting stress, commuting mode choice, and consequences of such choice for commuters’ health. To fill the gaps in the transportation and psychology literature, our proposal addresses two key research questions: 1) Under what life and work circumstances are commuting workers more likely to commute via car vs. public transit vs. bicycle vs. on foot? 2) What are the different implications of choosing different commuting modes for commuters’ mental and physical health and work outcomes? In Study 1, we used nationally representative census data and we devised a series of multinomial, logistic regression models to predict the probability of choosing each commute mode to address research question 1. In Study 2, we used cortisol and survey data collected daily over a workweek to address research question 2. Findings from this research shed light on possible intervention opportunities that help commuting workers cope with various sources of life stress while making more informed decisions on travel mode choice. We contend that commuting workers, their employers, and transportation agencies and planners can all take part in these interventions that can benefit commuting workers’ productivity and well-being, organizational bottom line as well as performance and safety of the transportation system.

Subject Areas: Commute stress; Commute mode choice; Active commute; Stress; Health

6.6. Title: Understanding and Modeling the Activity-Travel Behavior of University Commuters at a Large Canadian University

Authors: Daisy, N.S., Hafezi, M.H., Liu, L. and Millward, H.

Abstract: This paper examines the daily activity-travel behavior of undergraduate students, graduate students, faculty, and staff at a large university to better understand their activity travel demands for automobile, active transportation (AT), and transit trips. The data were derived from the first university-based activity travel diary survey [Environmentally Aware Travel Diary Survey (EnACT)] conducted in spring 2016 at Dalhousie University, Canada. Results show that students reside nearer to the campus than faculty and staff, and their trip length from home to school is significantly shorter. Zero-inflated negative binomial (ZINB) models show that if housing tenure is less than 1 year, it is more likely that the traveler will make more AT trips but fewer automobile trips. It indicates that individuals living far from the campus will produce fewer transit trips than those who live nearer. Interestingly, the mean number of AT trips per day for the overall sample is more than one trip, whereas for automobile trips and transit trips it is less than one. The behavioral analysis and empirical models provide useful insights that can be utilized to represent university populations in regional travel demand models, as well as to develop campus-based travel demand management (TDM) strategies.

Subject Areas: Activity-travel behavior; University Students; Active Transportation; Trip length; Zero-inflated negative binomial (ZINB) models

Title: E-hail (Rideshare) Knowledge, Use, Reliance, And Future Expectations Among Older Adults

Authors: Vivoda, J.M., Harmon, A.C., Babulal, G.M. and Zikmund-Fisher, B.J.

Abstract: The goals of this study were to explore e-hail (e.g., Uber/Lyft) knowledge, use, reliance, and future expectations among older adults. Specifically, we aimed to identify factors that were related to e-hail, and how older adults view this mode as a potential future transportation option. Data were collected from a sample of older adults using a pencil-and-paper mailed survey. Univariate, bivariate, and regression techniques were used to assess the relationships among e-hail and several demographic and other factors. Almost three quarters of the sample (74%) reported no e-hail knowledge. Only 1.7% had used e-hail to arrange a ride, and only 3.3% reported that they relied on e-hail for any of their transportation needs. Younger age, male gender, more education, higher transportation satisfaction, and discussing transportation options with others were all independently associated with greater e-hail knowledge. Male gender also predicted e-hail use. E-hail was the mode least relied upon by older adults. Current e-hail knowledge was the biggest predictor of anticipated future use. E-hail may be a viable future option for older adults who have limited or stopped driving. More exposure to e-hail and continued evolution of these services is required to overcome older adults’ lower internet/smartphone use. Policies could be implemented at departments of motor vehicles to pair information or training on transportation alternatives (like e-hail) with elimination of driving privileges, or at doctors’ offices, senior centers, or hospitals. Potential underlying reasons for the findings are also discussed.

Subject Areas: Aging; Driving; Technology; Uber/Lyft

6.8. Title: Turn taking Behavior in Dual Earner Households with Children: A Focus on Escorting Routines

Authors: Han, B., Kim, J. and Timmermans, H.

Abstract: This article discusses results of a study on turn taking behavior in escorting children in dual-earner households. Using a multinomial logit model, the probability of different turn taking routines in escorting children is analyzed as a function of age and gender of the children, personal and household characteristics of the parents, properties of the job, and day of the week. Two types of turn taking behavior are examined. The first concerns routines in which during a single day one of the parents drops off the child and the other parent picks up the children again after completing the concerned activity (school, day care, outdoor activity). The second concerns routines in which one of the parents takes full responsibility and commits to all escorting duties on a particular day and the other parent does the same on another day of the week. Results, based on a sample of dual-earner households, indicate that turn taking represents a substantial, yet smaller share of escorting activities. The propensity of turn taking behavior is higher for highly educated, high-income dual-earner households. Fathers show the tendency of dropping off the children in the morning. Mothers tend to take responsibility for more flexible escorting needs.

Subject Areas: Task allocation; Turn taking behavior; Escorting; Dual-earner households; Gender role

6.9. Title: Young People’s Travel – What’s Changed and Why?

Authors: Chatterjee, K., Goodwin, P., Schwanen, T., Clark, B., Jain, J., Melia, S., Middleton, J., Plyushteva, A., Ricci, M., Santos, G. and Stokes, G.

Abstract: Young adults in Great Britain and other countries are driving less now than young adults did in the early 1990s. The Department for Transport (DfT) commissioned the Centre for Transport and Society (UWE, Bristol) and the Transport Studies Unit (University of Oxford) to carry out a systematic assessment of available evidence on the subject, both by review of UK and overseas published literature, and by new secondary analysis of existing UK data sets. The study sought to address the questions: In what ways have changes in young people’s social and economic conditions, and lifestyles and attitudes impacted on their travel behaviour? How might those drivers, or other anticipated changes, be expected to impact their future travel demand?

The evidence has been evaluated on the basis of an extensive review of both transport-specific and wider social science literature in the UK (and other countries where, despite national differences, the trends show many similar patterns), and new analysis of data from the National Travel Survey (NTS) (1995-2014), the Census (2001 and 2011) and Understanding Society (five waves from 2009/10 to 2013/14).

Subject Areas: Young adults; Travel behaviour


http://eprints.uwe.ac.uk/34640/
6.10. Title: A Survey of Restraint Methods for the Safe Transport of Children in Ground Ambulances

Authors: Woods, R.H., Shah, M., Doughty, C. and Gilchrest, A.

Abstract:
Objectives: The National Highway Traffic Safety Administration (NHTSA) released draft recommendations in 2010 on the safe transport of children in ground ambulances. The purpose of this study was to assess awareness of these guidelines among emergency medical service (EMS) agencies and to identify implementation barriers.
Methods: We conducted a cross-sectional, anonymous online survey of 911-responding, ground transport EMS agencies in Texas. Demographics, modes of transport based on case scenarios, and barriers to implementation were assessed.
Results: Of 62 eligible EMS agencies that took the survey, 35.7% were aware of the NHTSA guidelines, 62.5% agreed they would improve safety, and 41.1% planned to implement them. Seventy-five percent of EMS agencies used the ideal or acceptable alternative to transport children requiring continuous monitoring, and 69.5% chose ideal or acceptable alternatives for children requiring spinal immobilization. The ideal or acceptable alternative was not chosen for children who were not injured or ill (93.2%), ill or injured but not requiring continuous monitoring (53.3%), and situations when multiple patients required transport (57.6%). The main requirements for implementation were provider education, ambulance interior modifications, new guidelines in the EMS agency, and purchase of new equipment.
Conclusions: Few EMS agencies are aware of the NHTSA guidelines on safe transport of children in ground ambulances. Although most agencies appropriately transport children who require monitoring, interventions, or spinal immobilization, they use inappropriate means to transport children in situations with multiple patients, lack of injury or illness, or lack of need for monitoring.

Subject Areas: Safe Transport; Children

6.11. Title: Sharing is Caring: The Potential of the Sharing Economy to Support Aging in Place

Authors: Miller, J., Ward, C., Lee, C., D’Ambrosio, L. and Coughlin, J.

Abstract: This article explores innovative applications of sharing economy services that have the potential to support a population aging in place, especially the “oldest old,” aged 85 and older, and their caregivers. A mixed-methods study conducted by the MIT AgeLab examined perceptions of and experiences with sharing economy services, ultimately finding opportunities and barriers to use. Thus, although sharing economy services have potential to support aging in place, to do so successfully will require reconstructing how older adults, family caregivers, aging service professionals, gerontology educators, and gerontology students conceptualize and deliver care to an aging population. We suggest examples for gerontology educators to integrate into their classrooms to further cultivate an appreciation among students of multiple approaches to intervention, including those that leverage sharing economy and technology-enabled platforms to support older adults and their caregivers.

Subject Areas: Aging in place; Caregivers; Technology; Sharing economy; Business; Gerontology and geriatrics curricula

6.12. Title: The Gender Earnings Gap in the Gig Economy: Evidence from over a Million Rideshare Drivers

Authors: Cook, C., Diamond, R., Hall, J., List, J.A. and Oyer, P.

Abstract: The growth of the “gig” economy generates worker flexibility that, some have speculated, will favor women. We explore this by examining labor supply choices and earnings among more than a million rideshare drivers on Uber in the U.S. We document a roughly 7% gender earnings gap amongst drivers. We completely explain this gap and show that it can be entirely attributed to three factors: experience on the platform (learning-by-doing), preferences over where to work (driven largely by where drivers live and, to a lesser extent, safety), and preferences for driving speed. We do not find that men and women are differentially affected by a taste for specific hours, a return to within-week work intensity, or customer discrimination. Our results suggest that there is no reason to expect the “gig” economy to close gender differences. Even in the absence of discrimination and in flexible labor markets, women’s relatively high opportunity cost of non-paid-work time and gender-based differences in preferences and constraints can sustain a gender pay gap.

Subject Areas: Uber; Gig Economy; Gender pay gap

6.13. Title: An Investigation into the Role of Information and Communication Technologies on Travel Behaviour of Working Adults and Youth

Author: Wu, G.

Abstract: This thesis aims to investigate the diverse roles information and communications technologies (ICT) play in shaping individuals’ mobility behaviour. In doing so, three strands of interrelated research questions are empirically analysed to better understand the use of ICT and its implications for travel among both working adults and millennials. A cross-sectional analysis is firstly performed to examine the variations in the relationships between Internet use and non-mandatory travel patterns according to household working status. By employing data from the 2005/06 Scottish Household Survey (SHS) and the two-part model, the ICT-travel relationships are found to be characterised by individual employment status and intra-household interactions, which impose different constraints on individuals’ non-mandatory mobility patterns. A repeated cross-sectional analysis using the difference-in-differences (DD) estimation and the pooling of cross sections from the 2005/06 SHS data and the 2015 Integrated Multimedia City Data (iMCD) subsequently examines the evolutions in the ICT-travel relationships over time, and how temporal changes differ between the general adult population and the millennial generation. Findings suggest that the changes over time are generally characterised by diminishing complementarity and increasing substitution. Moreover, while the temporal changes for the general population are mostly found among the medium-to-heavy Internet users, for millennials, it is the light or medium-to-light users who see significant temporal changes. Finally, using the longitudinal datasets from the British Household Panel Survey (BHPS) and the Understanding Society Survey, an exploration is undertaken of the direct and indirect effects of prior experience with using ICT (as children) on millennials’ current travel behaviour. The structural equation model is applied to examine the relationships between ICT use, travel choices, and environmental attitude. The longitudinal analysis finds that millennials’ long-term exposure to ICT (since adolescence) may shape their current travel patterns by influencing their environmental attitudes. The findings from these analyses highlight the importance of considering the effects of personal, household, and social characteristics on the ICT-travel interactions. In addition, the research focuses on dynamic interactions and on the indirect or higher order roles of ICT in affecting travel behaviour as well as on the implications for transport planning practices and policy making.

Subject Areas: Information and Communications technologies (ICT); Mobility behaviour; Working adults and millennials


Abstract: Older drivers aged ≥70 years old have among the highest rates of motor vehicle collisions (MVC) compared to other age groups. Driving is a highly visual task, and older adults have a high prevalence of vision impairment compared to other ages. Most studies addressing visual risk factors for MVCs by older drivers utilize vehicle accident reports as the primary outcome, an approach with several methodological limitations. Naturalistic driving research methods overcome these challenges and involve installing a high-tech, unobtrusive data acquisition system (DAS) in an older driver’s own vehicle. The DAS continuously records multi-channel video of driver and roadway, sensor-based kinematics, GPS location, and presence of nearby objects in front of the vehicle, providing an objective measure of driving exposure. In this naturalistic driving study, the purpose is to examine the relationship between vision and crashes and near-crashes, lane-keeping, turning at intersections, driving performance during secondary tasks demands, and the role of front-seat passengers. An additional aim is to compare results of the on-road driving evaluation by a certified driving rehabilitation specialist to objective indicators of driving performance derived from the naturalistic data.

Subject Areas: Vision; Vision impairment; Driving; Aging; Motor vehicle collision; Naturalistic driving

6.15. Title: When rideshare companies strand seniors the Jewish community does the driving

Author: Kronenfeld, J.

Abstract: Blog

Subject Areas: Seniors; Driving; Rideshare; Jewish Community; Transportation

6.16. **Title:** Millennials Are Driving Again (but Not the Rich Ones)

**Author:** Grabar. H.

**Abstract:** Blog

**Subject Areas:** Millennials; Vehicle Miles Travelled

6.17. Title: Uber gender pay gap ‘explained’ — Men drive faster than Women

Author: Bodkin. H.

Abstract: Blog

Subject Areas: Uber; Gender gap;

Title: An Examination of Children’s School Travel: A Focus on Active Travel and Parental Effects

Authors: Sener, I.N., Lee, R.J. and Sidharthan, R.

Abstract: Concerns regarding children’s health and physical activity levels have prompted a growing interest in understanding the school mode choice decision. Walking and biking to school can help school-age children achieve recommended daily physical activity levels. The growing literature in this area has provided valuable insights but has often failed to adequately consider the influence of parents on children’s decision making. This study aims to provide additional insights by examining the school mode choice with a focus on active travel and the role of parental effects. A multinomial logit model was estimated for children’s school mode choice using the 2009 National Household Travel Survey with the add-on sample for Texas. A comprehensive set of variables, including individual and household characteristics, built and travel environment measures, and parental characteristics and attitudes, were found to be influential on the decision of active travel to school. Although the focus of this study is on children’s school mode, a model examining parent’s active travel was also estimated to provide a picture of parents and their own active travel decisions through a Poisson count regression model for the parents’ non-motorized travel frequency (weekly). Findings strongly suggested that mothers’ concerns regarding traffic conditions in the neighborhood can discourage children’s active mode use. In contrast, fathers’ work flexibility seemed to facilitate more non-motorized school travel. Similarly, many factors were important in determining non-motorized trip frequency. A flexible work environment, particularly for the mothers, was observed to increase the overall trip frequency of parents. The results from this study corroborate the findings from several earlier studies while also indicating new factors not previously identified. The work done in this study can be extended in several directions. One particularly interesting avenue of future research is to model the two decisions in a joint model to identify the causal direction while accounting for unobserved factors.

Subject Areas: Children’ school mode; Parent’s travel; Active travel; Physical activity; NHTS 2009 Texas add-on sample

Title: Travel Patterns of American Adults with Disabilities

Author: Brumbaugh, S.

Abstract: NA

Subject Areas: Travel patterns; Adults; Disabilities

6.20. **Title:** What Explains Neighborhood Sorting by Income and Race?

**Authors:** Aliprantis, D., Carroll, D. and Young, E.

**Abstract:** Even when compared among high-income parents, black children grow up to have lower incomes than white children. Neighborhood effects could explain this disparity, which suggests the question we answer in this paper: Why do high-income black households live in neighborhoods with characteristics similar to those of low-income white households? This paper shows that wealth cannot explain this sorting pattern, but racial preferences can. We find that wealth has no predictive power beyond income and race for a household’s neighborhood, in terms of both quality and racial composition. We find that the gap in neighborhood quality can be explained at all income levels by black households sorting into black neighborhoods.

**Subject Areas:** Neighborhood; Income; Wealth; Race Preference; Intergenerational Mobility

**Availability:** Aliprantis, D., Carroll, D. and Young, E., 2018. *What Explains Neighborhood Sorting by Income and Race?* GATE/University of Lyon, University of Virginia, and AFR, Zhejiang University.

6.21. Title: Essays on Aging Americans’ Travel Preferences: Behavioral Survey Analyses

Authors: Pan, X.

Abstract: The baby boomer generation began turning sixty-five in 2011. Twenty percent of the U.S. population will be over age sixty-five by 2030. Such a rapidly aging population has posed significant challenges to transportation planning and operating agencies since this large number of aging boomers demand dependable transportation access so they can remain independent and age in place. It is crucial to understand, in a timely manner, aging Americans’ travel mode choices, their preferences and perspectives on transportation supports, and communication channels through which they prefer to receive information on existing and new transportation options. My dissertation presents three essays to explore these important and urgent issues. Essay One uses the 2009 National Household Travel Survey (NHTS) data to investigate whether the predominant travel preference — favoring private automobiles — hold for different groups of aging Americans. The analyses not only include the commonly used travel mode choice factors, such as socio-demographics, built environment, and transportation attributes; but also include behavioral aspects such as attitudes towards safety, congestion, public transit, and walking environment. Results show no evidence that Americans are giving up driving as they age. Therefore, planning as though baby boomers will give up driving private automobiles as they age is not likely to be successful. Results also imply that although it may not be effective for existing seniors, promoting positive attitudes on certain travel options that were otherwise not preferred by middle-aged boomers (e.g., public transit) could be a useful way to encourage this group of boomers to change their future travel mode choices. Essay Two discusses the design and implementation of my own survey on senior transportation options. A comprehensive survey questionnaire is constructed to target various user groups of senior transportation services, including seniors, caregivers and their elderly dependents, and younger individuals. All these respondents represent current or future customers of senior transportation services. The survey is then successfully implemented via the Amazon Mechanical Turk (MTurk) crowdsourcing platform. Survey data collected from the MTurk platform represents a fairly diversified population; it can capture respondents from different socio-demographic categories, and it shares a similar distribution pattern with the general population data (e.g., U.S. Census) and the large-scale nationwide transportation survey using random sampling method (e.g., NHTS). Essay Three analyzes my MTurk survey data and investigates the impact of behavioral factors derived from the Theory of Planned Behavior (TPB) on travel mode choices among different user groups of senior transportation services. Survey respondents’ preferences on types of senior transportation supports, as well as respondents’ preferable channels from which they want to receive information about senior transportation options, are also examined. Results show attitude factors (e.g., convenience, preference, and independence) in general are perceived as more important drivers for seniors’ mode choices than other aspects of TPB (e.g., social norm, feasibility, and cost). This indicates more attention should be drawn to attitude factors, rather than the traditional concerns such as feasibility and cost, when designing and implementing interventions on senior transportation services.
Compared to the extant literature, this dissertation research reveals a more comprehensive set of the factors that affect aging Americans’ travel mode choices. In particular, it highlights the important role of behavioral factors in seniors’ travel mode choices. This dissertation research also demonstrates that Amazon MTurk can serve as a valuable crowdsourcing platform for planning related surveys, experiments, and data collections, especially when addressing timely issues such as aging Americans’ travel needs. It generates useful insights for researchers and practitioners to develop effective policy and service interventions to improve senior’s transportation access, and to address transportation challenges along with the rapid population aging process.

Subject Areas: City Planning; Older people — Transportation; Choice of transportation

Title: Does Economic Vulnerability moderate the association between Transportation Mode and Social Activity Restrictions in Later Life?

Authors: Lehning, A., Kim, K., Smith, R. and Choi, M.

Abstract: Transportation is critical to older adults’ ability to participate in social activities in their community. We examined the association between modes of transportation and restrictions in social activity (i.e. visiting with others, religious attendance, clubs and organised activities, and going out for enjoyment), with particular attention to the moderating effects of economic vulnerability. We used logistic regression to analyse data from 7,197 community-dwelling older adults from the 2011 wave of the National Health and Aging Trends Study, a representative sample of adults aged 65 and over in the United States of America. Economic vulnerability moderated the association between transportation mode and social activity restrictions. Findings suggest that even when economically vulnerable older adults have access to driving, walking or public transit, they may be at a higher risk for social exclusion than their counterparts with more financial resources.

Subject Areas: Older adults; Transportation Mode; Social exclusion; Economic vulnerability

6.23. Title: Analytical Method to Determine Transportation Service Gaps for Transportation Disadvantaged Populations

Authors: Bejleri, I., Noh, S., Gu, Z., Steiner, R.L. and Winter, S.M.

Abstract: Transportation disadvantaged (TD) populations, which include elderly people, people with disabilities, and people who do not own a vehicle, face mobility challenges because alternative transportation services are limited. To identify specific transportation service gaps for TD populations, an assessment of both transportation demand and transportation accessibility is necessary. Previous studies have focused on a single aspect of transportation accessibility or on studying geographic transportation gaps at the state or county level. This study develops a methodology aimed at identifying TD populations with major gaps in alternative transportation services. Using spatial overlays and network analysis, we develop a model for calculating transportation supply through a comprehensive transportation accessibility measure that considers relevant trip destinations and three alternative transportation services: public transportation, on-demand services, and taxi services. Gaps in service are identified by overlaying the TD population demand volume with transportation accessibility. The resulting supply-demand matrix highlights transportation deficient areas and populations, based on overlays of high demand and low supply. We apply this methodology to Alachua County, Florida. Results expose areas of deficiency, some in unexpected places. The findings highlight the need to assess alternative transportation for TD populations, to determine gaps to be addressed to improve TD populations’ mobility and reduce personal auto trips and related traffic injuries. This method can guide policy makers in fostering equitable transportation provision across users.

Subject Areas: Transportation Disadvantaged Populations; Transportation Service Gaps; Alachua County, Florida

Title: Does Location Matter? Performance Analysis of the Affordable Housing Programs with Respect to Transportation Affordability in Dallas Fort Worth (DFW) Metropolis

Authors: Hamidi, S., Jahan, J. and Moazzeni, S.

Abstract: Transportation costs are the second largest expenditure for a family, thus have a substantial influence on housing affordability. In an auto-oriented region like DFW, the situation is exacerbated for low-income families due to limited transportation options. This study seeks to evaluate the efficiency of major affordable housing programs for low-income people in terms of transportation affordability. This study uses a rigorous methodology that involves a solid transportation cost modeling with disaggregated data available at property level for housing assistance programs in DFW. Our findings show that about 69% of the assisted units in DFW are unaffordable in terms of transportation costs. The majority of them are spending about 17% to 20% of their income on transportation. The most affordable program is Low-Income Housing Tax Credit with 58% affordability rate and the least affordable program is the Continuum of Care with 9% affordability rate when accounting for transportation costs. We also found that almost all affordable units (regarding the transportation costs) are located in main economic hubs of the region such as Dallas and Fort Worth which have better access to jobs and public transit. In contrary, almost all housing properties in the areas between Dallas and Fort Worth are unaffordable. These are areas adjacent to the University of Texas at Arlington with a high number of transit dependent population and in Arlington, the biggest midsize city with no public transit. Our findings urge HUD to consider modifying these programs by incorporating the location-efficiency factors to ensure true affordability.

Subject Areas: Transportation costs; Low income families; Affordable Housing Programs; Dallas Fort Worth (DFW) Metropolis

6.25. Title: Building Supportive Infrastructure For Low-income Entrepreneurs

Authors: Morris, M.H., Santos, S.C. and Neumeyer, X.

Abstract: Infrastructure is defined and a distinction is drawn between general infrastructure in the neighborhoods and communities of the poor and entrepreneurship-specific infrastructure, or the entrepreneurial ecosystem. Ways in which components of each affect the poor and their ventures are identified. The dynamic nature of infrastructure is emphasized. Challenges confronted by the poor in accessing the elements of an entrepreneurial ecosystem are examined. The role of infrastructure components across the stages of venture development are assessed, and implications are drawn for those in poverty attempting to start and grow ventures.

Subject Areas: Infrastructure; Poor; Poverty

Title: Understanding Mobility Characteristics and Needs of Older Persons in Urban Pakistan with Respect to use of Public Transport and Self-Driving

Authors: Ahmad, Z., Batool, Z. and Starkey, P.

Abstract: Since 1990, Pakistan’s demographic transition has been increasing life spans with a steady rise in the number of older persons. Pakistan faces many challenges in caring for its older population. The proportion of the population aged 60?years and above is estimated to increase from 5.8% in 2000 to 12.4% in 2050. A study was conducted to understand the existing mobility characteristics of the elderly, their perceived needs and constraining factors. Data was collected using convenient sampling from 450 people aged 60?years or older in nine towns within Lahore City. Older people were approached around urban facilities (shops, banks, terminals) and asked to respond to survey questions. Within-residence interviews were also conducted, mainly for those women who declined interviews in public places. Descriptive and comparative analyses were performed, including Pearson’s chi squared test for independence. The results are discussed in terms of mode choice, public transport preferences, self-driving issues and the relative benefits of formal and informal public transport options. The study found lower levels of weekly trip-making compared to those reported for older people in China, South Korea and USA. Vehicle ownership (mainly cars and motorcycles) and socio-demographic factors were found to significantly affect trip making. There were large gender differences in trip making and vehicle ownership, suggesting further research and policy action targeting the mobility needs of elderly women. Older persons were concerned about safety issues concerning public transport and self-driving, and also the behavior of transport crews, and this has informed several of the concluding policy recommendations.

Subject Areas: Elderly; Mobility; Trip frequency; Public transport; Self-driving

Title: Correlated Grouped Random Parameters Hazard-Based Duration Analysis of Elderly Travel Times and Distances

Author: Jordan, G.

Abstract: Populations around the world are steadily getting older. Ageing populations present numerous challenges for national, regional, and local transportation policy makers, planners and engineers. This dissertation extracts travel data from the 2009 National Household Travel Survey for three age groups—working adults (ages 25 through 64), young seniors (age 65 through 74), and old seniors (age 75 and older)—from the New York Consolidated Metropolitan Statistical Area (CMSA) and the Buffalo-Niagara Metropolitan Statistical Area (MSA). Using hazard-based duration analysis the effects of household, traveler, travel mode, and travel purpose characteristics on temporal (time-based) and spatial (distance-based) trip durations are analyzed. Assessment of such effects can be used to identify and quantify mobility gaps for travelers, especially marginalized groups such as the elderly and disabled. To account for unobserved heterogeneity in underlying hazard functions and across observations, as well as unobserved effects due to correlation among random parameters, a correlated grouped random parameters approach is employed. To the author’s knowledge, this is the first study to use this statistical modeling framework to analyze both travel times and travel distances. Results indicate that the use of a correlated grouped random parameters approach provides a superior statistical fit to corresponding models using correlated random parameters, grouped random parameters, random parameters, random effects, and fixed parameters. The findings also reveal that young and old seniors are not a homogeneous group, and that the underlying distribution characterizing the hazard function for each age group is different. To that end, separate models are estimated for working adults, young seniors, and old seniors. With respect to temporal and spatial durations, the dissertation reveals apparent disparities associated with location, age, gender, birth nationality, ethnicity, medical condition, and education level. The dissertation also reveals individual that explanatory factors may manifest their influence upon corresponding temporal and spatial durations in markedly distinctive ways.

Subject Areas: Correlated grouped random parameters; Hazard-based duration analysis; Elderly mobility; Travel mode; Travel purpose; Mobility gap.

https://ubir.buffalo.edu/xmlui/handle/10477/78616
Title: How Vehicle Access Enables Low-Income Households to Live in Better Neighborhoods

Authors: Jeon, J.S., Dawkins, C. and Pendall, R.

Abstract: Transportation influences residential location choices generally, but low-income households often face unique constraints because of a lack of access to automobiles. This article examines how vehicle access influences the type of neighborhoods in which low-income households are able to secure housing following a move to a new neighborhood. We rely on data from the Moving to Opportunity program to estimate locational attainment models, including a wide range of variables capturing various dimensions of neighborhood opportunity. Our findings suggest that auto access enables low-income households to secure housing in neighborhoods that exhibit a wide range of positive neighborhood attributes, including lower poverty rates, lower housing vacancy rates, higher median household income, higher labor-force participation, and higher adult high school graduation rates.

Subject Areas: Moving to Opportunity; Geography of opportunity; Housing Choice Voucher; Locational attainment; Automobiles; HUD (U.S. Department of Housing and Urban Development)

6.29. Title: Factors Preventing the Use of Alternative Transport Modes to the Car in Later Life

Authors: Luiu, C., Tight, M. and Burrow, M.

Abstract: Recent research related to transport gerontology argues that the autonomy, flexibility and independence provided by the car are fundamental in fulfilling travel needs in later life. Statistics show that in the western world the car is the most used mode of travel among the older population. Despite the importance of promoting transport policies to incentivize people to switch to more sustainable forms of transportation, alternatives to the car are still underused by older people. The aim of this scoping review is to analyze the transport barriers affecting the use of alternative modes to the car in later life. The paper investigates how issues related to personal security, health impairments, service provision, affordability, comfort, attitude, built environment, information and awareness of all transport modes influence modal choice. The analysis of the literature shows that despite the benefits provided by public transport, flexible transport services, taxis, walking and cycling, there are still several factors that negatively affect the use of these modes. The paper concludes by reflecting on potential solutions that might help to create a transport system less reliant on the car and which is able to meet the mobility needs of the older population.

Subject Areas: Older people; Transport barriers; Mobility needs; Quality of life; Transport gerontology; Scoping review

https://www.mdpi.com/2071-1050/10/6/1982
6.30. Title: Quantification of Free-Living Community Mobility in Healthy Older Adults Using Wearable Sensors

Authors: Boissy, P., Blamoutier, M., Briere, S. and Duval, C.

Abstract: Introduction: Understanding determinants of community mobility disability is critical for developing interventions aimed at preventing or delaying disability in older adults. In an effort to understand these determinants, capturing and measuring community mobility has become a key factor. The objectives of this paper are to present and illustrate the signal processing workflow and outcomes that can be extracted from an activity and community mobility measurement approach based on GPS and accelerometer sensor data and 2) to explore the construct validity of the proposed measurement approach using data collected from healthy older adults in free-living conditions.

Methods: Personal, functional impairment and environmental variables were obtained by self-report questionnaires in 75 healthy community-living older adults (mean age=66±7 years old) living on the island of Montreal, QC, Canada. Participants wore, for 14 days during waking hours on the hip, a data logger incorporating a GPS receiver with a 3-axis accelerometer. Time at home ratio (THR), Trips out (TO), Destinations (D), Maximal distance of destinations (MDD), Active time ratio (ATR), Steps (S), Distance in a vehicle (DV), Time in a vehicle (TV), Distance on foot (DF), Time on foot (TF), Ellipse area (EA), and Ellipse maximum distance (EMD) were extracted from the recordings.

Results: After applying quality control criteria, the original data set was reduced from 75 to 54 participants (28% attrition). Results from the remaining sample show that under free-living conditions in healthy older adults, location, activity and community mobility outcomes vary across individuals and certain personal variables (age, income, living situation, professional status, vehicle access) have potential mitigating effects on these outcomes. There was a significant (yet small) relationship (rho<0.40) between self-reported life space and MDD, DV, EA, and EMD.

Conclusion: Wearability and usability of the devices used to capture free-living community mobility impact participant compliance and the quality of the data. The construct validity of the proposed approach appears promising but requires further studies directed at populations with mobility impairments.

Subject Areas: GPS; Accelerometers; Signal processing; Wearability; Usability; Activity space measures; Lifespace measures

6.31. Title: NYC’s Battle With Uber And Lyft Could Hurt Middle Income Riders

Author: Hayward, L.

Abstract: Blog

Subject Areas: New York City; TNC; Middle income riders

7. Survey, Data Synthesis, and Other Applications

7.1. Title: Optimizing Copious Activity Type Classes Based on Classification Accuracy and Entropy Retention

Authors: Ectors, W., Reumers, S., Lee, W.D., Kochan, B., Janssens, D., Bellemans, T. and Wets, G.

Abstract: Despite the advantages, big transport data are characterized by a considerable disadvantage as well. Personal and activity-travel information are often lacking, making it necessary to deduce this information with data mining techniques. However, some studies predict many unique activity type classes (ATCs), while others merge multiple activity types into larger ATCs. This action enhances the activity inference estimation, but destroys important activity information. Previous studies do not provide a strong justification for this practice. An objectively optimized set of ATCs, balancing model prediction accuracy and preserving activity information from the original data, becomes essential. Previous research developed a classification methodology in which the optimal set of ATCs was identified by analyzing all possible ATC combinations. However, for the US National Household Travel Survey (NHTS) 2009 data set which comprises 36 ATCs (home activity excluded), this approach is practically impossible in a finite amount of time since there would be $3.82 \times 10^{30}$ unique combinations. The aim of this paper is to optimize which original ATCs should be grouped into a new class, and this for data sets for which it is impossible or impractical to simply calculate all ATC combinations. The proposed method defines an optimization parameter $U$ (based on classification accuracy and information retention) which is maximized in an iterative search algorithm. The optimal set of ATCs for the NHTS 2009 data set was determined. A comparison finds that this optimum is considerably better than many expert opinion activity type classification systems. Convergence was confirmed and performance gains were benchmarked.

Subject Areas: Accuracy; Activity choices; Algorithms; Classification; Data analysis; Data fusion; Entropy (Communications); Machine learning; Optimization; Sensitivity analysis; Trip purpose

7.2. Title: Tool for Querying the National Household Travel Survey Data

Author: Rathore, A.

Abstract: The goal of the project is to create a database for storing the National Household Travel Survey (NHTS) data, and a user interface to query the database. Currently, the survey data is stored in excel files in the CSV format, which makes it hard to perform complex analyses over the data. Analyses of interest to transportation community include comparisons of the trips made by urban household to those made by rural household, finding the average trip time spent based on ethnicity, the total travel time of a particular household, the preferred vehicle by a specific household, average time spent per shopping trip, etc. The tool designed for the purpose of querying the NHTS database is a Python-based Web application. Django is used as the Web framework for this project and PostgreSQL is used for the back-end purpose. The user interface consists of various drop-down lists, text-boxes, buttons and other user interface components that facilitate querying the database and presenting the results in formats that allow easy interpretation. FusionCharts Django-Wrapper and FusionCharts Jquery-Plugin are used to visualize the data in the chart form. A Codebook of the NHTS dataset is also linked for the reference purpose at any point for the user. The tool built in the project allows the user to get a deeper understanding of the data, not only by plotting the data in the form of line charts, bar charts, two column graph, but also by providing the results of the queries in the CSV format for further analysis.

Subject Areas: NHTS; National Household Travel Survey; Database; Python; FusionCharts

7.3. Title: Assessing the Effects of A Mixed-Mode Design in a Longitudinal Household Travel Survey

Authors: Eisenmann, C., Chlond, B., Minster, C., Jödden, C. and Vortisch, P.

Abstract: The German Mobility Panel (MOP) is a national household travel survey, which has been collecting data on travel behavior in Germany since 1994. One of the MOP’s central assets is its ability to provide time-series data on travel behavior. Thus, the comparability of survey results from different years is a major objective of the survey method used. Declining survey participation rates in the last decade in various socio-demographic groups resulted in the implementation of a mixed-mode design for the MOP in 2013, both for the sampling stage (landline and mobile phone recruitment) and the data collection stage (paper and web). In this study, we analyze whether the adaptations in the survey mode do indeed improve the results and, if so, why and to what degree. Ideally, the survey mode adaptions have increased the representativeness of the MOP. However, measurement biases due to the mixed-mode design are also conceivable. To decompose survey mode effects, we applied the propensity score weighting method. This method imputes the hypothetical responses participants would have given in different survey modes; disparities between actual responses and hypothetical responses under another mode are then traced back to the mixed-mode design. Our analysis indicates that trip-rate biases on shopping, leisure, and short trips are partly caused by the mixed-mode design; in contrast, quantities of time spent in the transportation system, trips made by car and public transportation, and commuting trips are hardly biased.

Subject Areas: Germany Mobility Panel; Mixed-Mode Survey; National Household Travel Survey; Propensity Score Weighting

7.4. Title: Are Cars Used Differently in Germany than in California? Findings from Annual Car-Use Profiles

Authors: Eisenmann, C. and Buehler, R.

Abstract: The personal car is the most important mode of transport in most countries. Many policies are in place in different countries and regions to tackle unsustainable trends associated with car travel. A reason for the varying success of the same measure from one country to another might be different car-usage patterns. Using Germany and California as case studies to investigate differences and similarities in car use, we adapted the CUMILE model both for Germany and California in order to generate detailed profiles of car use over one year. Hierarchical cluster analysis subdivided the sample into clusters with similar car-usage characteristics. Then, we compared clusters of cars with similar usage between Germany and California in terms of cluster size, car properties and sociodemographic characteristics of their owners. The same eight car-usage clusters emerged in both study areas with varying cluster sizes. We descriptively labeled the clusters: standing cars, moderate-range cars, day-to-day cars, workday cars, weekend cruisers, long-distance cars, short-haul cars and all-rounders. A better understanding of car-use patterns throughout a year and the size and characteristics of car-use clusters is beneficial for the identification of policies to make transport systems more sustainable.

Subject Areas: Car-use; Cluster analysis; German mobility panel; California Household Travel Survey

7.5. Title: Aggregation Biases in Discrete Choice Models

Authors: Wong, T., Brownstone, D. and Bunch, D.S.

Abstract: This paper examines the common practice of aggregating choice alternatives within discrete choice models. We carry out a Monte Carlo study based on realistic vehicle choice data for sample sizes ranging from 500 – 10,000 individuals. We consider methods for aggregation proposed by McFadden (1978) and Brownstone and Li (2017) as well as the more commonly used methods of choosing a representative disaggregate alternative or averaging the attributes across disaggregate alternatives. The results show that only the “broad choice” aggregation method proposed by Brownstone and Li provides unbiased parameter estimates and confidence bands. Finally, we apply these aggregation methods to study households’ choices of new 2008 model vehicles from the National Household Travel Survey (NHTS) where 1120 unique vehicles are aggregated into 235 make/model classes. Consistent with our Monte Carlo results we find large differences between the resulting estimates across different aggregation methods.

Subject Areas: Discrete choice; Aggregation; Household vehicle demand

7.6. Title: An Investigation of Tour Generation Models Combining Two Waves of Household Travel Surveys through Pooled Models

Authors: Shams, K., Asgari, H., Hossan, M.S. and Jin, X.

Abstract: This paper presents a study that examines two waves of travel survey data through a pooled model structure. The pooled model structure provides a means to take advantage of multiple data sources which will lead to a better estimate and understanding of travel behavior. In particular, it accounts for the difference in data variance and therefore allows for the comparison of the true impacts of the model parameters on travelers’ tour-making behavior. Larger variance is found in the 1998 data than in the 2010 data. Comparison between model parameters reveals significant behavioral changes among several socio-economic and demographic groups. In terms of common variables, the magnitude of the coefficient values has generally decreased, which conforms to the overall decreasing trend in traveling. Overall, the model equality tests indicate that the models developed based on the two data sources do not have equal taste parameters, thus the transferability hypothesis is rejected. The results of this study are expected to have implications for the application of models based on cross-sectional data, especially over long time periods.

Subject Areas: Pooled Model; Temporal Transferability; Tour Generation Models; Regional Household Travel Survey; Model Equality Test Statistics

7.7. Title: Human-Machine Interaction for Vehicles: Review and Outlook

Author: Kun, A.L.

Abstract: Today’s vehicles have myriad user interfaces, from those related to the moment-to-moment control of the vehicle, to those that allow the consumption of information and entertainment. The bulk of the research in this domain is related to manual driving. With recent advances in automated vehicles, there is an increased attention to user interactions as they relate to automated vehicles. In exploring human machine interaction for both manual and automated driving, a key issue has been how to create safe in-vehicle interactions that assist the driver in completing the driving task, as well as to allow drivers to accomplish various non-driving tasks. In automated vehicles, human-machine interactions will increasingly allow users to reclaim their time, so that they can spend time on non-driving tasks. Given that it is unlikely that most vehicles will be fully automated in the near future, there are also significant efforts to understand how to help the driver switch between different modes of automation. This paper provides a review of these areas of research, as well as recommendations for future work.

Subject Areas: Research; Future recommendations; Autonomous Vehicle; Safe in-vehicle interactions

7.8. Title: How Commuters’ Motivations to drive relate to Propensity to Carpool: Evidence from the United Kingdom and the United States

Authors: Neoh, J.G., Chipulu, M., Marshall, A. and Tewkesbury, A.

Abstract: This paper examines how commuter motivations to drive relate to propensities to carpool, using two sequential studies: Study 1 determines the key dimensions of commuters’ motivations for driving using secondary data (N=432) from staff and postgraduate student commuters at a United Kingdom university. We code the contents of the respondents’ self-reported reasons for driving (i.e. the instrumental rationalities attributed to driving with respect to varying purposes) to identify keywords representing motivation to drive; we then analyse the keyword data using multidimensional scaling (MDS). Study 2 examines how the dimensions discovered through study 1 relate to propensity to carpool, using structural equation modelling (SEM). Data for Study 2 are the survey responses of commuters (N=1028) based in the United States. The MDS reveals four key dimensions of motivation to drive. These capture instrumental rationalities for driving within four situational domains which we term: (1) Family; (2) Public transport impractical changes; (3) Rigid schedule; and (4) Non-urban areas. The SEM results show that the regression coefficients on propensity to carpool of Public transport impractical changes and Rigid schedule are significant and negative; the Family domain has a positive but non-significant regression coefficient. Regarding demographics, men’s mean values on all four domain variables are significantly higher than those for women, except for the Family domain where the mean value for women is higher; meanwhile, age predicts decreasing propensity to carpool. Additionally, the situational domains of Public transport impractical changes, Rigid schedule and Non-urban areas significantly positively correlate. Consequently, overall, the results imply that addressing commuters’ instrumental rationalities for driving, namely increasing schedule flexibility and providing more direct or quicker public transport, could indirectly encourage commuters to carpool. The study makes an original contribution by estimating the causal relationship between commuters’ motivation to drive and propensity to carpool.

Subject Areas: Propensity to carpool; Motivations to drive; Carpooling; Commuting; Multidimensional scaling; Structural equation modelling


Title: Construction of Register-based Commuting Measures

Authors: Blind, I., Dahlberg, M., Engström, G. and Östh, J.

Abstract: Early empirical studies in labour and urban economics addressing the role of commuting (on, e.g., wages and locational choice) have typically been confined to the use of survey data. Researchers are, however, increasingly getting access to large register databases with detailed information on where individuals live and work. A variety of methods have thus emerged to exploit the geocoded characteristic of the data to calculate commuting measures that go beyond simple Euclidean metrics. These methods involve new techniques that make use of geographic information system (GIS) routing software or application programming interfaces provided by third-party developers. This article provides (i) a brief survey of the small but emerging literature that uses geocoded register data to calculate different commuting measures, (ii) an example on how register-based commuting measures can be constructed along with descriptive evidence on how different commuting measures compare for different socio-economic groups using rich Swedish register data, (iii) a discussion of the pros and cons of different methods and measures, and (iv) a discussion of the potential of using mobile phone data to further improve register-based commuting measures.

Subject Areas: Commuting; Geographic Information System (GIS); Research; Databases; Euclidean metrics

Title: Are We Ready to Embrace Connected and Self-Driving Vehicles? A Case Study of Texans

Authors: Akbar, Bansal, P. and Kockelman, K.M.

Abstract: While connected, highly automated, and autonomous vehicles (CAVs) will eventually hit the roads, their success and market penetration rates depend largely on public opinions regarding benefits, concerns, and adoption of these technologies. Additionally, the introduction of these technologies is accompanied by uncertainties in their effects on the carsharing market and land use patterns, and raises the need for tolling policies to appease the travel demand induced due to the increased convenience. To these ends, this study surveyed 1088 respondents across Texas to understand their opinions about smart vehicle technologies and related decisions. The key summary statistics indicate that Texans are willing to pay (WTP) $2910, $4607, $7589, and $127 for Level 2, Level 3, and Level 4 automation and connectivity, respectively, on average. Moreover, affordability and equipment failure are Texans’ top two concerns regarding AVs. This study also estimates interval regression and ordered probit models to understand the multivariate correlation between explanatory variables, such as demographics, built-environment attributes, travel patterns, and crash histories, and response variables, including willingness to pay for CAV technologies, adoption rates of shared AVs at different pricing points, home location shift decisions, adoption timing of automation technologies, and opinions about various tolling policies. The practically significant relationships indicate that more experienced licensed drivers and older people associate lower WTP values with all new vehicle technologies. Such parameter estimates help not only in forecasting long-term adoption of CAV technologies, but also help transportation planners in understanding the characteristics of regions with high or low future-year CAV adoption levels, and subsequently, develop smart strategies in respective regions.

Subject Areas: Connected and autonomous vehicles; Ordered probit; Interval regression; Public opinion survey; Willingness to pay

Title: Detecting Popular Temporal Modes in Population-scale Unlabelled Trajectory Data

Authors: Xu, F., Xia, T., Cao, H., Li, Y., Sun, F. and Meng, F.

Abstract: With the rapid process of urbanization, revealing the underlying mechanisms behind urban mobility has become a crucial research problem. The movements of urban dwellers are often constituted by their daily routines, and exhibit distinct and contextual temporal modes, i.e., the patterns of individuals allocating their time across different locations. In this paper, we investigate a novel problem of detecting popular temporal modes in population-scale unlabelled trajectory data. Our key finding is that the detected temporal modes capture the semantic feature of human’s living style, and is able to unravel meaningful correlations between urban mobility and human behavior. Specifically, we represent the temporal mode of a trajectory as a partition of the time duration, where the time slices associated with same locations are partitioned into same subsets. Such abstraction decouples the temporal modes from actual physical locations, and allows individuals with similar temporal modes yet completely different physical locations to have similar representations. Based on this insight, we propose a pipeline system composed of three components: 1) noise handler that eliminates the noises in the raw mobility records, 2) representation extractor for temporal modes, and 3) popular temporal modes detector. By applying our system on three real-world mobility datasets, we demonstrate that our system effectively detects the popular temporal modes embedded in population-scale mobility datasets, which is easy to be interpreted and can be justified through the associated PoIs and mobile applications usage. More importantly, our further experiments reveal insightful correlations between the popular temporal modes and individuals’ social economic status, i.e. occupation information, which sheds light on the mechanisms behind urban mobility.

Subject Areas: Urban mobility; Temporal modes; Trajectory data; Mobility datasets

https://dl.acm.org/citation.cfm?id=3191778
7.12. Title: Residential Location Choice in the Era of Shared Autonomous Vehicles

Authors: Zhang, W. and Guhathakurta, S.

Abstract: This study examines the potential changes in residential location choice in a scenario where shared autonomous vehicles (SAVs) are a popular mode of travel in the Atlanta metropolitan area. This hypothetical study is based on an agent-based simulation approach, which integrates residential location choice models with a SAV simulation model. The coupled model simulates future home location choices given current home location preferences and real estate development patterns. The results indicate that commuters may relocate to neighborhoods with better public schools and more amenities due to reductions in commute costs.

Subject Areas: Shared autonomous vehicles; Residential location choice; Urban form; Sprawl

7.13. Title: Applying Census Data for Transportation: 50 Years of Transportation Planning Data Progress

Author: Lawson, Catherine T.

Abstract: Held in Kansas City, Missouri, November 14-16, 2017, the 2-day Census Conference — Applying Census Data for Transportation: 50 Years of Transportation Planning Data Progress — reflected on past accomplishments, current lessons learned, and the future of the Census and related data products. This circular summarizes the proceedings of the conference. The Transportation Research Board organized the event, with support from the American Association of State Highway Transportation Officials Census Transportation Planning Products (CTPP) program and the U.S. Department of Transportation. The conference provided a forum for participants to share experiences with the use of Census data, including new techniques for integrating different data sets for use in transportation planning and decision making. Participants also learned about recent and forthcoming Census products (e.g., updates in the CTPP software). The conference further provided an opportunity for participants to discuss opportunities, limitations, and challenges involved in using Census data, data available from the private sector, and data from global positioning systems and other technologies. Finally, participants were able to discuss research and training needs associated with applying Census data and data from other sources to transportation planning and decision making. Data sets covered during the conference included the Decennial Census; the American Community Survey; the Longitudinal Employer-Household Dynamics (LEHD); LEHD Origin-Destination Employment Statistics; Public Use Micro Samples (PUMS); and the National Household Travel Survey (NHTS).

Subject Areas: Census; Data analysis; Data collection; Data files; Data quality; Statistical sampling; Surveys; Transportation planning

7.14. Title: Effects of additional capacity on vehicle kilometers of travel in the U.S.: Evidence from National Household Travel Surveys

Author: Zolnik, E.J.

Abstract: Adding capacity is one policy mechanism to alleviate congestion. However, the empirical evidence strongly suggests that additional capacity only makes congestion worse. This study analyzes the differential effects of additional freeway capacity versus additional arterial capacity on vehicle kilometers of travel (VKT) in metropolitan areas across the U.S. The analysis uses vehicle data and household data from the 2001 and the 2009 National Household Travel Surveys (NHTS) and includes stock and flow measures of road capacity, road congestion, commuter demand, and economic growth for metropolitan areas. Taking into account differences between metropolitan areas on each measure, the study adopts a novel multilevel model approach to estimate how additional capacity affects VKT. Results indicate that adding more arterial capacity slightly decreases VKT over a lag period from six years (1995 to 2001) to eight years (2001 to 2009), probably because adding arterials shortens routes between origins and destinations more so than adding freeways. Consistent with expectations, VKT is lower in more congested metropolitan areas, and in metropolitan areas that got more congested. Results also indicate that rebound effects (higher fuel-economy vehicles are driven much more than lower fuel-economy vehicles) will at least partially offset the demand management benefits of (gasoline) price sensitivity (higher gasoline prices decrease VKT).

Subject Areas: Induced demand; Vehicle kilometers of travel; Capacity; Multilevel models

7.15. Title: Selectivity Correction in Discrete-Continuous Models for the Willingness to Work as Crowd-Shippers and Travel Time Tolerance

Authors: Le, T.V. and Ukkusuri, S.V.

Abstract: The objective of this study is to understand the different behavioral considerations that govern the choice of people to engage in a crowd-shipping market. Using novel data collected by the researchers in the US, we develop discrete-continuous models. A binary logit model has been used to estimate crowd-shippers’ willingness to work, and an ordinary least-square regression model has been employed to calculate crowd-shippers’ maximum tolerance for shipping and delivery times. A selectivity-bias term has been included in the model to correct for the conditional relationships of the crowd-shipper’s willingness to work and their maximum travel time tolerance. The results show socio-demographic characteristics (e.g. age, gender, race, income, and education level), transporting freight experience, and number of social media usages significant influence the decision to participate in the crowd-shipping market. In addition, crowd-shippers pay expectations were found to be reasonable and concurrent with the literature on value-of-time. Findings from this research are helpful for crowd-shipping companies to identify and attract potential shippers. In addition, an understanding of crowd-shippers — their behaviors, perceptions, demographics, pay expectations, and in which contexts they are willing to divert from their route — are valuable to the development of business strategies such as matching criteria and compensation schemes for driver-partners.

Subject Areas: Crowd-shipping; Willingness to work; Last-mile delivery; On-demand delivery; Selectivity correction; Discrete-continuous model

7.16. Title: Reporting Quality of Travel and Non-Travel Activities: A Comparison of Three Different Survey Formats

Authors: Aschauer, F., Hössinger, R., Schmid, B. and Gerike, R.

Abstract: This paper reports a comparison of the Austrian National Household Travel Survey (HTS) and Time Use Survey (TUS) with a 3rd survey format – the “Mobility-Activity-Expenditure-Diary” – to better understand the specific strengths and weaknesses of HTS and TUS in terms of quantifying travel and non-travel activities and their specific underreporting effects. The main goal is to demonstrate how reliable we can infer from both survey types on travel and non-travel activities regarding different indicators.

Subject Areas: Data collection; Time use; Travel behaviour; Travel survey methods; Mobility-activity-expenditure diary

Title: Workshop Synthesis: Household Travel Surveys in an Era of Evolving Data Needs for Passenger Travel Demand

Authors: Miller, E.J., Srikukenthiran, S. and Chung, B.

Abstract: Household travel surveys (HTS) have been an extremely successful method for efficiently gathering standardized, high-quality information on passenger travel demand. However, changes in communication technologies and methodological issues are presenting increasing challenges to the conventional approaches used in HTS. This workshop explored a wide range of needs and options for improved HTS design and conduct to exploit the potential of emerging new methods and to meet 21st Century transportation planning and modelling needs. A set of policy recommendations and research priorities which emerged from this discussion are presented.

Subject Areas: Household travel surveys; Individual travel surveys; Core-satellite design; Travel demand big data; Multi-instrument travel data collection


7.18. Title: Estimation of a Nonseparable Heterogeneous Demand Function with Shape Restrictions and Berkson Errors

Authors: Blundell, R., Horowitz, J. and Parey, M.

Abstract: Berkson errors are commonplace in empirical microeconomics and occur whenever we observe an average in a specified group rather than the true individual value. In consumer demand this form of measurement error is present because the price an individual pays is often measured by the average price paid by individuals in a specified group (e.g., a county). We show the importance of such measurement errors for the estimation of demand in a setting with nonseparable unobserved heterogeneity. We develop a consistent estimator using external information on the true distribution of prices. Examining the demand for gasoline in the U.S., accounting for Berkson errors is found to be quantitatively important for estimating price effects and for welfare calculations. Imposing the Slutsky shape constraint greatly reduces the sensitivity to Berkson errors.

Subject Areas: Consumer demand; Nonseparable models; Quantile regression; Measurement error; Gasoline demand; Berkson errors

7.19. Title: Development of the TRAISI Web Survey Builder: Designing to Reduce Bias and Respondent Burden in Household Travel Surveys

Author: Chung, B.

Abstract: Household travel surveys (HTS) are undoubtedly the most common and amongst the largest data collection undertakings by transport agencies worldwide. Within recent years, web-based surveys have been the dominant survey mode for HTS’s. However, given the extensive detailed data collected in HTS’s, web-based HTS’s have been facing declining response rates and challenges with collecting quality data, largely due to proxy bias and poor survey designs. This study investigates methods to improve HTS data quality and reduce response burden by sharing lessons learned from the development of the TRAISI web survey builder. The study presents findings from field tests using novel features built into the platform, such as interactive maps and adaptive designs for household trip diary collection. Survey methods to reduce proxy bias, such as voluntary self and proxy reporting methods and announce-in-advance procedures, are also investigated. Overall, the study provides survey designers guidelines and recommendations for web-based HTS design.

Subject Areas: Household Travel Surveys; Proxy Bias; Respondent Burden; Trip Diary; Usability Testing; Web-survey

https://tspace.library.utoronto.ca/handle/1807/91628
7.20. Title: An Empirical Assessment of the Complexity and Realism of Synthetic Social Contact Networks

Authors: Karra, K., Swarup, S. and Graham, J.

Abstract: We use multiple measures of graph complexity to evaluate the realism of synthetically-generated networks of human activity, in comparison with several stylized network models as well as a collection of empirical networks from the literature. The synthetic networks are generated by integrating data about human populations from several sources, including the Census, transportation surveys, and geographical data. The resulting networks represent an approximation of daily or weekly human interaction. Our results indicate that the synthetically generated graphs according to our methodology are closer to the real world graphs, as measured across multiple structural measures, than a range of stylized graphs generated using common network models from the literature.

Subject Areas: Social and Information Networks (cs.SI); Machine Learning (cs.LG); Machine Learning (stat.ML)

Title: Travel time use over Five Decades

Authors: Song, C. and Wei, C.

Abstract: In this paper, we use five decades of time-use surveys in the U.S. to document trends in travel time uses. We find that total travel time features an inverted-U shape, registering a 20 percent increase from 1975 to 1993, but an 18 percent decline from 1993 to 2013. We find that demographic shifts explain roughly 45 percent of the increase from 1975 to 1993, but play a much smaller role afterwards. From 2003 to 2013 the shift of time allocation from travel-intensive non-market work to travel-non-intensive leisure accounts for around 50 percent of the decline in total travel time.

Subject Areas: Travel time use; Time-use survey; Market work; Non-market work; Leisure

7.22. Title: Incorporating Long-Distance Travel into Transportation Planning in the United States

Author: Aultman-Hall, L.

Abstract: In the early years of transportation planning and highway infrastructure development in the United States the focus was on intercity or long-distance travel, a contrast to the metropolitan travel and state-based models that dominate today. Daily home and work-based travel, which have been the focus of data collection and models since the 1950s, are well-modeled by regional agencies and a limited number of state travel demand models even include some long-distance travel. Nonetheless, long-distance travel demand and factors affecting behavior are not thoroughly considered in transportation planning or behavior research. Only one recent activity-based model of national travel demand has been created and its scope was limited by a severe lack of data. The conceptualization of models to consider intercity long-distance travel has changed little since its inception in the 1970s and 1980s. In order to comprehensively consider transportation system sustainability, there is a critical need for improved nation-wide annual overnight activity data and models of overnight travel (a re-focus and important distinct re-framing of long-distance trips that this white paper suggests).

Truly addressing the economic, environmental, and social equity issues required to create a sustainable global transportation system will entail completely updating our existing planning framework to meaningfully include long-distance travel. It is clear that long-distance passenger miles must be accounted for when addressing greenhouse gas (GHG) emissions and other negative environmental externalities. Less well-known are the questions of social justice that loom large when one considers the details of long-distance travel. Travel in our society is becoming increasingly associated with quality of life. Those without intercity access may miss opportunity and social capital. However, without representative long-distance travel data it is impossible to compare the relative participation by different groups and to consider latent demand. It is difficult to measure who comprises the global mobile elite and who lacks sufficient intercity mobility for reasonable social network obligations and personal services.

This white paper suggests utilizing a common framework for long-distance data collection and tabulation that re-defines long-distance travel into daily or overnight. The author advocates using overnight as the defining characteristic for data collection, which complements existing daily travel surveys already capturing long day-trips. Within frameworks moving forward it is important to clearly characterize all trip purposes, including mixed purposes and purposeless travel, which comprise an appreciable portion of long-distance travel. Spatial data that distinguish between simple out-and-back trips and spatially complex trips are necessary and mobile devices have now made this measurement of long-distance tours feasible. In order to truly model all travel in the current system, we must move away from the idea that most travel is routine, within region, and home-based. Many people, especially the most frequent travelers, have long-distance routines including multiple home bases. Additionally, our models should not assume that travelers staying at a second home, hotel, or friend’s home travel like residents. Efforts to measure and model non-home-based travel or travel at destination are essential to accurately modeling behavior. Daily surveys such as the 2017 National Household
Transportation Survey are increasingly doing this. A nation-wide annual activity model of overnight travel must fully incorporate both surface and air travel to allow full consideration of alternative future system scenarios.

**Subject Areas:** Transportation planning; Long-Distance Travel; Data collection

**Availability:** Aultman-Hall, L., 2018. *Incorporating Long-Distance Travel into Transportation Planning in the United States*. UC Davis: Institute of Transportation Studies (UCD).

https://escholarship.org/uc/item/0ft8b3b5#main
7.23. Title: Area Sampling

Authors: Valliant, R., Dever, J.A. and Kreuter, F.

Abstract: Area sampling is a catchall term for a set of procedures in which geographic areas are selected as intermediate units on the way to sampling lower-level units that are the targets of a survey. The chapter contains geographic summaries of data on population counts, demographic distributions, and other detailed estimates that are used in sample design in lieu of a population registry. We discuss composite size measures for the PSUs that are particularly useful in accomplishing the design goals for domains at the element level while keeping cost in check. Given the amount of time to develop an area frame and to select units at lower sampling stages, we discuss methods for addressing differences between the frame and what can be found in the field. Finally, the chapter also reviews a relatively new type of sampling methodology known as address-based sampling, which can reduce or eliminate the need for field-listing of households before sampling.

Subject Areas: Transportation planning; Long-Distance Travel; Data collection

7.24. Title: Dynamic Ride Sharing using Traditional Taxis and Shared Autonomous Taxis: A Case Study of NYC

Authors: Lokhandwala, M. and Cai, H.

Abstract: This study analyzes the potential benefits and drawbacks of taxi sharing using agent-based modeling. New York City (NYC) taxis are examined as a case study to evaluate the advantages and disadvantages of ride sharing using both traditional taxis (with shifts) and shared autonomous taxis. Compared to existing studies analyzing ride sharing using NYC taxi data, our contributions are that (1) we proposed a model that incorporates individual heterogeneous preferences; (2) we compared traditional taxis to autonomous taxis; and (3) we examined the spatial change of service coverage due to ride sharing. Our results show that switching from traditional taxis to shared autonomous taxis can potentially reduce the fleet size by 59% while maintaining the service level and without significant increase in wait time for the riders. The benefit of ride sharing is significant with increased occupancy rate (from 1.2 to 3), decreased total travel distance (up to 55%), and reduced carbon emissions (up to 866 metric tonnes per day). Dynamic ride sharing, which allows shared trips to be formed among many groups of riders, up to the taxi capacity, increases system flexibility. Constraining the sharing to be only between two groups limits the sharing participation to be at the 50–75% level. However, the reduced fleet from ride sharing and autonomous driving may cause taxis to focus on areas of higher demands and lower the service levels in the suburban regions of the city.

Subject Areas: Ride sharing; Shared autonomous vehicles; Taxi sharing; Agent-Based model; Simulation

7.25. **Title:** Big Data Fusion to Estimate Driving Adoption Behavior and Urban Fuel Consumption

**Author:** Kalila, A.

**Abstract:** Data from mobile phones is constantly increasing in accuracy, quantity, and ubiquity. Methods that utilize such data in the field of transportation demand forecasting have been proposed and represent a welcome addition. We propose a framework that uses the resulting travel demand and computes fuel consumption. The model is calibrated for application on any range of car fuel efficiency and combined with other sources of data to produce urban fuel consumption estimates for the city of Riyadh as an application. Targeted traffic congestion reduction strategies are compared to random traffic reduction and the results indicate a factor of 2 improvement on fuel savings. Moreover, an agent-based innovation adoption model is used with a network of women from Call Detail Records to simulate the time at which women may adopt driving after the ban on females driving is lifted in Saudi Arabia. The resulting adoption rates are combined with fuel costs from simulating empty driver trips to forecast the fuel savings potential of such a historic policy change.

**Subject Areas:** Civil and Environmental Engineering

Title: Hands Off the Wheel in Autonomous Vehicles?: A Systems Perspective on over a Million Miles of Field Data

Authors: Banerjee, S.S., Jha, S., Cyriac, J., Kalbarczyk, Z.T. and Iyer, R.K.

Abstract: Autonomous vehicle (AV) technology is rapidly becoming a reality on U.S. roads, offering the promise of improvements in traffic management, safety, and the comfort and efficiency of vehicular travel. The California Department of Motor Vehicles (DMV) reports that between 2014 and 2017, manufacturers tested 144 AVs, driving a cumulative 1,116,605 autonomous miles, and reported 5,328 disengagements and 42 accidents involving AVs on public roads. This paper investigates the causes, dynamics, and impacts of such AV failures by analyzing disengagement and accident reports obtained from public DMV databases. We draw several conclusions. For example, we find that autonomous vehicles are 15 - 4000 times worse than human drivers for accidents per cumulative mile driven; that drivers of AVs need to be as alert as drivers of non-AVs; and that the AVs’ machine-learning-based systems for perception and decision-and-control are the primary cause of 64% of all disengagements.

Subject Areas: Accidents; Autonomous vehicles; Roads; Control systems; Process control; Vehicle dynamics

8. Traffic Safety

8.1. Title: A High-Injury Network for Atlanta: How are Severe and Fatal-Injury Crashes Concentrated on Atlanta’s Streets?

Author: Saxton, J.

Abstract: Following the lead of Sweden in 1997, 32 US cities have adopted Vision Zero policies that aim to eliminate all traffic deaths on their streets (Vision Zero Network 2017). After New York City in 2012, numerous cities in the northeast and on the west coast have adopted such policies as a first step toward eliminating the tens of thousands of preventable deaths that occur in the US every year. Adding urgency to their cause is the fact that in the United States, the annual number of traffic fatalities has increased since 2011, after decreasing steadily for decades. Cities can target future investments by creating a High-Injury Network which identifies the city streets where the majority of severe injuries and fatalities occur. This paper examines the precedent of Vision Zero policies and High-Injury Networks established in US cities and around the world. It looks at varying approaches to analyzing and representing severe injury and fatality data while considering a number of challenges posed in implementing a High-Injury Network. It aims to address the following question: How does street design in Atlanta impact the incidence of severe injury and fatality in traffic collisions?

Subject Areas: Vision Zero policies; Traffic deaths; High-Injury Networks

8.2. Title: The Exploration of Factors That Affect Travel Safety of Child Passengers

Author: Liu, K.

Abstract: There are few studies on the travel safety of child passenger in China. The study aims to describe the seating position and restraint practice of child passenger in China’s first-tier cities. The travel information on the children enrolled in 10 early education institutions, 15 kindergartens and 10 primary schools was randomly selected in Beijing, Shanghai, Guangzhou, Chongqing and Jinan in recent years. A total of 4900 parents were surveyed to collect children’s travel information and 3556 valid questionnaires were taken back. The adjusted rate ratios for optimal seating position (rear-seated alone) versus suboptimal seating position and restraint use versus non-use of restraints among child passengers were analyzed and evaluated using multivariate binomial regression. Through the survey, it is found that the suboptimal seating position (31.2%) and non-use of restraints (45.4%) were common among child passengers. Younger age (≤8 years old) is an unfavorable factor resulting in seating in rear seats by child passengers; and the higher the driver’s degree of education, the higher the family income and the more understanding about car seat is, the bigger likelihood of being rear-seated alone by child passengers is. Younger age (≤8 years old) is also an unfavorable factor resulting in restraint use by child passengers; and the more understanding about car seat, the bigger likelihood of using restraints for their children during travel. This study suggests that restraint non-use and suboptimal seating position are still common among child passengers in China’s first-tier cities and also identifies the factors influencing restraint use and seating position choice for child passengers. There is an urgent need to improve child passenger safety in China. At the same time, it is also necessary to strengthen the publicity about child passenger’s safety before the relevant laws and regulations are promulgated.

Subject Areas: Child Passengers; Restraints; Seating Position; Questionnaire Survey; Travel Safety

8.3. Title: Sturdy Inference and the Amelioration Potential For Driverless Cars: The Reduction of Motor Vehicle Fatalities due to Technology

Author: Fowles, R. and Loeb, P.D.

Abstract: Motor vehicle crashes continue to result in a large number of fatalities each year and represent the leading cause of death for young persons. This study is the first to examine specifically the effects of a set of focus variables thought to be major contributors to motor vehicle fatalities including distractions caused by, for example, cell phones, suicidal propensities among others using a newly developed Bayesian technique designed to measure the sturdiness of the results. The analysis is conducted using a rich panel data set for the period 1980-2010 by the State and the District of Columbia which includes motor vehicle, economic, and driver-related variables. As mentioned, the analysis makes use of a new Bayesian statistic developed by Leamer, that is, S-values. This statistic summarizes both estimation uncertainty and model ambiguity by considering millions of potential models of motor vehicle fatalities. Once the major factors of motor vehicle fatalities are unambiguously determined and their influences measured, the study considers the ameliorating potential of driverless cars on such fatalities as well as their costs to society. In particular, the ability of driverless cars with, for example, their self-braking capacity, to reduce the number of crashes, and their associated fatalities and injuries in a significant manner is examined. In addition, they may offer individuals the ability to use cell phones for calls and texting while not enhancing risks to vehicle occupants and pedestrians. Obviously, they may also serve in place of a designated driver should alcohol use be an issue. However, the ability of driverless vehicles to provide safe transportation is not without costs. These include developing and maintaining reliable computer systems and sensors along with back-up systems while addressing legal and possible environmental issues. We conclude that driverless cars offer the potential to ameliorate motor vehicle fatalities due to distractions, such as with the use of cell phones, alcohol use, and suicidal propensities. In addition, modernization of the vehicle fleet is expected to reduce motor vehicle fatalities since newer vehicles are expected to incorporate technologies which may be life saving.

Subject Areas: Alcohol; Bayesian econometrics; Driverless vehicles; Motor vehicle crashes; Motor vehicle fatalities; Vehicle safety

8.4. Title: Work Zone Intrusion Report Interface Design

Authors: Craig, C.M., Morris, N.L., Libby, D. and Davis, B.

Abstract: While necessary for roadways, work zones present a safety risk to crew. Half of road workers deaths between 2005 and 2010 were due to collisions with motorists intruding on the work zone. Therefore, addressing intrusions is an important step for ensuring a safe work environment for crew members. However, a recent research synthesis at the Minnesota Department of Transportation found that few states had an explicit method for systematically collecting work zone intrusion data. The purpose of this work zone intrusion interface design project was to design an efficient, comprehensive, and user-friendly reporting system for intrusions in work zones. A user-centric, iterative design process was employed to design an adaptable web-based and paper report to account for simple documentation of intrusions not deemed a threat to worker safety and a detailed report for more thorough documentation of serious intrusion events. Final recommendations include organizational changes and support to encourage workers to complete the form and provide valuable data to the state.

Subject Areas: Human factors in crashes; Transportation safety; Work zones; Data collection; Feasibility analysis

8.5. Title: “Complete Streets” Policies and Eliminating Pedestrian Fatalities

Author: Schneider, R.J.

Abstract: NA

Subject Areas: Public health; “Complete Street” Policy; Traffic injuries

8.6. Title: The Post-Discharge Car Seat Challenge: An Investigation of Utilization and Feasibility

Author: Haupt-Harrington, R.L.

Abstract: Assuring the safe transportation of infants is a well-known requirement at the time of hospital discharge, and consequently, medically fragile and/or premature infants generally undergo a car seat challenge to ensure they are physiologically ready to travel in a rear-facing car seat. Most tested (or challenged) infants will travel home from the hospital in a properly fitted car seat; however, because some infants are unable to maintain a patent airway in the semi-reclined position of a car seat, they must instead travel home in a recumbent car bed. Infants that initially fail the car seat challenge should undergo an additional car seat challenge prior to transitioning to a traditional, semi-reclined car seat. Although predischarge challenges are performed at the author’s local hospital on an as-needed basis, there was no locally accessible option for car seat challenges to occur after hospital discharge. To address this service gap, the author explored the feasibility, utilization, and potential implementation of a program to provide post-discharge car seat challenges using Kotter’s Change Management Model as a guide for program development. Informed by the evidence and study findings, the local clinic subsequently adopted a post-discharge car seat challenge program into current practice.

Subject Areas: Car seat; Car seat challenge; Airway; Safe infant transportation

8.7. Title: Awareness of Vision Zero among United States’ Road Safety Professionals

Author: Evenson, K.R., LaJeunesse, S. and Heiny, S.

Abstract: Background: Vision Zero is a strategy to eliminate all fatalities and serious injuries from road traffic crashes, while increasing safe and equitable mobility for all. In 2015, the United States’ Department of Transportation announced the official target of the federal government transportation safety policy was zero deaths. In 2017, we assessed the dissemination of Vision Zero in the United States.

Methods: We conducted a web-based survey in 2017 among road safety professionals. Email invitations were sent using relevant membership directories and conference lists.

Results: We surveyed 192 road safety professionals, including planning/engineering (57.8%), public health (16.7%), and law enforcement/emergency medical services (EMS) (8.9%). Awareness of Vision Zero was higher among planning/engineering fields (97.3%) compared to law enforcement/EMS (76.5%) and public health (75.0%). Awareness was similar by number of years working in the field. Awareness was higher in the South (95.9%) and Northeast (95.0%) regions, followed by the West (90.8%) and Midwest (85.2%) Census regions. Among those that heard of Vision Zero (n=174), 41.8% worked at a municipality with a Vision Zero campaign, while 41.2% did not. Among those working at a municipality with a Vision Zero campaign (n=71), about half participated in the campaign (54.9%) while the other half did not (45.1%).

Conclusions: With widespread dissemination of the Vision Zero strategy to road safety professionals, next steps include evaluating how Vision Zero is being adopted, implemented, and maintained in communities, as well as the awareness and acceptability by community members, and to identify the most promising policies and practices.

Subject Areas: Awareness; Bicycling; Diffusion of innovations; Motor vehicle crashes; Road safety; Pedestrians Walking

8.8. Title: Evaluation of Surrogate Measures for Pedestrian Trips at Intersections and Crash Modeling

Authors: Lee, J., Abdel-Aty, M. and Shah, I.

Abstract: Pedestrians are considered the most vulnerable road users who are directly exposed to traffic crashes. With a view to addressing the growing concern of pedestrian safety, Federal and local governments aim at reducing pedestrian-involved crashes. Nevertheless, pedestrian volume data are rarely available even though they among the most important factors to identify pedestrian safety. Thus, this study aims at identifying surrogate measures for pedestrian exposure at intersections. A two-step process is implemented: the first step is the development of Tobit and generalized linear models for predicting pedestrian trips (i.e., exposure models). In the second step, negative binomial and zero inflated negative binomial models were developed for pedestrian crashes using the predicted pedestrian trips. The results indicate that among various exposure models the Tobit model performs the best in describing pedestrian exposure. The identified exposure-relevant factors are the presence of schools, car-ownership, pavement condition, sidewalk width, bus ridership, intersection control type and presence of sidewalk barrier. It was also found that the negative binomial model with the predicted pedestrian trips and that with the observed pedestrian trips perform equally well for estimating pedestrian crashes. Also, the difference between the observed and the predicted pedestrian trips does not appear as statistically significant, according to the results of the t-test and Wilcoxon signed-rank test. It is expected that the methodologies using predicted pedestrian trips or directly including pedestrian surrogate exposure variables can estimate safety performance functions for pedestrian crashes even though when pedestrian trip data is not available.

Subject Areas: Pedestrian exposure; Pedestrian safety; Pedestrian crash analysis; Surrogate measures; Zero inflated negative binomial model; Risk factors


Authors: Lee, J., Abdel-Aty, M., Cai, Q., Wang, L. and Huang, H.

Abstract: In recent decades, considerable efforts have been made to incorporate traffic safety into long-term transportation plans (LTTPs), a process which is often termed transportation safety planning (TSP). Although some researchers have attempted to integrate transportation plans and safety by adopting transportation planning data (e.g., trip generation) for estimating traffic crash frequency at the macroscopic level, no studies have attempted to develop trip and safety models in one structure simultaneously. A Bayesian integrated multivariate modeling approach is suggested for estimating trips and crashes of non-motorized modes (i.e., walking and cycling). American Housing Survey (AHS) data were collected from the U.S. Census Bureau and were used for the proposed approach. In the first part of the proposed model, the probabilities of choosing walking and cycling modes were estimated, and the estimated probabilities were converted to trips by multiplying the number of sampled households. In the second part, the estimated trips were fed into crash prediction models (or safety performance functions) as an exposure variable. The modeling result revealed many contributing factors for pedestrian/bicycle trips and crashes. Possible shared unobserved features between pedestrian and bicycle trips, and between pedestrian and bicycle crashes, were accounted for by adopting a multivariate structure. In addition, it was found that the crash models with the estimated exposures outperform those with the observed exposures. It is expected that the integrated modeling approach for trips and crashes in this study will provide great insights into the future directions of TSP.

Subject Areas: Long-term transportation plans (LTTPs); Trips; Crashes


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8.10. Title: Potential Effects of lowering the BAC limit on Injuries, Fatalities, and Costs

Authors: Kostyniuk, L.P., Eby, D.W., Molnar, L.J., Louis, R.M.S., Zanier, N. and Miller, T.R.

Abstract: Introduction: Potential health and cost impacts of lowering the BAC limit for U.S. drivers below .08% were explored through analyses of reductions in crash incidence, injury severity, and costs based on five scenarios with varying assumptions about how the change to a .05% BAC limit might affect alcohol-impaired driving.

Methods: Distribution of crashes by injury level and highest driver or non-occupant BAC levels for 2010, together with unit crash costs provided a base for comparison. Scenario 1 assumed all alcohol-impaired driving ceased; scenario 2 assumed all drivers obeyed the law, and scenario 3 assumed decreases in driver BAC levels would be limited to those who had been driving near the legal limit before the change. Scenario 4 was based on changes in driver BAC levels associated with a .08% to .05% BAC limit change in Australia, and scenario 5 was based on changes in alcohol-related crashes associated with the change to the .08% BAC limit in the United States. The number of casualties prevented in each scenario was estimated using relative risks of crash involvement, and changes in societal costs were estimated using the unit costs.

Results: Reductions ranging from 71% to 99% in fatalities, injuries, and costs related to alcohol-impaired driving were estimated in scenarios 1 and 2. Scenarios 3–5 produced smaller reductions ranging from 4% to 16% for alcohol-impaired fatalities, injuries, and costs.

Conclusion: The wide difference between the outcomes of the two sets of scenarios reflects the sensitivity of BAC policy benefits to driver compliance behavior.

Subject Areas: Fatalities; Injury; Health; U.S. drivers; BAC

8.11. Title: Not all Crashes are Created Equal: Associations between the Built Environment and Disparities in Bicycle Collisions

Author: Barajas, J.M.

Abstract: Historically disadvantaged populations are disproportionately represented in bicycle crashes. Previous research has found that Black and Hispanic bicyclists and areas with higher populations of non-White residents, lower median income, and high poverty experience bicycle crashes more frequently than others. Although existing research has explored the role of socioeconomic status and the built environment in predicting crash frequency, few scholars have studied how these factors account for disparities along racial and ethnic lines. Using a database of 7,088 bicycle crashes over a three-year period in the San Francisco Bay Area, this study examines the influence of socioeconomic, transportation, and land-use characteristics as potential causes of differences in bicycle crash occurrences among racial and ethnic groups in the San Francisco Bay Area. While areas of high poverty and high land-use intensity are associated with higher numbers of bicycle crashes overall, lower-traffic streets and bicycle infrastructure do not affect the frequency of crashes involving Black and Hispanic cyclists. Black bicyclists have a disproportionate risk of being involved in a crash in poor urban neighborhoods, controlling for other factors. These findings draw attention to the need for planners to consider how socioeconomic differences and vulnerability at the neighborhood level play a role in safety.

Subject Areas: Bicycle crashes; Built Environment; Disadvantaged populations

8.12. Title: Estimated Total Costs from Non-fatal and Fatal Bicycle Crashes in the USA: 1997–2013

Authors: Gaither, T.W., Sanford, T.A., Awad, M.A., Osterberg, E.C., Murphy, G.P., Lawrence, B.A., Miller, T.R. and Breyer, B.N.

Abstract: Introduction: Emergency department visits and hospital admissions resulting from adult bicycle trauma have increased dramatically. Annual medical costs and work losses of these incidents last were estimated for 2005 and quality-of-life losses for 2000.


Results: Approximately 3.8 million non-fatal adult bicycle injuries were reported during the study period and 9839 deaths. In 2010 dollars, estimated adult bicycle injury costs totalled $24.4 billion in 2013. Estimated injury costs per mile bicycled fell from $2.85 in 2001 to $2.35 in 2009. From 1999 to 2013, total estimated costs were $209 billion due to non-fatal bicycle injuries and $28 billion due to fatal injuries. Inflation-free annual costs in the study period increased by 137% for non-fatal injuries and 23% for fatal injuries. The share of non-fatal costs associated with injuries to riders age 45 and older increased by 1.6% (95% CI 1.4% to 1.9%) annually. The proportion of costs due to incidents that occurred on a street or highway steadily increased by 0.8% (95% CI 0.4% to 1.3%) annually.

Conclusions: Inflation-free costs per case associated with non-fatal bicycle injuries are increasing. The growth in costs is especially associated with rising ridership, riders 45 and older, and street/highway crashes.

Subject Areas: Adult bicycle injuries; Costs; Bicycle Crashes

8.13. Title: Street Intersection Characteristics and Their Impacts on Perceived Bicycling Safety

Authors: Wang, K. and Akar, G.

Abstract: Safety concerns are among the main issues that deter people from bicycling in the U.S. Earlier studies have explored the associations between characteristics of intersection design and bicyclists’ safety perceptions. Research shows that there are significant links between bicycling choice, safety perceptions, bicycling experience levels, and socio-demographics. Yet the existing bicycling safety-rating models do not control for individuals’ socio-demographics and their levels of bicycling experience, which are known to affect bicycling choice. This study develops a Perceived Bicycling Intersection Safety (PBIS) model which helps engineers, planners, and decision makers to understand better how a wide range of intersection features contribute to bicyclists’ safety perceptions, controlling for socio-demographics and bicycling experience. The empirical analysis is based on an online visual survey conducted at the main campus of The Ohio State University through March and April 2017. Results showed that visual surveys are effective in capturing information about bicycling preferences. The paper concludes with recommendations for infrastructure decisions and suggestions for future research. The results of this study can help planners design street intersections that bicyclists will prefer. Our model can be applied elsewhere to test the effects of different intersection and street features.

Subject Areas: Bicycling; Safety; Socio-demographics; Street Intersection

8.14. Title: Investigating Proximity of Crash Locations to Aging Pedestrian Residences

Authors: Haule, H.J., Sando, T., Kitali, A.E. and Richardson, R.

Abstract: Many campaigns promote walking for recreation, work, and general-purpose trips for health and environmental benefits. This study investigated factors that influence the occurrence of crashes involving elderly pedestrians in relation to where they reside. Using actual pedestrian residential addresses, a Google integrated GIS-based method was developed for estimating distances from crash locations to pedestrian residences. A generalized linear mixed model (GLMM) was used to evaluate the effect of factors associated with residences, such as age group, roadway features, and demographic characteristics on the proximity of crash locations. Results indicated that the proximity of crash locations to pedestrian residences is influenced by the pedestrian age, gender, roadway traffic volume, seasons of the year, and pedestrian residence demographic characteristics. The findings of this study can be used by transportation agencies to develop plans that enhance aging pedestrian safety and improve livability.

Subject Areas: Elderly pedestrians; GIS-based method; Generalized linear mixed model (GLMM); Proximity

8.15. Title: Child Passenger Safety

Authors: Durbin, D.R. and Hoffman, B.D.

Abstract: Despite significant reductions in the number of children killed in motor vehicle crashes over the past decade, crashes continue to be the leading cause of death to children 4 years and older. Therefore, the American Academy of Pediatrics continues to recommend the inclusion of child passenger safety anticipatory guidance at every health supervision visit. This technical report provides a summary of the evidence in support of 5 recommendations for best practices to optimize safety in passenger vehicles for children from birth through adolescence that all pediatricians should know and promote in their routine practice. These recommendations are presented in the revised policy statement on child passenger safety in the form of an algorithm that is intended to facilitate their implementation by pediatricians with their patients and families. The algorithm is designed to cover the majority of situations that pediatricians will encounter in practice. In addition, a summary of evidence on a number of additional issues affecting the safety of children in motor vehicles, including the proper use and installation of child restraints, exposure to air bags, travel in pickup trucks, children left in or around vehicles, and the importance of restraint laws, is provided. Finally, this technical report provides pediatricians with a number of resources for additional information to use when providing anticipatory guidance to families.

Subject Areas: Children; Passenger; Safety; Crashes

8.16. Title: An Assessment of Traffic Safety Between Drivers and Bicyclists Based on Roadway Cross-Section Designs and Countermeasures Using Simulation

Authors: Lee, J. and Abdel-Aty, M.

Abstract: Cycling is encouraged in countries around the world as an economical, energy-efficient, and sustainable mode of transportation. Simulation is an important approach to analyzing the safety of cycling by identifying the effects of different factors. To ensure the success of a simulation study, it is essential to know the factors that have significant effects on bicycle safety. Although many studies have focused on analyzing bicycle safety, they lack bicycle exposure data, which could introduce biases for the identified factors. This study represents a major step forward in estimating safety performance functions for bicycle crashes at intersections by using crowdsourced data from STRAVA. Several adjustments considering the population distribution and field observations were made to overcome the disproportionate representation of the STRAVA data. The adjusted STRAVA data that includes bicycle exposure information was used as input to develop safety performance functions. The functions are negative binomial models aimed at predicting frequencies of bicycle crashes at intersections.

The developed model was compared with three counterparts: a model using the unadjusted STRAVA data, a model using the STRAVA data with field observation data adjustments only, and a model using the STRAVA data with adjusted population. The results revealed that the STRAVA data with both population and field observation data adjustments had the best performance in bicycle crash modeling.

The results also addressed several key factors (e.g., signal control system, intersection size, bike lanes) that are associated with bicycle safety at intersections. It is recommended that the effects of these identified factors be explored in simulation studies.

Additionally, the safety-in-numbers effect was acknowledged when bicycle crash rates decreased as bicycle activities increased. The study concluded that crowdsourced data is a reliable source for exploring bicycle safety after appropriate adjustments.

Subject Areas: Bicycle; Safety; Simulation

Title: Aging Road User Survey and Crash Analysis to Identify Issues and Applicable Improvement Strategies for Kansas Conditions

Authors: Dissanayake, S. and Koththigoda, S.

Abstract: The percentage of the United States population aged 65 years or older is increasing rapidly. Statistics show this age group was 14.9 percent of the population in 2015 and is expected to be 20.7 to 21.4 percent for the years 2030–2050. Kansas has similar statewide trends with its aging population. Therefore, identifying issues, concerns, and factors associated with highway safety of older drivers in Kansas is necessary and useful. The Kansas Crash Analysis and Reporting System (KCARS) database maintained by the Kansas Department of Transportation was used in this study to identify older-driver crash characteristics, compare older drivers with all drivers, and develop crash severity models.

According to KCARS data, older drivers were involved in more than one in five fatalities in Kansas from 2010 to 2014. When compared with all drivers, older drivers were overly represented in fatal and incapacitating injuries. The percentage of older-driver fatal injuries was more than twice that of all drivers. Older drivers were involved more often in crashes at four-way intersections, on straight and level roads, in daylight hours, and at stop or yield signs.

Due to the high severities of older-driver crashes, an in-depth crash severity analysis was carried out for the older drivers involved in crashes. Three separate binary logistic regression models were developed for single-vehicle crashes where only the older driver was present (Model A), single-vehicle crashes involving an older driver with at least one passenger (Model B), and multi-vehicle crashes involving at least one older driver (Model C). From the crash severity analysis, it was found that left turns were significant in changing the crash severity for Model A, though it was not significant in Model B. For Model B, none of the passenger attributes were significant, though it was originally developed to identify passenger attributes. Gender of the older driver was not significant in any of the models. For all models, variables such as safety equipment use, crash location, weather conditions, driver ejected or trapped, and light conditions distinguished crash severity. Furthermore, for Model A, variables such as day of the week, speed, accident class, and maneuver, were associated with crash severity. Accident class, surface type, and vehicle type changed crash severity in Model B. Number of vehicles, speed, collision type, maneuver, and two-lane roads were significant in Model C.

A road-user survey was also conducted to identify habits, needs, and concerns of Kansas’ aging road users, since it was not advisable to conclude safety factors solely on crash data. The probability of occurrence was calculated by taking the weighted average of answers to a question. Contingency table analysis was carried out to identify relationships among variables. For older drivers, seatbelt use as a driver had the highest probability of occurrence. Driving in heavy traffic, merging into traffic, moving away from traffic, and judging gaps were dependent on age group. Findings of this research gave understanding of older-driver crashes and associated factors. Since more than 85 percent of crash contributory causes were related to drivers, driver awareness programs, driver licensing restrictions, providing public transportation, and law enforcement can be considered as potential countermeasures. Accordingly, results of this study could be used to enhance
older-driver safety and awareness programs.

**Subject Areas:** Crash Analysis; Older drivers; Road User Survey

8.18. Title: Self-driving Startup Nuro Delivers Safety Report to Feds

Author: Plautz, J.

Abstract: Blog

Subject Areas: Autonomous delivery vehicle; Safety Report; Nuro

8.19. Title: Understanding the Difference Between Safety and Access

Author: DeGood, K.

Abstract: Blog

Subject Areas: Autonomous vehicle; Pedestrians; Road signs

9. Transit Planning

9.1. Title: The Impacts of Built Environment Characteristics of Rail Station Areas on Household Travel Behavior

Authors: Park, K., Ewing, R., Scheer, B.C. and Tian, G.

Abstract: Transit-oriented development (TOD) has gained popularity worldwide as a sustainable form of urbanism by concentrating developments near a transit station so as to minimize auto-dependency and maximize ridership. Existing TOD studies, however, have limits in terms of small sample size and aggregate-level analysis. This study examines various travel outcomes — VMT, auto trips, transit trips, and walk trips — in rail-based station areas in eight U.S. metropolitan areas in order to understand the role of neighborhood built environment characteristics. Two-stage hurdle models handle excess zero values in trip count variables and multi-level models deal with three-level data structure — household within station areas within regions. The final models show that automobile use is associated with land-use diversity and street network design of a station area; transit use is strongly related to transit availability and land-use diversity; and walking is related to transit availability, land-use diversity, and street network design. The weakest influence among station-area environment factors is density. In sum, a TOD, a station area having a dense, mixed-use, walkable, and transit-friendly environment, motivates residents to walk more and take transit more while driving less.

Subject Areas: Transit-oriented development; Travel outcomes; Household travel survey; Two-stage hurdle model; Multi-level model

9.2. Title: Determining Transit Service Coverage by Non-Motorized Accessibility to Transit: Case Study of Applying GPS Data in Cincinnati Metropolitan Area

Authors: Zuo, T., Wei, H. and Rohne, A.

Abstract: To more effectively expand transit service coverage through promoting bicycling, a practical approach is presented in the paper for estimating the coverage of transit service accessible by non-motorized modes (i.e. walking and bicycling). The non-motorized accessibility to transit is determined by the connectivity and facilities of non-motorized network. Using the data from 2009 to 2010 GPS-based Household Travel Survey in the Cincinnati metropolitan area, the study examines distance thresholds of such non-motorized transit access trips and identifies the spatial boundary and geographic area of transit catchment areas in the Geographic Information System environment. Results suggest that bicycle enables people to access the transit service. The bicycle-transit catchment area is estimated as 1.7 and 2.3 times of the size of pedestrian-transit catchment area at home and activity ends respectively. As a result, more households and employment can reach the transit service via bicycling than walking (52.45% vs. 36.72% for households and 47.82% vs. 33.07% for employment in the study area). Suburbs, where near half of population and employment situate, are comparatively underserved. Especially, only 27.14% of the disadvantaged population in suburbs, can access transit by walking, but the percent is increased to 50.96% if using a bicycle. Besides the distance threshold, the non-motorized accessibility to transit is found to be a significant factor determining transit catchment areas. The transit service area can be expanded if a safer and more comfortable bicycling environment is available. Those findings can also be further used as references in the transit-oriented development planning.

Subject Areas: Transit service coverage; Non-motorized accessibility to transit; Transit catchment area

Abstract: Over the next 30 years, technological innovation will make automobile travel more convenient. Automated and connected vehicles will perform an increasing number of driving tasks without human input and will lure customers away from traditional public transportation. This paper first explores key characteristics of public transportation demand in the United States today – based on an international comparison with other Western countries. Next, the paper provides potential pathways on how public transportation agencies and local governments in the United States could respond to the emergence of automated and connected vehicles. The paper argues that space efficiency in urbanized areas and the rush hour commute will remain public transportation’s key strengths. In addition, public transportation will retain its important role in providing mobility for all – in particular, for those who cannot afford costly automated and connected vehicles. To remain competitive with the car, public transportation agencies and governments have to harness emerging automated and connected technologies for public transportation, integrate public transportation with other mobility services, coordinate and integrate public transportation services regionally, and coordinate planning for public transportation and land use.

Subject Areas: Technological innovation; Automobile travel; Public transportation

Title: Multi-level Urban Form and Commuting Mode Share in Rail Station Areas across the United States; A Seemingly Unrelated Regression Approach

Authors: Nasri, A. and Zhang, L.

Abstract: Transit-friendly development has recently become a popular strategy to increase transit mode share in the United States. Many policies and programs have been proposed and implemented across the country to increase residential and job densities, walkability, and mixed-use development around major transit stations in order to encourage transit ridership. Using data from all rail transit stations across the United States, this paper presents an analysis of commute mode share for people who live within walking distance to rail transit with regard to the urban form at both neighborhood and regional levels. This study provides additional evidence to better understand how transit accessibility and urban design jointly aim to encourage transit use and reduce driving in rail stations areas across the U.S. and thus cope with ever-growing traffic congestion in urban areas. It is one of the first analyses to examine the relationships between urban form measured at both local/neighborhood and metropolitan levels and the commuting mode share across major transit station areas nationwide. It utilizes a Seemingly Unrelated Regression modeling method (SUR) — which is based on generalized least squares (GLS) — and estimates three primary modes of auto, transit, and walk/bike. Findings suggest that urban form at both station area (local effect) and at the whole metropolitan area (regional effect) influences commuting patterns. Factors such as population and employment densities, walkability, and transit accessibility at both local and regional levels are significantly associated with commute mode share. Job accessibility via transit in the entire region (measured by the number of jobs located within 45-min from a transit stop) is another important factor encouraging transit ridership for everyday commuting trips.

Subject Areas: Built environment; Regional urban form; Transit accessibility; TOD; Commute mode choice; Seemingly unrelated regression; Travel behavior; Urban design

9.5. Title: Can Metro Transit Reduce Driving? Evidence from Xi’an, China

Authors: Huang, X., Cao, X.J., Yin, J. and Cao, X.

Abstract: Rail transit investment has increased greatly because of its potential to attract choice riders to switch from driving to transit. However, there is limited knowledge about the impacts of rail transit on driving, particularly in fast-growing developing countries. Furthermore, many studies are subject to one or more limitations from methodological and practical perspectives. Using the 2014 data from Xi’an, this paper employs both cross-sectional and quasi-longitudinal analyses to examine how metro transit influences driving. The quasi-longitudinal analysis shows that moving into metro neighborhoods is negatively associated with change in driving although the cross-sectional analysis shows no effect. Therefore, the results based on cross-sectional analysis may be misleading. Taken all together, metro transit development and the design of station-area neighborhoods have the potential to reduce driving, and mitigate its impact on environment and slow the growth of traffic congestion.

Subject Areas: Transit-oriented development; Residential self-selection; Rail transit; Longitudinal design; Sustainable travel

9.6. Title: Comparative Trip Generation Models of the US Households: With and Without Heavy Rail System

Author: Uddin, M.S.

Abstract: This study is conducted with an object to develop the general trip generation models of US households with and without the existence of heavy rail system. Four multiple linear regression models are developed in this study. First two models are developed for predicting total household daily trips. Rest two models are developed for estimating household auto and non-auto trips. Seven socio-economic variables are incorporated in the models as predictors. Predictors are selected based on their individual power of explaining the total number of household trips per day. Besides these seven variables, two dummy variables are also included in the models. One is for the existence heavy rail system and another one is for the urban and rural area. Data of National Household Travel Survey, 2017 are used in this study. Total 89,414 household’s information are considered in this study. 9175 households were deleted from the primary database due to the lack of information. As training dataset 80% (71,535) households are randomly selected from the dataset. Rest 17,884 households are used for the verification of the models. US households are vastly dependent on auto trips. About 82% trips of total household trips are automobile dependent. Only 18% trips of total household trips use other types of modes. In case of trip purpose, US households generate a significant percentage of Non-home base (NHB) trips which is about 31%. People also travel longer mileage (31 miles) for NHB trips. In general, from the models, it is found that household with female members generates more trips than a household with male members. Household income, number of drivers in a household influence the number of trips positively. Number of working persons in a household negatively influence the total number of trips. The impact nature of household vehicle is not statistically identified in the developed models. The existence of heavy rail system helps to reduce the overall trip numbers. Finally, it is also found that people in the urban area are producing more trips than the people of rural areas.

Subject Areas: Trip generation models; Heavy rail system; Regression models

9.7. Title: Just Around the Corner: The Future of US Public Transportation

Author: Polzin, S.E.

Abstract: N.A.

Subject Areas: Public transportation; Mobility

http://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=1739&context=jpt
9.8. Title: Associations between Public Transit Usage and Bikesharing Behaviors in The United States

Authors: Zhang, Y. and Zhang, Y.

Abstract: Public bikesharing systems have rapidly expanded across many cities in the United States (US). Previous studies in the literature found that, in general, bikesharing is associated with public transit ridership. However, the interdependencies between public transit usage and bikesharing behaviors have been mixed and have not been fully understood. Therefore, the objective of this research is to examine the associations between the frequency of public transit usage and the probability and frequency of bikesharing usage in the US using data from the 2017 National Household Travel Survey. The respondents were asked how many times they had used public transit and bikesharing in the last 30 days. Zero-inflated negative binomial regression models were conducted to assess the associations between the frequency of public transit usage and the probability and frequency of bikesharing usage. The results show that, in general, a one-unit increase in the frequency of public transit usage is significantly associated with a 4.0% increase in the probability of bikesharing usage and a 1.4% increase in the frequency of bikesharing usage. The significantly positive relationship between the frequency of public transit usage and the frequency of bikesharing usage is more pronounced among those living in areas with higher population density or with rail service. The empirical results demonstrate that public transit usage is significantly positively associated with bikesharing usage, and suggest policy implications that improving public transit usage tends to increase the usage of bikesharing. This study also provides significant empirical evidence for the formulation of interventions and policies targeting to promote integrated transportation systems that support multimodal transportation and mutually sustainable transport networks.

Subject Areas: bikesharing; Public Transit; Regression models

9.9. Title: Transit in the 2000s: Where Does It Stand and Where Is It Headed?

Authors: Manville, M., Taylor, B.D. and Blumenberg, E.

Abstract: U.S. public transit has experienced something of a renaissance in the 2000s, with per capita service levels increasing nationwide and public investment growing even faster – particularly expenditures on rail transit. Despite this expansion, overall transit patronage has been relatively flat, and has declined significantly since 2014. What is behind these trends, and what do they portend for the future of transit? In this paper we consider three challenges shaping transit today and in the years ahead: (1) the asymmetry of transit supply and use make it especially vulnerable to changes and disruptions; (2) many of the factors that determine transit ridership, such as levels of private vehicle ownership and use, are largely beyond the control of transit agencies; and (3) there remains no consensus about what purpose transit should serve – politically the industry thrives on the idea that it will reduce congestion or clean the air, while in practice it primarily moves poor people, a very different and sometimes conflicting role. How successfully transit systems manage each of these challenges will shape their future roles and significance.

Subject Areas: Transit supply; Ridership; Private vehicle ownership

http://scholarcommons.usf.edu/jpt/vol21/iss1/11/
9.10. Title: Transit Fare Structure and Equity: Case of MARTA, Atlanta

Authors: Rao, P.

Abstract: Public transit in the US is heavily used by captive riders who depend on transit for their mobility. Studies have shown that the poor and minority groups live in the inner-city areas, travel shorter distances to downtown jobs and thus subsidize the trips by the rich suburban dwellers. These transit dependent riders also travel during non-peak hours and thus pay more for the service. However, studies have also indicated a trend of suburbanization of poverty across the cities of the United States. This is in contradiction to the earlier studies on travel patterns of transit dependent riders. This applied research paper uses the Atlanta Regional Commission’s (ARC) 2009-2010 Regional On-Board Transit Survey data to examine this discrepancy and evaluate equity impacts of alternative variable fare structures.

Subject Areas: Transit; Mobility; Riders; Fare structure

9.11. Title: A Transport Justice Evaluation of Employer-Based Transit Subsidies

Author: Hamre, A.K.M.

Abstract: National statistics regarding subsidized commuting suggest that employer-based transit subsidies may be inaccessible to the vast majority of the working poor. My main purpose with this study is to increase our understanding of employer-based transit subsidies from a transport justice perspective. I apply the theory of transport justice developed by Karel Martens to evaluate whether the provision of transit subsidies varies significantly by income, and whether the subsidies are significantly associated with accessibility as measured by daily trip levels. I use worker-level data from household travel surveys for 10 of the 22 largest MPOs in the U.S., organized into 7 cases: 1) Atlanta; 2) Baltimore and Washington, DC; 3) Denver; 4) Los Angeles and San Diego; 5) New York and Newark; 6) Philadelphia; and 7) San Francisco. In each of the 7 cases, the odds of being offered a transit subsidy were significantly lower for workers in the 1st income quintile compared to workers in the 4th and 5th income quintiles, even after controlling for other relevant worker and employer characteristics. I found a lack of evidence, in most cases, that transit subsidies are significantly associated with accessibility, both in terms of daily trip levels for low-income workers and daily trip differentials between income groups. Given my finding that low-income workers are the least likely to have access to employer-based transit subsidies, policymakers may consider reform alternatives, such as commuter benefit ordinances, a refundable tax credit for commuting expenses, or alternatives such as income- and location-based subsidies for transit that may support all trip purposes. I hope this study will serve as a reference for policymakers deliberating commuter benefit reforms as well as strategies to support affordable access to opportunities for the working poor.

Subject Areas: Transit subsidies; Daily trip levels; Income; MPOs

9.12. Title: Trade-offs between Headway, Fare, and Real-Time Bus Information under different Weather Conditions

Authors: Rahman, M.M., Kattan, L. and Wirasinghe, S.C.

Abstract: Given the increasing interest in real-time bus information, quantifying the value of such information from a user’s perspective is useful for transport modelers and service planners. Although a number of studies have investigated several other aspects of real-time bus information systems, there is a lack of studies that compare the disutility associated with the bus headway of a scheduled arrival information system and that of a real-time information system from a user’s perspective. In addition, no analyses in the literature examined the value of real-time information as affected by trip purpose and weather, which is important especially for the cities in which the weather remains below zero degrees during winter. The primary objectives of this research are to elucidate these issues. A stated preference survey describing the choice between scheduled and real-time information systems was conducted in Calgary, Canada. A total of 426 people participated in the survey, and each person was presented with three randomly selected choice situations. This data set was utilized to estimate the coefficients in different utility functions using a mixed logit model, which avoided several major limitations of a standard multinomial logit model. It was found that the disutility of the headway of a real-time information system was about half of the disutility of a scheduled information system. The analysis also showed that there was a nonlinear trend for the real-time information system, in which people found a higher disutility rate for a longer headway. Further, the value of real-time information availability was normally distributed in the population, with a mean of $0.50 and a standard deviation of $0.40. The results also revealed that the value of real-time information was significantly different when the weather was below and above 0°C, those values were $0.59 and $0.41, respectively. Many of the findings obtained here are novel and have implications for both theory and practice. Particularly, they are important for transport modelers and service planners to design or adjust the headway for a desired level of service for a given (or a change in) bus arrival information type.

Subject Areas: Real-time information; Headway disutility; The value of information; Stated preference; Mixed logit


301
9.13. Title: Elevating access: Comparing Accessibility to Jobs by Public Transport for Individuals With and without a Physical Disability

Authors: Grisé, E., Boisjoly, G., Maguire, M. and El-Geneidy, A.

Abstract: Equal access to opportunities has emerged in public transport planning as a social objective that many transport agencies are trying to achieve. Yet in practice, not all public transport agencies are currently providing urban residents with comparable levels of service due to physical barriers in the public transport network that can significantly hinder the ability of individuals with physical disabilities to access opportunities. In countries without a strong federal accessibility act and/or with major financial constraints, some public transport agencies fall behind in applying universal access design principles, making it even harder for people with a physical disability to access opportunities. The objective of this study is to develop a methodology that can be used by public transport agencies or disability advocates to clearly highlight and quantify the performance of the public transport network in a region, in terms of providing transit services to people in a wheelchair and compare that to the service offered to an individual not in a wheelchair. In this study we use accessibility, the ease of reaching destinations, by public transport as the key performance measure in two major Canadian Cities (Montreal and Toronto). Furthermore, we focus on job accessibility in the most socially vulnerable census tracts in both cities, to evaluate levels of job accessibility for wheelchair users residing in socially vulnerable areas. The findings from our study show striking contrasts between the numbers of accessible jobs by public transport for wheelchair users compared to the general population. On average, wheelchair users in Toronto have access to 75% of jobs that are accessible to users that are not in a wheelchair, whilst their counterparts in Montreal have access to only 46% of the jobs accessible to other users. This research is expected to highlight for public transport engineers, planners, policy makers and advocates for those with disabilities, the importance of universal access in a region, especially along public transport networks, using a widely used land use and transport performance measure.

Subject Areas: Public transport planning; Physical disabilities; Job accessibility

9.14. Title: Public Transit in America 2017


Abstract: Understanding transit ridership and the characteristics of transit markets is a fundamental necessity for all individuals involved in planning, operating, marketing, and policy decision-making for public transit. The 2017 National Household Travel Survey (NHTS) data set is set to be released in early 2018. This will afford researchers the ability to assess a range of public transit markets from multiple perspectives such as socio-demographics of transit markets, transit-specific trip characteristics, modal shares, overall transit market size, attitudes on transportation issues within each transit market, etc. The Mobility Policy Research Team has a strong history of participation and extensive dissemination of NHTS data analysis with published reports dating back to the early 1990’s. This research will build on the series of reports titled “Public Transit in America: Findings From the 1995 Nationwide Personal Transportation Survey,” “Public Transit in America: Analysis of Access Using the 2001 National Household Travel Survey,” and “An Assessment of Public Transportation Markets Using NHTS Data” which analyzed the 2009 NHTS data set. Given the history of NHTS data analysis involvement, our research team will have the ability to draw meaningful conclusions by understanding of the nuances associated with the trends. In addition to the trend analysis, the new NHTS survey will have unique data relative to the emerging transportation network company (TNC) mode of travel, allowing the exploration of meaningful modal relationships with quality data.

Subject Areas: Transit; National Household Travel Survey; Trend Analysis

Title: Does Investing in Rail Transit Benefit the Poor? A Comparative Study of Rail and Bus Travel by Low-Income Households in the California Household Travel Survey

Author: Lu, R.

Abstract: This paper addresses academic discourse that critiques urban rail transit projects for their regressive impacts on the poor and proposes bus funding as a more equitable investment for urban transit agencies. The author analyzed data from the 2012 California Household Travel Survey on transit trips in Los Angeles County. The author cross-tabulated data on the modal breakdown of transit trips by household income category and on the breakdown of household income associated with trips by bus and rail transit modes. The author also comparatively evaluated the speed of trips (as a ratio of miles per hour) taken by rail and by bus by low-income households in the county. The author found convincing evidence that, on average, trips low-income households made by rail transit covered a greater distance per hour than trips taken by bus transit, but that trips made on the county’s bus rapid transit services with dedicated rights-of-way had a higher mean speed than those taken by rail. Moreover, the mode and income cross-tabulations indicate that rail transit projects only partially serve low-income households’ travel needs. To the extent that equitable transit planning entails minimizing the disparities in access, both rail and bus rapid transit projects can advance social justice if they are targeted at corridors where they can serve travel demand by low-income, transit dependent households.

Subject Areas: Rail transit; Low-income households

Title: The Impact of Oil Boom and Bust Cycles on Western North Dakota

Authors: Peterson, D. and Taleqani, A.R.

Abstract: Discoveries of shale gas reserves along with the development of horizontal drilling and hydraulic fracturing techniques, as well as the initiative to move the United States toward greater energy independence led to the most recent oil boom in western North Dakota (U.S. Congress 2007). Overall, the boom brought a billion-dollar surplus for the state budget in North Dakota from severance taxes and extensive mineral rights. The population doubled in some areas, e.g., the city of Williston grew by 67% from 2010 to 2014 (Scheyder 2016). After almost a decade of production of North Dakota shale oil, prices dropped from about $100 a barrel in 2014 to about $30 in early 2016 and the industry went into the bust portion of the economic cycle where oil production and affiliated employment and spending contracted and where the industry and state are waiting for crude oil prices to rise again (Scheyder 2016).

Transit livability index measures showed large increases from 2008 to 2012 followed by overall corrections from 2013 to 2016. These measures declined as oil production and economic advances diminished. Further, transit fleet size failed to increase with population growth, and pedestrian safety has become a concern along both rural and city highways. System dynamics simulations focused on potential mode shifts from private automobile to transit, finding that seemingly small shifts (1-2%) from auto to transit would result in millions of dollars of fuel savings in the oil patch alone.

Various models of either fixed-route or flex-route busing should be considered by transit agencies and local policy makers for the larger communities of Williston and Dickinson, while more rural providers need to update their fleets to meet demand as well. Because of recent cutbacks in state and local funding, agencies should also strive to better coordinate services while continuing to provide rides to county population centers that offer goods and services required by rural residents.

Subject Areas: Transit livability index; Transit fleet size; Oil production, Gas reserves

Title: Factors Affecting Travel Demand by Bus: An Empirical Analysis at U.S. Metropolitan Statistical Area Level

Authors: Alam, B.M., Nixon, H. and Zhang, Q.

Abstract: Understanding the nature of transit travel demand is at the heart of transportation policy making and the success of transit systems. Unfortunately, most existing studies focus narrowly on a single or a few transit systems or metropolitan areas to analyze the determinants of transit travel demand. It is, therefore, difficult to generalize their findings over a broader geographic scale. This paper examines and explores the determinants of transit travel demand by bus generalizable to the entire U.S. by investigating internal and external factors at the U.S. metropolitan statistical area (MSA) level for 2010. The authors collected and used data for all 358 MSAs nationwide. Internal factors are those that the transit managers and operators have some control over (e.g., transit supply, transit coverage), whereas external factors are those that they do not have control over (e.g., population density, vehicles per household). Several variables came directly from the U.S. Census Bureau and National Transit Database, whereas the authors constructed others using data from these two sources. The paper employs a log-log regression model to address the issues of non-normality, non-linearity, and heteroscedasticity. Findings suggest that internal factors tend to be significant predictors of travel demand by bus mode compared with external ones. As such, transit authorities have the ability to attract ridership by adjusting the influential internal factors under their control.

Subject Areas: Transit travel demand; Transit systems; Bus; Metropolitan Statistical Area; U.S. Census Bureau; National Transit Database

Title: Immigration, Income, and Public Transit Perceptions: Findings from an Intercept Survey

Authors: Barajas, J.M., Chatman, D.G. and Weinstein Agrawal, A.

Abstract: Although a significant fraction of public transit riders in the United States are immigrants, relatively little research explores whether immigrants have unique transit experiences. This paper analyzes intercept survey data from 1,247 transit riders in the San Francisco Bay Area to explore how mode choices and travel experiences differ for low-income immigrants compared to higher-income immigrants and US-born residents. We find that some public transit experiences are similar across all immigrant status and income groups, while in other ways low-income immigrants differ from their higher-income counterparts or from US-born respondents. In particular, low-income immigrants were less likely to have a bus pass or bicycle access. They were far more likely to substitute driving for taking public transit than all other immigrant and income groups. The results underscore the importance of collecting data on country of origin together with travel behavior data, because many experiences are more burdensome for low-income immigrants.

Subject Areas: Public Transit; San Francisco Bay Area; Mode choices; Immigrants; US-born residents; Income groups

9.19. Title: Urban Decongestion Solution: Expansion of Light Rail Transit

Author: Clarke, K.T.

Abstract: In understanding the imminent growth of world population, the overpopulation of our metropolitan cities is a real concern. Be it the massive carbon footprint created by the many accelerating factors, the housing limitability and limited affordability, or the possible economic strain for cities and citizens to manage properly, the threat of overly congested metro areas is a threat to maintaining steady economic growth. Research on overpopulation has been conducted regularly specific to targeted metropolitan areas, attempting to not only identify that area’s specific issues, but to explore solutions to identified problems. This study examines the easing of overcrowded urban areas through Light Rail Transit (LRT). It tests the hypothesis that the expansion of LRT would spread the concentrated Metro-Seattle city population to surrounding cities (in this case, the Edmonds urban area), by offering living options outside of the metro areas with reliable transportation to and from city centers. The study uses a Pearson’s correlation between the area populations to identify any analytical relationship. This study identifies an $r = .95$ correlation between the two areas. Although a strong correlation was identified, the study does not find plausible evidence of congestion relief based on population alone. However, it does identify future research areas that may isolate the benefits of LRT expansion. Transportation polices that are pro-LRT may be the solution to decongestion, but more research is needed.

Subject Areas: Light Rail Transit (LRT); Overcrowded urban areas; Metropolitan cities

9.20. Title: Understanding the Effects of Demographic and Socio-Economic Factors on Public Transit Ridership Trends

**Author:** Lehmann, K.R.

**Abstract:** Public transit, an important mobility service for many, has incurred ridership decline in the U.S. for the past three years. In 2014, U.S. transit ridership was 10.74 billion unlinked passenger trips. In 2015, total ridership was 1.0 percent fewer, and the 2016 decrease was 2.2 percent from 2015. The consistent abandonment of transit in the U.S. does not seem to be ending. In 2017, ridership predicted from year-to-date data is 2.4 percent less than 2016. Furthermore, per capita ridership has decreased 17 percent since 1980. Both the short-term ridership trend and long-term per capita ridership trend is concerning given the increased spending and service provision during the same periods. In seeking to understand the many factors that influence transit ridership trends, it is important to analyze each so that policymakers and practitioners can respond and position transit accordingly. Numerous demographic and economic phenomena help explain this decline in transit use. This research focuses on five of these considerations—age, vehicle availability, telecommuting, fuel price, and geographic distribution of the population.

**Subject Areas:** Public Transit; Aging Population; Growth in Telecommuting; Geographic Distribution; Vehicle Availability; Gasoline Prices


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9.21. Title: Productivity in Transit: A New Measure of Labor Productivity for Urban Transit Systems

Authors: Chansky, B. and Modica, N.F.

Abstract: The U.S. Bureau of Labor Statistics productivity program introduces a new measure of labor productivity for urban transit systems. Urban transit systems, predominantly operated by state and local governments, include numerous modes of transportation, such as buses, subways, and light rail systems. This labor productivity index relies upon a volume-based index of industry services, which are defined as passenger miles traveled.

Subject Areas: Labor productivity; Urban transit systems; Passenger miles traveled; Volume-based index

9.22. Title: First and Last Mile Assessment For Transit Systems

Authors: Liu, X.C., Zlatkovic, M., Porter, R.J., Fayyaz, K. and Taylor, J.

Abstract: The First Mile Last Mile (FMLM) challenge garners significant attention as a means to assess the accessibility of the first leg to transit and the last leg from public transit. As a critical barrier to public transit accessibility, the challenge provides many opportunities to closely analyze conditions from the level of the transit station upwards to the level of the system-wide network. Its usefulness in contributing to the body of knowledge on barriers to transit access provides planners and researchers important information with implications in increasing ridership, transit efficiency, multimodal travel options, and accessible mobility. In this project, we propose a methodological framework for analyzing the FMLM problems by determining varying causes of poor public transit accessibility and identifying areas with immediate needs for improvements. We showcase the analytical framework using a transit network in the state of Utah operated by the Utah Transit Authority. We also conducted analysis on the impacts of reduced automobile use on personal and environmental health. As a companion product, a spreadsheet based sketch planning tool is developed to estimate health cost savings as a result of mode shifts from private automobiles to active transportation options.

Subject Areas: Public transit; Transit efficiency; Ridership; Utah Transit Authority

9.23. Title: Services like UberPool are making traffic worse, study says

Author: Siddiqui, F.

Abstract: Blog

Subject Areas: Public transit; Subway; Bus; Uberpool

9.24. Title: Calhan Connection bringing public transportation to rural El Paso County

Author: Riley, R.

Abstract: Blog

Subject Areas: Public transportation; Bus; El Paso County

9.25. Title: 10 Shocking Takeaways on Public Transit and Commuting From a Month in Cleveland Without a Car

Author: Allard, S.

Abstract: Blog

Subject Areas: Public transit; Alternative transit modes; Lyft

10. Travel Behavior

10.1. Title: Does Context Matter? A Comparative Study Modelling Autonomous Vehicle Impact on Travel Behaviour for Germany and the USA.

Authors: Kröger, L., Kuhnimhof, T. and Trommer, S.

Abstract: This paper, for the first time, presents comparable projections of travel behaviour impacts of the introduction of autonomous vehicles (AVs) into the private car fleet for two countries, namely the USA and Germany. The focus is on fully autonomous vehicles (AVs) which allow drivers to engage in other activities enroute. Two 2035 scenarios — a trend scenario and an extreme scenario — are presented for both study countries. For these projections, we combine a vehicle technology diffusion model and an aspatial travel demand model. Factors that influence AV impact in the behavioural model are mainly new automobile user groups, e.g. travellers with mobility impairments, and altered generalized costs of travel, e.g. due to a lower value of travel time savings for car travel. The results indicate that AV penetrations rates might be higher in Germany (10% or 38% respectively) than in the USA (8% or 29% respectively) due to a higher share of luxury cars and quicker fleet turnover. On the contrary, the increase of vehicle mileage induced by AVs is not higher in Germany (+2.4% or +8.6% respectively) than in the USA (+3.4% or +8.6% respectively). This is mainly due to the lack of mode alternatives and lower fuel costs resulting in a higher share of travel times among the total generalized costs of travel in the USA. These results clearly indicate that context factors shaped by national policy will influence AV adoption and impact on travel demand changes. Based on these results the paper draws policy recommendations which will help to harness the advantages of AVs while avoiding their negative consequences.

Subject Areas: Vehicle automation; Autonomous vehicles; Diffusion rates of autonomous vehicles; Market penetration; Fleet evolution; Modelling travel demand; Impact on travel demand

10.2. Title: Metropolitan Size and the Impacts of Telecommuting on Personal Travel

Authors: Zhu, P., Wang, L., Jiang, Y. and Zhou, J.

Abstract: Telecommuting has been proposed by policy makers as a strategy to reduce travel and emissions. In studying the metropolitan size impact of telecommuting on personal travel, this paper addresses two questions: (1) whether telecommuting is consistently a substitute or complement to travel across different MSA sizes; and (2) whether the impact of telecommuting is higher in larger MSAs where telecommuting programs and policies have been more widely adopted. Data from the 2001 and 2009 National Household Travel Surveys are used. Through a series of tests that address two possible empirical biases, we find that telecommuting consistently had a complementary effect on one-way commute trips, daily total work trips and daily total non-work trips across different MSA sizes in both 2001 and 2009. The findings suggest that policies that promote telecommuting may indeed increase, rather than decrease, people’s travel demand, regardless of the size of the MSA. This seems to contradict what telecommuting policies are designed for. In addition, model results show that the complementary impact of telecommuting on daily travel is lower in larger MSAs, in terms of both daily total work trips and daily total non-work trips.

Subject Areas: Telecommuting; Personal travel; Commute; Non-work trips

10.3. Title: Understanding Urban Travel Behaviour by Gender for Efficient and Equitable Transport Policies

Authors: Ng, W.S. and Acker, A.

Abstract: Gender is one of the key socio-demographic variables that can influence travel behaviour, but it is often the least understood. Understanding travel behaviour by gender will help better design transport policies that are efficient and equitable. Due to the gendered division of work in households, women often have multiple tasks and activities. As a result, women are more likely to have shorter commute distances, to chain trips, to have more non-work related trips, to travel at offpeak hours, and to choose more flexible modes. This study examines travel behaviour by gender in eight different cities, across three different continents, focusing on transport mode, trip purpose, travel distance and departure time for Auckland, Dublin, Hanoi, Helsinki, Jakarta, Kuala Lumpur, Lisbon and Manila. The most common trends found in the cities are that women tend to travel shorter distances and prefer public transport and taxi services to cars more than men.

Subject Areas: Telecommuting; Personal travel; Commute; Non-work trips

https://link.springer.com/article/10.1007/s11116-017-9846-3
10.4. Title: Transportation Impacts of Affordable Housing: Informing Development Review With Travel Behavior Analysis

Authors: Howell, A., Currans, K., Gehrke, S., Norton, G. and Clifton, K.

Abstract: Planning for affordable housing is challenged by development policies that assess transportation impacts based on methodologies that often do not distinguish between the travel patterns of residents of market-rate housing and those living in affordable units. Given the public goals of providing affordable housing in areas with good accessibility and transportation options, there is a need to reduce unnecessary costs imposed by the potential overestimation of automobile travel and its associated impacts. Thus, the primary objective of this paper is to examine and quantify the influences of urban characteristics, residential housing type, and income on metrics commonly used to assess the transportation impacts of new development, namely total home-based trips and home-based vehicle trips. Using the 2010-2012 California Household Travel Survey, we regressed these metrics on urban place type, regionally adjusted income, and housing type, controlling for household size, weekday travel, and home location. The results indicate significant reductions in vehicle trip making with lower incomes and increasing urbanization. These findings support more differentiation of affordable and market-rate housing in the development review process and emphasize the need for development standards to be more sensitive to the characteristics of future residents and location.

Subject Areas: Affordable Housing; Transportation Impact Analysis; Vehicle Miles Traveled; Vehicle Ownership; Low-Income; Land Use

10.5. Title: Estimating Revenue Neutral Mileage-Based Fees For Urban And Rural Households In Eight Western States

Authors: Fitzroy, S.S. and Schroeckenthaler, K.

Abstract: Presentation

Subject Areas: Travel Pattern; Rural-urban; Vehicle Miles Travelled

10.6. Title: The Relationship Between Urban Environment and Travel Behavior

Author: Antipova, A.

Abstract: This chapter links urban landscape and residential travel behavior. Travel behavior can be measured by modal choice, car ownership rates, trip generation, commuting time and distance, and trip chaining. This chapter focuses on active travel, including walking and cycling, promoted by researchers. Alternative travel modes are compared between Germany and the United States as well as policies increasing public transport demand and improving road safety. Germany’s land-use and public policies promote compact, mixed-use development, and active travel. Other countries might build upon Germany’s experience. To control traffic congestion, impact travel behavior, and drive cars less, urban development strategies are pursued including transit-oriented development (TOD). Research findings on the links between neighborhood characteristics and non-motorized transport can be useful to investigate the effects of neighborhood environment on residential health.

Subject Areas: Urban landscape; Residential travel behavior; Modal Choice

10.7. Title: Does Telecommuting Promote Sustainable Travel and Physical Activity?

**Author:** Chakrabarti, S.

**Abstract:** Researchers have explored the efficacy of telecommuting as a travel demand management strategy in the U.S. Conditions under which telecommuting can reduce VMT (vehicle miles traveled) and ease peak-period traffic congestion have been extensively investigated; empirical findings are well documented in the literature. Analysis of the impact of telecommuting on non-motorized travel, public transit use, and physical activity, however, has received relatively less attention in the past.

In this paper, I use the 2009 U.S. National Household Travel Survey to explore how telecommuting is associated with usual travel behavior, i.e. walking/bicycling, transit use and driving, as well as with average time spent in daily physical activity. I also compare telecommuters’ travel behavior and physical activity on a typical workday in telecommuting vs. non-telecommuting scenarios.

I find that frequent telecommuting (4+ times/month) is associated with 15% more walk trips per week, 56% higher odds of 1+ transit trip per month, 44% higher odds of 30+ minutes of physical activity per day, and 27% higher odds of driving 20,000+ miles per year compared to no-telecommuting scenario. On a typical workday, telecommuting is associated with 41% higher odds of walking/bicycling >1 mile, 71% higher odds of 30+ minutes of physical activity, 71% lower odds of riding transit, and 3.58 times greater odds of driving <10 miles. Findings suggest that telecommuting can increase non-motorized travel and physical activity in the presence of latent demand for active living. Increase in transit ridership and reduction in VMT are not automatic. Planning and policy implications are discussed.

**Subject Areas:** Telecommuting; Travel behavior; Non-motorized transportation; Public transit; Physical activity


10.8. Title: An Analysis of the Relationship between Land Use and Weekend Travel: Focusing on the Internal Capture of Trips

Author: Gim, T.H.T.

Abstract: Weekend travel has not been duly considered in academics and practice regarding its relationship with land use. A lack of consideration is notable in terms of how land use internalizes weekend travel. Thus, by separating the internal and external travel of the traffic analysis zone, this study analyzes the land use effect on weekend travel in comparison with that on weekday travel. Two structural equation models, each of which is specified for weekday and weekend travel, construct the same sample and their results become comparable. At the travel variable level, the models find consistent results: Stronger effects are made on internal travel than on external travel and particularly, on trip frequency than on travel time. This implies that compact land use causes a stronger addition of internal trips and a less strong reduction of external trips, that is, changes in destinations rather than in total travel time. At the factor level, unlike the weekday model in which the sociodemographic factor exerts a stronger effect, the weekend model presents that land use more strongly affects travel patterns. This magnitude difference is explained by the different flexibility of compulsory weekday travel and discretionary weekend travel in relation to the choice of trip destination and frequency.

Subject Areas: Weekend travel; Land Use; Internal Trips; Traffic Analysis Zone; Structural Equation Modeling; Seoul

10.9. Title: Ridehail Revolution: Ridehail Travel and Equity in Los Angeles

Author: Brown, A.E.

Abstract: A stark mobility divide separates American households with and without cars. While households with cars move easily across space, households without cars face limited access to opportunities. But no longer. Ridehail companies such as Uber and Lyft divorce car access from ownership, revolutionizing auto-mobility as we know it. Despite its high-tech luster, we do not yet know how ridehailing serves different neighborhoods and travelers, and who, if anyone, is left behind. The closest historical analog to new ridehail services is the taxi industry, which has a history of discrimination, particularly against black riders and neighborhoods. Ridehail services may discriminate less than taxis and extend reliable car access to neighborhoods underserved by taxis. Or they may not.

In this study, I pose and answer three questions about ridehail access and equity in Los Angeles. First, what explains the geographical distribution of ridehail trips across neighborhoods? Second, what explains ridehail use by individuals? Finally, is there evidence of racial or gender discrimination on ridehail and taxi services? To answer these questions, I relied on two novel data sets. First, I used trip-level data to evaluate ridehail travel in neighborhoods and by individuals. Second, I conducted an audit study of ridehail and taxi services to evaluate if and how wait times and ride request cancellation rates vary by rider race, ethnicity, or gender.

I find that ridehailing extends reliable car access to travelers and neighborhoods previously marginalized by the taxi industry. Ridehailing served neighborhoods home to 99.8 percent of the Los Angeles County population. Strong associations between ridehail use and neighborhood household vehicle ownership suggests that ridehailing provides auto-mobility in neighborhoods where many lack reliable access to cars. For most users, ridehailing filled an occasional rather than regular travel need, and a small share of avid users made the majority of ridehail trips. While hailing shared rides was common in low-income neighborhoods, I also find that people shared less if they lived in racial or ethnically diverse neighborhoods. Finally, audit data reveal high levels of discrimination against black riders by taxi drivers. Black riders were 73 percent more likely than white riders to have a taxi trip cancelled and waited between six and 15 minutes longer than white riders, all else equal. By contrast, ridehail services nearly eliminate the racial-ethnic differences in service quality. Policy and platform-level strategies can erase the remaining mobility gap and ensure equitable access to ridehailing and future technology-enabled mobility services.

Subject Areas: Ridehail services; Neighborhoods home; Trips

Title: Are Activity Patterns Stable or Variable? Analysis of Three-Year Panel Data

Authors: Hilgert, T., Behren, S., Eisenmann, C. and Vortisch, P.

Abstract: Routines and mandatory activities, such as work and school, shape the activity patterns of individuals and strongly influence travel demand. Knowledge about stability and variability of these routines could strengthen travel demand modelling and forecasting. A longitudinal perspective is required to investigate these aspects. In this study, the activity patterns of a sample of people is compared for one week in two successive years. It is analyzed whether the activity patterns of a given person vary from year to year, to what degree, and how this variability and stability can be measured. It is considered whether socio-demographic factors and life events determine stability in weekly activity patterns. The study is based on the representative panel survey, German Mobility Panel. The weekly activity patterns of the same respondents in different years is assessed, using two methods to measure stability and variability. The survey respondents are clustered into three groups according to the degree of variability in their activity patterns. A logistic regression model is also used to identify socio-economic and demographic covariates for similarity in weekly activity patterns. Results show that about one-third of the sample had the same or very similar weekly activity patterns in the two years examined. A person’s occupation status is a good predictor for the variability of activity patterns. Moreover, persons undergoing a change in occupation status are quite likely to show a greater variability in their activity patterns.

Subject Areas: Activity Pattern; German Mobility Panel; Modelling; Forecasting


http://journals.sagepub.com/doi/abs/10.1177/0361198118773557#articleCitationDownload Container
Title: Perceptions and Preferences of Autonomous and Shared Autonomous Vehicles: A Focus on Dynamic Ride-Sharing

Author: Gurumurthy, K.M.

Abstract: This thesis covers certain aspects of autonomous and shared autonomous vehicles (S/AVs), with a focus on dynamic ride-sharing (DRS). The first part investigates Americans’ preferences in adopting AVs. Rapid advances in technologies have accelerated the timeline for public use of fully-automated and communications-connected vehicles. Public opinion on self-driving vehicles or AVs is evolving rapidly, and many behavioral questions have not yet been addressed. This study emphasizes AV mode choices, including Americans’ willingness to pay (WTP) to ride with a stranger in a shared AV fleet vehicle on various trip types and the long-distance travel impacts of AVs. 2,588 complete responses to a stated-preference survey with 70 questions provide valuable insights on privacy concerns and crash ethics, safety and ride-sharing with strangers, long-distance travel and preferences for smarter vehicles and transport systems. While the starting sample data were relatively demographically unbiased, Texans were purposefully over-sampled, and all statistics adjusted/corrected (via sample weights) to match US demographics on gender, education, income, and age. Weighted results suggest that Americans are willing to pay, on average, $2073 to own AVs over conventional vehicles and an additional $1078 to maintain/include a manual driving option on such vehicles. Ride-sharing will be popular at 75c per mile, under most scenarios, and many Americans are willing to pay $1, on average, to anonymize their trip ends’ addresses. Most are also willing to let children 16 years of age and older have unsupervised access to AVs (both privately owned and shared). Nearly 50% of long-distance travel appears captured by AVs and SAVs in the future, rather than airlines, at least for one-way trip distances up to 500 miles. Two hurdle models (which allow for a high share of zero-value responses) were estimated: one to predict WTP to share a ride and another to determine WTP to anonymize location while using AVs. The first two-part model shows how travel time delays, person and household attributes, and land use densities can significantly affect Americans’ willingness to share rides. The second hurdle model suggests that traveler age, presence of children, household income, vehicle ownership and driver’s license status are major predictors of one’s WTP to obscure pick-up and drop-off locations. A binary logit was used to model current mode choice for long-distance (over 50 miles, one-way) travel (between one’s private car and an airplane), with household income as the leading predictor. On average, older Americans and/or those with children prefer such travel by car. Finally, a multinomial logit anticipated mode shifts when AVs and SAVs become available and affordable. Everything else constant, private cars remain preferred by older people, but SAVs may be used in the future for more business travel. In the second part of this thesis, a trip-matching framework is programmed to evaluate DRS opportunities for trips across Orlando, Florida. Transportation network companies (TNCs) are regularly demonstrating the economic and operational viability of DRS to any destination within a city, thanks to real-time information from smartphones. In the foreseeable future, fleets of SAVs may largely eliminate the need for human drivers, while lowering per-mile operating costs and increasing the convenience of travel. This may dramatically reduce private vehicle ownership and deliver extensive use of SAVs.
Using AirSage’s cellphone-based trip tables across 1,267 zones over 30 consecutive days, this study anticipates DRS matches (by assigning independent travelers with overlapping routes in time and space to the same SAV) and simulates SAV travel across the Orlando network to determine optimal SAV fleet size. Those results suggest significant opportunities for DRS-enabled SAVs: Nearly 60% of the single-person trips can be shared with other persons traveling solo and with less than 5 minutes added travel time (to arrive at their destinations). This value climbs to 80% and 86% for 15 and 30 minutes of added wait or travel time, respectively. On the average travel day in Orlando, a fleet of just 30,000 SAVs can serve nearly 45% of those 3 million person-trips traveled solo. In other words, just 1 SAV per 100 person-trips is able to serve almost half of the region’s demand, helping reduce congestion while filling up passenger vehicle seats.

**Subject Areas:** Autonomous vehicles; Shared; Dynamic ride-sharing; Travel behavior; Models; Willingness to pay; Mode choice

https://repositories.lib.utexas.edu/handle/2152/63553
10.12. Title: Examining the Relationship between Different Urbanization Settings, Smartphone use to Access the Internet and Trip Frequencies

Authors: Hong, J. and Thakuriah, P.V.

Abstract: N.A.

Subject Areas: Urbanization Settings; Smartphone Use; Travel Behaviour

10.13. Title: Analyzing Destination Choices of Tourists and Residents from Location Based Social Media Data

Author: Hasnat, M.M.

Abstract: Ubiquitous uses of social media platforms in smartphones have created an opportunity to gather digital traces of individual activities at a large scale. Traditional travel surveys fall short in collecting longitudinal travel behavior data for a large number of people in a cost effective way, especially for the transient population such as tourists. This study presents an innovating methodological framework, using machine learning and econometric approaches, to gather and analyze location-based social media (LBSM) data to understand individual destination choices. First, using Twitter’s search interface, we have collected Twitter posts of nearly 156,000 users for the state of Florida. We have adopted several filtering techniques to create a reliable sample from noisy Twitter data. An ensemble classification technique is proposed to classify tourists and residents from user coordinates. The performance of the proposed classifier has been validated using manually labeled data and compared against the state-of-the-art classification methods. Second, using different clustering methods, we have analyzed the spatial distributions of destination choices of tourists and residents. The clusters from tourist destinations revealed most popular tourist spots including emerging tourist attractions in Florida. Third, to predict a tourist’s next destination type, we have estimated a Conditional Random Field (CRF) model with reasonable accuracy. Fourth, to analyze resident destination choice behavior, this study proposes an extensive data merging operation among the collected Twitter data and different geographic database from state level data libraries. We have estimated a Panel Latent Segmentation Multinomial Logit (PLSMNL) model to find the characteristics affecting individual destination choices. The proposed PLSMNL model is found to better explain the effects of variables on destination choices compared to trip-specific Multinomial Logit Models. The findings of this study show the potential of LBSM data in future transportation and planning studies where collecting individual activity data is expensive.

Subject Areas: Travel Behavior; Logit Model

10.14. Title: Getting Paid to Commute: Will it Work?

Author: Ved, N.R.

Abstract: Traffic congestion is a phenomenon that occurs when transportation infrastructure begins to reach or exceed capacity in relation to the number of drivers, riders or bikers utilizing the same space at the same time. From Monday through Friday in the United States this phenomenon generally occurs twice a day: once in the morning and once in the evening as individuals travel to and from their homes and their workplaces. In the United States, the workday in each city begins and ends at roughly the same time for all individuals which means that the vast majority of commuters enter and exit the available transportation infrastructure at roughly the same time every day. Yet outside of those commuting times, the available infrastructure is usually clear and free of traffic. This report seeks to add to ongoing research of relieving congestion at peak travel times by examining the possibility of workers incorporating commutes into their workday within the Austin metropolitan area. Essentially, workers will get paid for their commutes.

Subject Areas: Travel Behavior; Commute; Pay for commute

Title: Microsimulation of Activity Participation, Tour Complexity, and Mode Choice within an Activity-Based Travel Demand Model System

Author: Daisy, N.S.

Abstract: Over the past few decades, trip-based travel demand approaches have been replaced by activity-based microsimulation travel demand techniques, which are able to capture the latent demand for activity participation, interdependency among trips, and household interactions. Activity-based models consider trips as a derived demand which arise from activity engagement behavior. This research aims to depict the daily activity-travel behavior of travelers as a result of choice decision making processes through the development of the Scheduler for Activities, Locations, and Travel (SALT) microsimulation travel demand model. The SALT model is comprised of five main components: population synthesis, time-use activity pattern recognition, tour mode choice, activity destination choice, and activity/trip scheduling. A series of advanced econometric micro-behavioral modules are developed to model behavioral mechanisms of different population groups in the region. An under-recognized issue in most of the econometric activity-based models is that they treat all out-of-home travelers, whether workers or non-workers, as undifferentiated groups, decreasing the ability to predict activity-travel decisions. To this end, an advanced disaggregated modeling framework is developed that can derive separate utility functions for both in-home and out-of-home activities for travelers with heterogeneous daily-activity patterns, along with simulation of correlation matrices. Additionally, a cluster-based technique is developed to model trip chaining, tour complexity, and tour mode choice of worker and non-worker clusters. These models capture associations between socio-demographics characteristics, trip attributes, and land use patterns in order to predict travel tour incidence and type, and mode choice. For empirical analysis of activity-travel behavior this study employs data from the large Halifax Space Time Activity Research (STAR) household time-use and travel survey, which consists of GPS-verified data for 2,778 person-days. This study also contributes by designing and conducting the first Canadian university-based travel-diary survey (EnACT), to better understand activity-travel patterns and trip making frequencies of university commuters. In addition, a synthetic pseudo-panel modeling framework is developed to explore the longitudinal activity-travel behavior of urbanites. In summary, the disaggregated modeling framework presented in this study is useful for deeper understanding of individuals’ activity-travel decisions, and may be operationalized to examine sensitive policy issues such as transportation control measures and congestion-pricing.

Subject Areas: Travel Behavior; Activity Participation; Tour Complexity; Mode Choice; Activity-based Travel Demand Model

10.16. Title: Modality, Activity Participation and Well-being: Evidence from Commuters in Beijing

Author: Mao, Z.

Abstract: In the recent decades, daily mobility and mode choice in Chinese cities have developed in the presence of fundamental transformations in the built environment and soaring car ownership. Encouraging sustainable travel become a goal for planners and also transport policy makers in China. In this research, empirical analyses are carried out to understand the share and determinants of individuals’ modality styles in Beijing, and to explore how their modality styles affect activity participation, social interaction, travel time and well-being. Our study finds that not only the share of the modality styles but also the determinants and the interpretation of determinant values can vary across different contexts at different developing stages. Car ownership does not necessarily lead to car dependency but rather provides an extra choice and increases multimodality at the current stage. The interpretation of this result can be closely associated with both the geographical and institutional background in Beijing. As for the influence of modality styles, this research shows that to a certain extent, the functionality of car use can be substituted by the use of multiple travel modes in the research context of Chinese cities. At the weekly level, multimodal travelers benefit from more participation in non-work activities, while car users do not show much advantage. However, this influence may differ when the commuters have different activity agendas between commute and non-commute days and differ between the companionship of different social contacts. Our findings reveal that a conclusion regarding the facilitating/impeding effect of car on activity participation cannot generally be achieved without considering the context for observations, including geographic context, social-cultural settings, and also the observed time period. In addition to the participation in travel/activities, this study also investigates individuals’ experience of their daily travel and activities in the context of Chinese cities. Consistent with previous studies in Western contexts, it is found that active commuters always have the highest levels of travel satisfaction, and activities at leisure/recreational facilities are generally more satisfying than other non-work activities. This research extends the current literature of trip/activity satisfaction, by including the context of travel choices as an explanatory factor. Specifically, trip satisfaction is not only affected by travel modes but also individual’ experiences with other modes (due to multimodality) and their freedom in decision making (with different modal flexibility levels). For activity satisfaction, it is not only related to the objectively observed activity attributes but also the factors related to the freedom in choosing the timing and location for these activities (temporal and spatial flexibility). The research also delivers some implications for transport policies.

Subject Areas: Modality; Activity participation; Well-being; Commuter; Beijing

10.17. Title: Virtual Immersive Reality for Stated Preference Travel Behavior Experiments: A Case Study of Autonomous Vehicles on Urban Roads

Authors: Farooq, B., Cherchi, E. and Sobhani, A.

Abstract: Stated preference experiments have been criticized for lack of realism. This issue is particularly visible when the scenario does not have a well understood prior reference, as in the case of research into demand for autonomous vehicles. The paper presents Virtual Immersive Reality Environment (VIRE), which is capable of developing highly realistic, immersive, and interactive choice scenarios. We demonstrate the use of VIRE in researching pedestrian preferences related to autonomous vehicles and associated infrastructure changes on urban streets in Montréal, Canada. The results are compared with predominantly used approaches: text-only and visual aid. We show that VIRE results in respondents having better understanding of the scenario and it yields more consistent results.

Subject Areas: Virtual Immersive Reality Environment (VIRE); Stated Preference experiments; Travel Behavior

Title: Toward Sustainable Travel Behavior and Activity Engagement: Connected Users, Technology Engagement and Cohort Effects

Author: Mjahed, L.B.

Abstract: The ongoing generational shift whereby millennials are overtaking baby boomers as the largest generation in the U.S. population, along with the technology-fueled evolution of transportation patterns, offer opportunities for policy makers to leverage changing behavior and build a more sustainable future. Much research has emerged seeking to understand whether the observed changes in travel behavior stemming from these trends are transient or permanent, though it has remained limited in several respects, including: (1) looking at travel as a single transaction, focusing only on interactions preceding travel (i.e. looking for information for travel) or following the decision to travel (i.e. navigation), and (2) neglecting to explicitly capture the childhood technology experience and its impact on adulthood behavior.

This dissertation tackles some of these limitations through novel approaches to: (1) characterizing the travel behavior and activity engagement of young adults and the sample population more broadly, (2) capturing the underlying attitudinal and behavioral mechanisms behind their travel decisions, and (3) assessing the long-term prospects of uncovered patterns of behavior. The originality of the approach includes disaggregating the travel process (capturing the permeation of technology therein) and retrospectively capturing the technology use during childhood as a measure of “digital nativeness” and in turn cohort effects. This approach is formalized in a full-fledged conceptual framework and tested by collecting and modeling original qualitative and quantitative data.

Subject Areas: Travel Behavior; Sustainable future; Cohort effects

10.19. Title: Minneapolis-Saint Paul Metro Travel Mode Shares

Author: Totten, J.

Abstract: Blog

Subject Areas: Mode share; Trips

Title: U.S. households with two vehicles log 21,600 miles per year

Author: Kellanish Energy

Abstract: Blog

Subject Areas: Household; Vehicle ownership; Vehicle Miles Travel

10.21. Title: FHWA survey finds multiple-vehicle homes are able to travel significantly more

Author: Galford, C.

Abstract: Blog

Subject Areas: Household; Vehicle ownership; Vehicle Miles Travel; FHWA

10.22. Title: The Millennial Question: Changes in Travel Behaviour or Changes in Survey Behaviour?

Authors: Bradley, M., Greene, E., Spitz, G., Coogan, M. and McGuckin, N.

Abstract: A great deal has been written in recent years in the travel behaviour research literature about “peak travel” or “peak car” – particularly with respect to the so-called “Millennials”, young adults currently between the ages of 16 and 35. The paper reports and extends the results of longitudinal multivariate regression analysis carried out on the US National Household Travel Survey data from 1995, 2001 and 2009. The results show robust evidence for a decline in auto miles traveled between 2001 and 2009 that cannot be explained by demographic, socio-economic or land use variables or by pure trend effects. The paper then provides a discussion of whether such changes in travel behaviour over time observed from surveys could be due to changes in the survey methods or the way in which different age groups respond to specific types of surveys. There is evidence that young adults have the highest non-response bias (underreporting of trips) for diary-based surveys, but it is not clear if this bias has been growing over time. The paper closes with some suggestions for further data collection.

Subject Areas: Travel behavior; Travel surveys; Millennial; Vehicle-miles traveled

10.23. Title: Indian Vehicle Ownership and Travel Behavior: A case study of Bengaluru, Delhi and Kolkata

Authors: Bansal, P., Kockelman, K.M., Schievelbein, W. and Schauer-West, S.

Abstract: India’s vehicle fleet and travel behaviors will have enormous consequences to the world’s economy and environment. This study developed a survey for over 1000 residents of India (or Indians) on topics of vehicle ownership and travel behavior in the key cities of Bengaluru (India’s “Silicon Valley”), Kolkata (India’s third most-populous metro area, formerly known as Calcutta) and Delhi (India’s capital city). The data were then used to model vehicle ownership and use decisions, and other trip-making choices in those three regions, versus other parts of India. Covariates of personal income, household size and residence location were all found to be statistically and practically significant in models of vehicle distances traveled. A multinomial logit model was used to predict vehicle types owned (including motorized two-wheel and four-wheel vehicles), and a Poisson model was used for vehicle ownership counts. Income and other household assets were also valuable predictors. An origin model for vehicle manufacture was also calibrated to help deliver future-year projections. The results suggest that the vehicles-per-person statistic will grow at an average annual growth rate of 5.7% over the next 20 years – at least in the regions of sampled data.

Subject Areas: Travel behaviour; Vehicle ownership; Multinomial logit model; Trip generation

10.24. Title: Car-deficit households: Determinants and Implications for Household Travel in the U.S.

Authors: Blumenberg, E., Brown, A. and Schouten, A.

Abstract: In the U.S., households with less than one car per driver (auto-deficit households) are more than twice as common as zero-vehicle households. Yet we know very little about these households and their travel behavior. In this study, therefore, we examine whether car deficits, like carlessness, are largely a result of financial constraint or of other factors such as built environment characteristics, household structure, or household resources. We then analyze the mobility outcomes of car-deficit households compared to the severely restricted mobility of carless households and the largely uninhibited movement of fully-equipped households, households with at least one car per driver. Data from the California Household Travel Survey show that car-deficit households are different than fully-equipped households. They have different household characteristics, travel less, and are more likely to use public transit. While many auto-deficit households have incomes that presumably enable them to successfully manage with fewer cars than adults, low-income auto-deficit households are — by definition — income constrained. Our analysis suggests that low-income car-deficit households manage their travel needs by carefully negotiating the use of household vehicles. In so doing, they travel far more than carless households and use their household vehicles almost as much as low-income households with at least one car per driver. These results suggest that the mobility benefits of having at least one car per driver are more limited than we had anticipated. Results also indicate the importance of transportation and employment programs to ease the potential difficulties associated with sharing cars among household drivers.

Subject Areas: Travel behaviour; Automobile ownership; Car-deficit households

Title: Employment Subcenters, Polycentricity, and Travel Behavior: The Tale of Two Cities in the U.S.

Authors: Nasri, A. and Zhang, L.

Abstract: This paper investigates the influence of spatial distribution of employment centers on travel behavior using data from two large metropolitan areas: Atlanta, GA, and Phoenix, AZ. Up-to-date fine-grained land-use data and a consistent GIS-based framework were employed to first identify regional employment subcenters and statistical models were developed to analyze the travel outcomes of employment subcenters. Results suggest that a polycentric urban form encourages transit mode choice more than monocentric pattern especially when transit accessibility is improved in polycentric pattern. We found evidence that trips ending in subcenters are shorter and have a higher probability of transit mode choice compared to trips originating from or destined to the city center. These findings suggest that any form of employment concentration would be more efficient in multiple smaller clusters distributed throughout the entire region rather than in a single large cluster.

Subject Areas: Travel behaviour; Employment Subcenters; Polycentric urban form

Title: Wired at Birth: Childhood, Technology Engagement, and Travel Behavior

Authors: BouMjahed, L. and Mahmassani, H.S.

Abstract: The ongoing demographic transition from baby boomers to millennials and technology-fueled evolution of transportation bring to the fore key trends that will determine how the future of transportation systems will unfold. This paper examines the implications of such trends on travel behavior by quantifying the impacts of a technologically engaged childhood—generally attributed to millennials—and an increased use of technology during travel on travel behavior now and in the future. Results indicate that individuals who grew up with a stronger childhood technology experience are more likely to be technologically engaged as adults, have stronger pro-environmental attitudes, lower car dependence, and stronger interest in autonomous vehicles. The results also support a simultaneous relationship between technology use during travel and car dependence, which posits that individuals with lower car dependence (or availability) are more likely to use technology during travel. Emanating results put forward potential benefits of policy starting at the childhood level. The implications of this work will only gain importance as the interplay between technology and travel deepens and as a larger share of the adult population become “digital natives.”

Subject Areas: Travel behaviour; Demographic transition; Technologically engaged childhood

https://ascelibrary.org/doi/pdf/10.1061/9780784481561.010
10.27. Title: A Study of Tour-based Mode Choice Based on a Support Vector Machine Classifier

Authors: Pirra, M. and Diana, M.

Abstract: A new approach in recognizing travel mode choice patterns is proposed, based on the Support Vector Machine classification technique. The tour-based travel demand dataset that is analysed is for New York State, derived from the 2009 U.S. National Household Travel Survey. The main features characterizing each tour are the means used, travel-related variables and socioeconomic aspects. Results obtained demonstrate the ability to predict to some extent, in real settings where car use dominates, which tours are likely to be made by public transport or non-motorized means. Moreover, the flexibility of the technique allows assessing the predictive power of each feature according to the combination of travel means used in different tours. Potential applications range from activity-based travel choice simulators to search engines supporting personalized travel planners—in general, whenever ‘best guesses’ on mode choice patterns have to be made quickly on large amounts of data prejudicing the possibility of setting up a statistical model.

Subject Areas: Trip chain, Tour, mode choice; Support Vector Machine; Multimodality, New York State

https://www.tandfonline.com/doi/abs/10.1080/03081060.2018.1541280
Title: Examining the Relationship between Household Vehicle Ownership and Ridesharing Behaviors in the United States

Authors: Zhang, Y. and Zhang, Y.

Abstract: To improve the sustainability and efficiency of transport systems, communities and government agencies throughout the United States (US) are looking for ways to reduce vehicle ownership and single-occupant trips by encouraging people to shift from driving to using more sustainable transport modes (such as ridesharing). Ridesharing is a cost-effective, sustainable and effective alternative transportation mode that is beneficial to the environment, the economy and society. Despite the potential effect of vehicle ownership on the adoption of ridesharing services, individuals’ ridesharing behaviors and the interdependencies between vehicle ownership and ridesharing usage are not well understood. This study aims to fill the gap by examining the associations between household vehicle ownership and the frequency and probability of ridesharing usage, and to estimate the effects of household vehicle ownership on individuals’ ridesharing usage in the US. We conducted zero-inflated negative binomial regression models using data from the 2017 National Household Travel Survey. The results show that, in general, one-vehicle reduction in households was significantly associated with a 7.9% increase in the frequency of ridesharing usage and a 23.0% increase in the probability of ridesharing usage. The effects of household vehicle ownership on the frequency of ridesharing usage are greater for those who live in areas with a higher population density than those living in areas with a lower population density. Young people, men, those who are unable to drive, individuals with high household income levels, and those who live in areas with rail service or a higher population density, tend to use ridesharing more frequently and are more likely to use it. These findings can be used as guides for planners or practitioners to better understand individuals’ ridesharing behaviors, and to identify policies and interventions to increase the potential of ridesharing usage, and to decrease household vehicle ownership, depending on different contextual features and demographic variables. Comprehensive strategies that limit vehicle ownership and address the increasing demand for ridesharing have the potential to improve the sustainability of transportation systems.

Subject Areas: Ridesharing; Household Vehicle Ownership; 2017 NHTS; United States; ZINB model

https://www.mdpi.com/2071-1050/10/8/2720/htm
10.29. Title: The Rural Telecommuter Surplus in Southwestern Ontario, Canada

Authors: Hambly, H. and Lee, J.D.

Abstract: This paper asks the question: what kind of economic benefits do rural telecommuters experience in Southwestern Ontario? This is a relevant question in Canada where, according to Statistics Canada (2017) one in 14 people work from home. This paper presents an overview of the current literature on telecommuting. We estimate the telecommuter surplus in Southwestern Ontario where the region is currently deploying one of Canada’s largest publicly-funded ultra-high-speed broadband initiatives known as SouthWest Integrated Fibre Technology Inc. (SWIFT). The analysis is based on SWIFT residential and farm surveys (n=3948) conducted in 2017. We find that an average telecommuter’s surplus in terms of costs saved, including opportunity cost ranges from $8820 to $23964 per annum per telecommuter, depending on the number of days telecommuted per week for home and primary residence dwelling type. The social net benefits of telecommuting differ from its private net benefit (the focus of our paper) since the former includes both positive and negative externalities associated with telecommuting such as reduced traffic congestion, reduced probability of road accidents, as well as some workers shirking their duties (a negative impact). We leave this for future work.

Subject Areas: Telecommuting surplus; Teleworking; Economics of telecommuting; Opportunity cost of commuting

Abstract: The effects of traffic congestion on travel behavior are complex and multidimensional because they are related to various factors such as density, land use patterns, network connectivity, and individual preferences. Traffic congestion is a phenomenon that not only affects transportation systems but also influences commuters’ quality of life and population mobility. The present research aims to analyze the effects of traffic congestion on individuals’ travel behaviors, addressing both direct and indirect effects of congestion on vehicle miles traveled (VMT) per driver by implementing structural equation modeling (SEM) techniques. In addition to the causal analysis between traffic congestion and VMT, this study examined the complex relationship between an individual’s socioeconomic characteristics, the built environment, congestion, and VMT. Measuring local congestion at a national level is also a key contribution of this research. This study used the same methodology as the Texas A&M Transportation Institute to compute a road congestion index and quantify local congestion for 93,769 drivers within 337 metropolitan areas. Our findings suggest that congestion is the main driver of VMT reduction. The findings also confirm that residents in compact development regions have lower daily VMTs because of the proximity of origins and destinations in denser areas with higher job-population balances. Therefore, rather than expanding highway networks, public transit investment might address traffic congestion more efficiently—not only by providing residents with more equitable and sustainable means of transportation, but also by encouraging people to reside in more compact and location-efficient areas.

Subject Areas: Traffic Congestion; Travel Behavior; Vehicle Miles Traveled

Title: Non-work accessibility and Related Outcomes

Author: McCahill, C.

Abstract: Accessibility metrics, which describe the ease of reaching destinations, are widely recognized as valuable indicators of transportation system performance. After decades of academic research on the subject, accessibility metrics are gaining use in practice. The most notable applications, however, focus solely on access to jobs. While commute travel is closely related to peak period travel demand, it makes up only a small share of overall travel.

This study presents a measure of local access to a wide range of non-work destinations, calibrated using data from Virginia. It focuses specifically on walking access as a proxy for multimodal accessibility and supportive land uses. The metric is intuitive, it can be calculated using available software and data, and it relates to important outcomes such as travel behavior and economic productivity. This work presents an opportunity for practitioners to incorporate accessibility metrics in various decision making applications and improve upon them as their knowledge and use of these metrics grow.

Subject Areas: Accessibility; Performance measures; Transportation; Land use

10.32. Title: Exploring the Relationships Among Travel Multimodality, Driving Behavior, Use of Ridehailing and Energy Consumption

Authors: Circella, G., Lee, Y. and Alemi, F.

Abstract: In the last decade, advances in information and communication technologies and the introduction of the shared economy engendered new forms of transportation options and, in particular, shared mobility. Shared mobility services such as carsharing (e.g., Zipcar and Car2go), dynamic ridesharing (e.g., Carma), ridehailing (e.g., Uber and Lyft), and bike/scooter sharing (e.g., CitiBike, Jump Bike, Bird, and Lime) have gained growing popularity especially among subgroups in the population including college-educated or urban-oriented young adults (e.g., millennials). These emerging transportation services have evolved at an unprecedented pace, and new business models and smartphone applications are frequently introduced to the market. However, their fast-changing nature and lack of relevant data have placed difficulties on research projects that aim to gain a better understanding of the adoption/use patterns of such emerging services, not to mention their impacts on various components of travel behavior and transportation policy and planning, and their related environmental impacts. This report builds on an on-going research effort that investigates emerging mobility patterns and the adoption of new mobility services. In this report, the authors focus on the environmental impacts of various modality styles and the frequency of ridehailing use among a sample of millennials (i.e., born from 1981 to 1997) and members of the preceding Generation X (i.e., born from 1965 to 1980). The total sample for the analysis included in this report includes 1,785 individuals who participated in a survey administered in Fall 2015 in California. In this study, the researchers focus on the vehicle miles traveled, the energy consumption and greenhouse gas (GHG) emissions for transportation purposes of various groups of travelers. They identify four latent classes in the sample based on the respondents’ reported use of various travel modes: drivers, active travelers, transit riders, and car passengers. They further divide each latent class into three groups based on their reported frequency of ridehailing use: non-users, occasional users (who use ridehailing less than once a month), and regular users (who use it at least once a month). The energy consumption and GHG emissions associated with driving a personal vehicle and using ridehailing services are computed for the individuals in each of these groups (12 subgroups), and the authors discuss sociodemographics and economic characteristics, and travel-related and residential choices, of the individuals in each subgroup.

Subject Areas: Travel behavior; Ridehailing; Energy Consumption

10.33. Title: Task Allocation and Gender Roles in Dual Earner Households: The Issue of Escorting Children

Authors: Han, B., Kim, J. and Timmermans, H.

Abstract: This article reports results of a study on task allocation in dual-earner households in Netherlands with special reference to escorting children. Using a multinomial logit model, the probability of who (father, mother, other or no-escorting) take care of escorting is analyzed as a function of age and gender of the children, personal characteristics of the parents, properties of the activity schedules of the parents, personal interest and gender match. Results indicate that gender equity in escorting is only approximated if both parents work full-time and are highly educated. Otherwise, classic gender roles prevail with mothers taking primary responsibility for escorting children. Involvement of others in escorting has a differential effect between fathers and mothers, setting free significantly more time for fathers. Fathers show a tendency to escort children to activities that interest them and demonstrate a stronger gender match.

Subject Areas: Task allocation; Gender roles; Escorting; Dual-earner households

https://www.sciencedirect.com/science/article/pii/S2214367X18300498#bi005
10.34. Title: Urban Form and Driving: Evidence from US cities

Authors: Duranton, G. and Turner, M.A.

Abstract: We estimate the effect of urban form on driving. We match the best available travel survey for the US to spatially disaggregated national maps that describe population density and demographics, sectoral employment and land cover, among other things. To address inference problems related to sorting and endogenous density, we develop an estimator that relies on an assumption of imperfect mobility and exploit quasi-random variation in subterranean geology. The data suggest that increases in density cause small decreases in individual driving. Applying our estimates to the observed distribution of density and driving in the US suggests that plausible densification policies cause decreases in aggregate driving that are small, both absolutely and relative to what might be expected from gas taxes or congestion charging.

Subject Areas: Urban form; Vehicle-kilometers traveled; Congestion

10.35. Title: Mode Choice of Commuter Students in a College Town: An Exploratory Study from the United States

Authors: Zhou, J., Wang, Y. and Wu, J.

Abstract: Research of travel behaviors of university students is of theoretical and empirical importance. The literature, however, has paid little attention to mode choice of students at college towns. This study aims to specifically explore influence factors of the mode choice of college town students. After conducting a survey of commuter students at Iowa State University, a college-town university in the United States, the study uses both simple statistics and advanced statistical models (e.g., multinomial logit and nested logit models) to analyze the data and produces findings to confirm and test existing knowledge and to gain new insights. Firstly, students at a college town are more likely to adopt greener (non-driving-alone) modes, especially walking, to commute compared to their counterparts at urban universities; this is as revealed in the literature. Secondly, students may use “bundled services” to fulfill their travel needs. The students who prioritized rent affordability in housing choice tend to live in proximity to bus stops and are more likely to ride buses. Lastly, commuter students who do not drive alone to school tend to prefer a residence with transit proximity. Moreover, students who reside in proximity to transit and who reported “peer effects” would use non-driving modes more if commute time was shortened.

Subject Areas: College Town; Mode Choice; Influence Factors; Bundled Services; Survey Data; Travel Demand Management

Title: Long-Distance Overnight Values of Travel Time Across Modes and Tour Characteristics

Author: Rani, J.

Abstract: The value of travel time (VoTT) quantifies the willingness of individuals to pay money in order to save a unit of travel time. It is a critical metric for the transportation industry that underlies many policy decisions and processes, including cost-benefit analyses, project evaluations, travel demand forecasting, and economic investments. However, despite the continuous growth of long-distance intercity travel in terms of the number of miles traveled and dollars spent on local/regional economies, existing metro area-based VoTT metrics are inadequate for long-distance trips. Therefore, this study completes three objectives: 1) examine the trade-offs between travel times and costs in the mode choices in representative observed long-distance trips, 2) model mode choice to quantify the VoTT for air and personal vehicles across multiple tour types in the Alabama and Vermont regions, and 3) develop a framework for characterizing individuals’ unique relationship with costs and travel times for long-distance travel. Specifically, this research combines detailed out-of-state long-distance tour records from the 2013 Longitudinal Survey of Overnight Travel (LSOT) with mode choice alternative data generated from the Bureau of Transport Statistics (BTS) and Google Maps to calculate VoTT for a variety of relevant individuals and tour factors using a multinomial logistic regression function. To represent as broad a definition as possible, long-distance trip in this study was defined as an overnight and out-of-state trip with at least 50 mi (one-way) distance between origin and destination. Trade-offs between travel cost and travel time in long-distance trips are examined to find that (1) minimizing travel costs was most important to long-distance overnight travelers, when the trip distance is less than 500 miles one-way and (2) minimizing travel time was most important to long-distance overnight travelers, when the trip distance is greater than 500 miles one-way. Values of travel time, calculated as a ratio of time and cost estimates from logistic regression, are found to have a negative sign more commonly in long-distance travel. This study identified different ways of interpreting negative VoTTs depending on the coefficients contributing to the negative sign. It further identified six different types of long-distance travel behaviors based on travelers’ attitudes towards saving time and/or money while taking their tour, annual travel and annual household characteristics into consideration. The results from this study are intended to assist transportation planners and analysts in the policy-making and decision-making processes related to transportation infrastructure.

Subject Areas: Value of travel time (VoTT); Long distance travel; Overnight travel; Multinomial logit regression; Types of travel behavior

10.37. Title: Travel Behaviour and Residential Location of the Millennials: A Case Study of Post-secondary Students from Four Toronto-Area Universities

Authors: Mitra, R. and Nash, S.

Abstract: NA

Subject Areas: Travel behaviour; Millennial; Universities; Toronto

https://www.ryerson.ca/content/dam/cur/pdfs/WorkingPapers/CUR_Millennial_Travel_Patterns_R_Mitra.pdf
Title: Outdoor Recreation Satellite Account Methodology

Authors: Highfill, T. and Smith-Nelson, C.

Abstract: This paper details the methodology for the inaugural outdoor recreation satellite account (ORSA) statistics released September 2018. The statistics include 2012–2016 estimates of the outdoor recreation economy’s contribution to gross domestic product (GDP), gross output, compensation, and employment. To explain the national economic accounting concepts used to develop the official federal statistics from which the ORSA statistics originate, the first section of this paper is derived from the methodology papers, “Concepts and Methods of the U.S. National Income and Product Accounts” and “Concepts and Methods of the U.S. Input-Output Accounts” (U.S. Bureau of Economic Analysis, 2017 and 2009). Following the introduction to the general national accounting concepts, the methods used to develop the ORSA estimates are explained.

Subject Areas: Travel behaviour; Leisure trips; Work trips; Local trips; Gross Domestic Product (GDP); Outdoor Recreation Satellite Account (ORS)

Title: Predictors of Attitudes Toward Autonomous Vehicles: The Roles of Age, Gender, Prior Knowledge, and Personality

Authors: Charness, N., Yoon, J.S., Souders, D., Stothart, C. and Yehnert, C.

Abstract: Autonomous vehicles (AVs) hold considerable promise for maintaining aging adults’ mobility as they develop impairments in driving skill. Nonetheless, attitudes can be a significant barrier to adoption as has been shown for other technologies. We investigated how different introductions to AV, video with a driver in the front seat, the rear seat, and a written description, affected attitudes, as well as how individual difference variables such as age, gender, prior knowledge, and personality traits predict attitudes within a middle-aged (Median age=34, IQR=20, n=441) Amazon Mechanical Turk sample. The 16-item attitude survey uncovered three factors: Concern with AV, Eagerness to Adopt AV technology, and Willingness to Relinquish Driving Control. ANOVAs showed that only age (younger less concerned) and gender, (females more concerned) were significant factors in Concern with AV. Only gender affected Willingness to Relinquish Driving Control, with males more willing. Multiple regressions that included previous knowledge level and personality traits showed a different pattern. Female gender and greater conscientiousness were associated with greater Concern about AV. Prior knowledge of AV was associated with less concern. Emotional stability and openness to experience were positive predictors of Eagerness to Adopt AV, whereas conscientiousness was a negative predictor. Prior knowledge and openness to experience, positively, and extraversion, negatively, were associated with being willing to relinquish driving control. These results suggest that different information dissemination campaigns are needed to persuade consumers to adopt AV technology. We discuss potential approaches.

Subject Areas: Autonomous vehicles (AVs); Attitudes

Title: Commuting and Land Use in a City with Bottlenecks: Theory and Evidence

Authors: Fosgerau, M. and Kim, J.

Abstract: This paper studies the interaction between urban spatial equilibrium and commuting congestion dynamics. We present a new monocentric city framework that combines a discrete urban space with multiple Vickrey (1969)-type bottlenecks. The model illustrates commute scheduling patterns by residents at different locations in the city. We confirm empirically the relationship between residential location and commute timing choices predicted by the model. In particular, we find that commuters traveling a longer distance tend to arrive at work at the edge of the morning peak time while commuters with a shorter distance tend to arrive at the peak time. The paper also characterizes the optimal policy of congestion toll and analyzes its impact on urban spatial structure.

Subject Areas: Commute scheduling; Dynamic congestion; Urban spatial structure

10.41. Title: Space-time Modeling of Urban Population Daily Travel-Activity Patterns using GPS Trajectory Data

Author: Scholz, R.W.

Abstract: People conduct travel to engage in a variety of activities every day. Their activities include working, dining, shopping, and so forth. Their travels include trips to these activity locations. Each individual may have the same or a different schedule of travels and activities (T-A for short) on different days. A group of individuals may have similar or completely different daily T-A routines. Human T-A behaviors are very complex. Similarities and differences in space, time, and attribute exist among different individuals and on different days. Modeling human T-A patterns at the individual and collective levels is a research challenge in the field of geography and transportation. Previous methods for modeling collective T-A patterns failed to combine the spatial and temporal dimensions. For individual T-A pattern modeling, existing methods do not combine travel and activity events in one model nor do they make a connection between them. This research aims to develop effective methods to model urban population collective activity patterns and individual daily T-A patterns. To accomplish this, the proposed method for modeling collective activity patterns identified the locations and times of activity hot spots in a large, metropolitan city, San Francisco, and tracked the evolution process of these hot spots over time. GPS trajectory data of 536 taxi cabs over twenty-two days in San Francisco were analyzed to demonstrate the effectiveness of the proposed method and reveal collective activity patterns across the city and over time. Taxi passengers’ pick-up and drop-off locations and times were extracted from the trajectories and treated as passengers’ activity instances. Census tracts with a significantly large number of activity instances during a one-hour interval were defined as activity hot spots. The evolving process of activity hot spots included emergence, expansion, stableness, shrinkage, displacement, and decease. This process was evaluated relative to the hot spot status at the census tract that hosted the hot spot and its neighboring tracts at two consecutive time intervals. The results indicated that collective activity patterns on a weekday were substantially different from those on a weekend day, and historical average data might be used to predict up-coming collective activity patterns. The proposed method for individual daily T-A pattern modeling identified the most frequent daily T-A events and their sequential relationships. The T-A events of an individual in one day was represented with a sequence of T-A elements. Daily T-A sequences of an individual from different days were grouped based on element similarity. The representative sequences of each group revealed the individual’s different daily routines. GPS trajectory data for two individuals living in the northern area of Beijing was used to demonstrate the proposed method. The results showed that an individual might have several different daily T-A patterns or no apparent pattern. The proposed methods provide researchers with tools to study complex T-A behaviors of urban people, and calls into question a fundamental assumption in transportation geography that each individual repeats their T-A routine every day (Huff and Hanson 1986; Hanson and Huff 1988; Stopher and Zhang 2011). Further testing of this assumption may change the current design of transportation surveys as well as the modeling of transportation demand, urban planning, traffic management, the delivery of Location-Based Services (LBS), and other services.
Subject Areas: Travel activity pattern; GPS trajectory data; Space-time modeling

[https://digital1.library.txstate.edu/handle/10877/7464](https://digital1.library.txstate.edu/handle/10877/7464)
Title: The Rising Value of Time and the Origin of Urban Gentrification

Author: Su, Y.

Abstract: I estimate a spatial equilibrium model to show that the rising value of high-skilled workers’ time is an important driving force behind the gentrification of American central cities. I show that the increasing value of time raises the cost of commuting and exogenously increases the demand for central locations by high-skilled workers. While change in value of time is an initial force behind gentrification, its effect is substantially magnified by endogenous amenity improvement. The model implies that welfare inequality in the recent decades increases by more than the rise in earnings inequality if the forces behind gentrification are considered.

Subject Areas: Urban gentrification; Spatial equilibrium; Value of time; Neighborhood; Amenities; Rent; Housing supply; Urban revival; Inequality; Work hours; Long-hour premium; Overtime

10.43. Title: Average vehicle occupancy in US remains unchanged from 2009 to 2017

Author: Harvey, D.

Abstract: Blog

Subject Areas: Average Vehicle Occupancy; NHTS

10.44. Title: US households took fewer vehicle trips in 2017

Author: Harvey, D.

Abstract: Blog

Subject Areas: Vehicle Trips; NHTS

10.45. Title: Nearly 60% of all vehicle trips in US in 2017 were less than six miles

Author: Harvey, D.

Abstract: Blog

Subject Areas: Vehicle Trips; NHTS

Title: New ASU Research Shows Impacts and Trends in Ride-Hailing

Author: Martin, M.

Abstract: Blog

Subject Areas: Ride-hail; Younger population; Impact; Trends

Title: Ride-hailing not pushing households to abandon cars

Author: Plautz, J.

Abstract: Blog

Subject Areas: Ride-hail; Uber; Lyft; Car ownership

Title: Daily Vehicle Miles traveled in US Varies with the Number of Household Vehicles

Author: Green Car Congress

Abstract: Blog

Subject Areas: Average daily mileage; Number of vehicles per household

11. Trend Analysis and Market Segmentation

11.1. Title: Evaluating Effects of Future Shared Mobility and Electrification Trends on Key Intermediate Indicator of Aluminum Transportation Demand: US Vehicle Fleet Size

Authors: Deshmukh, S., Bustamante, M. and Roth, R.

Abstract: The North American auto industry is in the midst of a major change with the emergence of disruptive technologies like ride-sharing and electrification of vehicles. These disruptive technologies are expected to change the vehicle stock and hence the embodied aluminum content of vehicles. These technologies are predicted to have a negative impact on the vehicle stock. The present work tries to address this gap by quantifying the impact of ride-sharing on growth of US vehicle fleet size, a key intermediate indicator of aluminum transportation demand, in the mid-term future.

Subject Areas: Light-vehicles; Ride-sharing; Electric vehicles; Vehicle fleet demand; Material demand

11.2. Title: Dynamic Ride-sharing and Fleet Sizing for a System of Shared Autonomous Vehicles in Austin, Texas

Authors: Fagnant, D.J. and Kockelman, K.M.

Abstract: Shared autonomous (fully-automated) vehicles (SAVs) represent an emerging transportation mode for driverless and on-demand transport. Early actors include Google and Europe’s CityMobil2, who seek pilot deployments in low-speed settings. This work investigates SAVs’ potential for U.S. urban areas via multiple applications across the Austin, Texas, network. This work describes advances to existing agent- and network-based SAV simulations by enabling dynamic ride-sharing (DRS, which pools multiple travelers with similar origins, destinations and departure times in the same vehicle), optimizing fleet sizing, and anticipating profitability for operators in settings with no speed limitations on the vehicles and at adoption levels below 10% of all personal trip-making in the region. Results suggest that DRS reduces average service times (wait times plus in-vehicle travel times) and travel costs for SAV users, even after accounting for extra passenger pick-ups, drop-offs and non-direct routings. While the base-case scenario (serving 56,324 person-trips per day, on average) suggest that a fleet of SAVs allowing for DRS may result in vehicle-miles traveled (VMT) that exceed person-trip miles demanded (due to anticipatory relocations of empty vehicles, between trip calls), it is possible to reduce overall VMT as trip-making intensity (SAV membership) rises and/or DRS users become more flexible in their trip timing and routing. Indeed, DRS appears critical to avoiding new congestion problems, since VMT may increase by over 8% without any ride-sharing. Finally, these simulation results suggest that a private fleet operator paying $70,000 per new SAV could earn a 19% annual (long-term) return on investment while offering SAV services at $1.00 per mile for a non-shared trip (which is less than a third of Austin’s average taxi cab fare).

Subject Areas: Connected and autonomous vehicles; Shared autonomous vehicles; MATSim simulation; Dynamic ride-sharing

Title: A Hazard-based Approach to Modelling the Effects of Online Shopping on Intershopping Duration

Authors: Suel, E., Daina, N. and Polak, J.W.

Abstract: Despite growing prevalence of online shopping, its impacts on mobility are poorly understood. This partially results from the lack of sufficiently detailed data. In this paper we address this gap using consumer panel data, a new dataset for this context. We analyse one year long longitudinal grocery shopping purchase data from London shoppers to investigate the effects of online shopping on overall shopping activity patterns and personal trips. We characterise the temporal structure of shopping demand by means of the duration between shopping episodes using hazard-based duration models. These models have been used to study inter-shopping spells for traditional shopping in the literature, however effects of online shopping were not considered. Here, we differentiate between shopping events and shopping trips. The former refers to all types of shopping activity including both online and in-store, while the latter is restricted to physical shopping trips. Separate models were estimated for each and results suggest potential substitution effects between online and in-store in the context of grocery shopping. We find that having shopped online since the last shopping trip significantly reduces the likelihood of a physical shopping trip. We do not observe the same effect for inter-event durations. Hence, shopping online does not have a significant effect on overall shopping activity frequency, yet affects shopping trip rates. This is a key finding and suggests potential substitution between online shopping and physical trips to the store. Additional insights on which factors, including basket size and demographics, affect inter-shopping durations are also drawn.

Subject Areas: Online shopping; Intershopping duration; Trip frequency; Hazard-based duration models; Travel demand modeling; Consumer panel data

11.4. Title: Shared Autonomous Vehicles and their Potential Impacts on Household Vehicle Ownership: An Exploratory Empirical Assessment

Authors: Menon, N., Barbour, N., Zhang, Y., Pinjari, A.R. and Mannering, F.

Abstract: Emerging transportation technologies have the potential to significantly reshape the transportation systems and household vehicle ownership. Key among these transportation technologies are the autonomous vehicles, particularly when introduced in shared vehicle fleets. In this paper, we focus on the potential impact that fleets of shared autonomous vehicles might have on household vehicle ownership. To obtain initial insights into this issue, we asked a sample of university personnel and members of the American Automobile Association as to how likely they would consider relinquishing one of their household’s personal vehicles if shared autonomous vehicles were available (thus reducing their household vehicle ownership level by one). For single-vehicle households, this would be relinquishing their only vehicle, and for multivehicle households (households owning two or more vehicles) this would be relinquishing just one of their vehicles. Possible responses to the question about relinquishing a household vehicle if shared autonomous vehicles are present are: extremely unlikely, unlikely, unsure, likely, and extremely likely. To determine the factors that influence this response, random parameters ordered probit models are estimated to account for the likelihood that considerable unobserved heterogeneity is likely to be present in the data. The findings show that a wide range of socioeconomic factors affects people’s likelihood of vehicle relinquishment in the presence of shared autonomous vehicles. Key among these are gender effects, generational elements, commuting patterns, and respondents’ vehicle crash history and experiences. While people’s opinions of shared autonomous vehicles are evolving with the continual introduction of new autonomous vehicle technologies and shifting travel behavior, the results of this study provide important initial insights into the likely effects of shared autonomous vehicles on household vehicle ownership.

Subject Areas: Automated Vehicles; Car Ownership; Econometric Modeling; Mobility On-Demand; Shared Mobility

11.5. Title: The Impact of Private Autonomous Vehicles on Vehicle Ownership and Unoccupied VMT Generation

Authors: Zhang, W., Guhathakurta, S. and Khalil, E.B.

Abstract: With 36 ventures testing autonomous vehicles (AVs) in the State of California, commercial deployment of this disruptive technology is almost around the corner (California Department of Transportation, 2016). Different business models of AVs, including Shared AVs (SAVs) and Private AVs (PAVs), will lead to significantly different changes in regional vehicle inventory and Vehicle Miles Travelled (VMT). Most prior studies have already explored the impact of SAVs on vehicle ownership and VMT generation. Limited understanding has been gained regarding vehicle ownership reduction and unoccupied VMT generation potentials in the era of PAVs. Motivated by such research gap, this study develops models to examine how much vehicle ownership reduction can be achieved once private conventional vehicles are replaced by AVs and the spatial distribution of unoccupied VMT accompanied with the vehicle reduction. The models are implemented using travel survey and synthesized trip profile from Atlanta Metropolitan Area. The results show that more than 18% of the households can reduce vehicles, while maintaining the current travel patterns. This can be translated into a 9.5% reduction in private vehicles in the study region. Meanwhile, 29.8 unoccupied VMT will be induced per day per reduced vehicles. A majority of the unoccupied VMT will be loaded on interstate highways and expressways and the largest percentage inflation in VMT will occur on minor local roads. The results can provide implications for evolving trends in household vehicles uses and the location of dedicated AV lanes in the PAV dominated future.

Subject Areas: Autonomous vehicles; Vehicle ownership; Unoccupied VMT

11.6. Title: Ridesourcing, the Sharing Economy, and the Future of Cities

Authors: Jin, S.T., Kong, H., Wu, R. and Sui, D.Z.

Abstract: As an integral part of the emerging sharing economy, ridesourcing refers to transportation services that connect community drivers with passengers via mobile devices and applications. The spectacular growth of ridesourcing has sparked a burgeoning literature discussing how it affects the future of cities. This paper presents a systematic review of the existing literature concerning the impact of ridesourcing on the efficiency, equity, and sustainability of urban development. Ridesourcing has a positive impact on economic efficiency. It both complements and competes with public transit, but its influence on traffic congestions near city centers is still unclear. Regarding urban equity, ridesourcing further amplifies the issue of the digital divide and raises concerns over the issues of discrimination and data privacy and security. It is also hotly contested whether prosumers (producers/consumers) are exploited by the sharing economy platforms, whether ridesourcing drivers are reasonably compensated, and how to better protect on-demand workers’ rights. Even though ridesourcing has been promoting a green image, its true environmental impact has not been thoroughly investigated. According to the evidence reported in the literature so far, it is unlikely that ridesourcing will reduce private car ownership. Ridesourcing’s impacts on energy consumption and greenhouse gas emissions are uncertain based on existing research. This paper outlines the danger of conceptual confusion and the methodological issues in the existing literature. Further research is sorely needed as the future of cities is indisputably tied to the sharing economy and its impacts on shared mobility.

Subject Areas: Ridesourcing; Shared mobility; The sharing economy; On-demand work; Future cities

11.7. Title: Trends Found by the 2017 National Household Travel Survey May Surprise You

Author: Wochit News

Abstract: Blog

Subject Areas: Driving; Lower income; Millennials; National Household Travel Survey.

11.8. Title: Transportation Capital and Its Effects on the US Economy: A General Equilibrium Approach

Authors: Gallen, T. and Winston, C.

Abstract: We analyze the effect of the transportation system on U.S. economic activity by building a dynamic computable general equilibrium model with a publicly provided transportation capital stock, which affects firm productivity, worker and shopping commute times, and government expenditures, thereby affecting households’ labor and consumption decisions. Our model highlights stark differences between the effect of infrastructure spending on GDP and welfare in the long run, and its effects when we account for the transition (time and delay) costs to build. Calibrating our model to the U.S. economy, we find that $50 billion in additional annual spending on the transportation capital stock increases annual welfare net of taxes by $29 billion in the long run, but that the addition has a much smaller, and potentially negative positive present value due to transition costs. Our paper highlights the importance of general equilibrium when considering transportation infrastructure, showing that slightly more than half of the response to GDP comes from the endogenous responses of capital and labor. Finally, an extension of our model finds possible GDP multipliers below one for high-investment countries like Japan.

Subject Areas: General Equilibrium, Transportation infrastructure, Efficiency

11.9. Title: Impacts of Transit and Walking Amenities on Robust Local Knowledge Economy

Authors: Zandiatashbar, A. and Hamidi, S.

Abstract: As of 2013, knowledge economy has held more than 10% of U.S. employment, generated nearly 20% of national GDP and expect to increase to 25% during the next 20 years. Likewise, Eurostat 2020 aims to increase investment in Knowledge Intensive Business Services (KIBS) to bypass the competitors, Japan and the U.S. As the result, investigating the determinants of robust knowledge economy is a continuing concern between city scholars, planners and leaders. To date, several locational and non-locational factors have been found to be influential. For instance, transit service, walkable street networks and dense neighborhoods that provide walkable access to urban amenities are the location preferences for the creative class. Creative class, in turn, attracts KIBS, and produces innovation which are all contributive to the knowledge-based economic vitality. While such trend is widely supported by the theoretical efforts, there is little empirical evidence on these complex multidimensional relationships and hence this study seeks to investigate both direct and indirect impacts of transit and walking amenities on the robust local knowledge economy. Using Structural Equation Modeling (SEM), we developed a comprehensive model that accounts for KIBS, creative economy and innovation productivity and investigates their locational and non-locational determinants with the particular focus on walking and transit amenities. Our results generally echo the findings of previous studies about the key role of industry clustering, place quality amenities, diversity and tolerance on the three drivers of robust local knowledge economy. We found that among all exogenous variables racial diversity and industry clustering have the most significant direct effect on innovation productivity. We also found that transit service quality and walkability contribute to a robust local knowledge economy through KIBS and creative class, but they have an adverse relationship to the innovation production of the STEM small firms. This might be due to the fact that walkability and transit access increase the property values and, therefore, make them unaffordable for small innovative firms. Our findings on the impacts of walkability and transit access on innovation productivity in vulnerable small firms call for attention to the equity aspects of innovation-supportive urban developments.

Subject Areas: Transit; Walkability; Knowledge economy; KIBS; Creative industries; Innovation

Title: The Great Divide: What Consumers Are Buying vs. The Investments Automakers & Suppliers Are Making in Future Technologies, Products & Business Models

Authors: Bailo, C., Dziczek, K., Smith, B., Spulber, A., Chen, Y. and Schultz, M.

Abstract: N.A.

Subject Areas: Light vehicle; Transport; Market; Consumer


11.11. Title: The Ongoing Transformation of the Global Transportation System: A US DOT Volpe Center Thought Leadership Series

Author: Merrefield, C.

Abstract: Automation, artificial intelligence, robotics, sensing technology, and computing will transform the future of travel and commerce. Technological advances continue to change the national and global transportation landscape at an unprecedented pace. As the private sector drives innovation across all modes, there is potential for dramatic impacts on the safety and efficiency of the future transportation system and the composition of the nation’s transportation workforce. The U.S. DOT Volpe Center’s 2017 speaker series – The Ongoing Transformation of the Global Transportation System – explored challenges and opportunities affecting the advancement of transportation systems.

Subject Areas: Future transportation system; Transformation


375
Title: Defining The Sharing Economy, Part I: Excess Capacity

Author: Schwartz, H.

Abstract: Blog

Subject Areas: Economy; Rideshare; Vehicle; Trip duration

**Title:** Americans’ Plans for Acquiring and Using Electric, Shared, and Self-Driving Vehicles and Costs and Benefits of Electrifying and Automating US Bus Fleets

**Author:** Quarles, N.T.

**Abstract:** This thesis is divided into three parts. The first part surveys 1,426 Americans to gauge how technology availability and costs influence public opinion, vehicle ownership decisions, travel, and location choices, and then adjusted all results for population weights, to offset any sample biases in U.S. demographics. Example results include average willing to pay (WTP) for full automation (on a newly acquired vehicle) of $3,252 with a very high standard deviation of +/- $3,861 with a human-driven-vehicle (HV) mode option and $2,783 (standard deviation=$3,722) without that option (AV driving only). These averages rise to $3685 and $3112 for AV with and without an HV option, respectively, if responses of zero WTP are removed. Americans’ average WTP for use of shared autonomous vehicles (SAVs) is $0.44 per mile (standard deviation=$0.43). If given the option, Americans expect to set their vehicles in AV (self-driving) mode 36.4% of the time. Respondents believe about 20% of AV miles should be allowed to travel empty, for both privately-owned AVs and shared AV fleets, which would be quite congesting in urban regions at many times of day. Among those likely to move their home in the next few years, 15.5% indicate that availability of AVs and SAVs would shift their new home locations relatively closer to the city center, while 10% indicate further away; the other 74.5% do not expect such technologies to influence their home location choices.

**Subject Areas:** Willing to pay (WTP); Costs; Self-Driving Vehicles; Shared autonomous vehicles (SAVs)


Author: Hall, J.D.

Abstract: Economists have long advocated road pricing as an efficiency-enhancing solution to traffic congestion, yet it has rarely been implemented because it is thought to create losers as well as winners. This paper uses survey and travel time data, combined with a structural model of traffic congestion, to estimate the joint distribution of agent preferences and evaluate the aggregate and distributional effects of road pricing. I find that adding tolls on half of the lanes of a highway yields a Pareto improvement. Further, the social welfare gains from doing so are substantial – up to $1,740 per road user per year.

Subject Areas: Road pricing; Congestion; Travel time data

11.15. Title: Trends in Taxi Use and the Advent of Ridehailing, 1995–2017: Evidence from the US National Household Travel Survey

Authors: Conway, M., Salon, D. and King, D.

Abstract: The advent of ridehailing services such as Uber and Lyft has expanded for-hire vehicle travel. We use data from the 2017 National Household Travel Survey (NHTS) to investigate the extent of this expansion in the United States. We report changes in the for-hire vehicle market since ridehailing services became available and statistically estimate the determinants of ridehailing use. From 2009–2017, the for-hire vehicle market share doubled. While for-hire vehicles still only account for 0.5% of all trips, the percent of all Americans who use ridehailing in any given month is nearly 10%. Within the for-hire vehicle market, this trend of growth has not been uniformly distributed across demographic groups or geographies; it has been greater in mid-sized and large cities, and among younger individuals and wealthier households. This suggests that understanding the equity implications of ridehailing is an important avenue for research. Multivariate analysis provides evidence that both transit and nonmotorized transport use are correlated with ridehailing use, that ridehailing has a negative relationship with vehicle ownership, and that residents of denser areas have higher ridehailing use. Given the rapid growth of ridehailing, it has become important for cities to include for-hire vehicles in their planning going forward. These NHTS data provide a starting point, but more detailed and frequent data collection is needed to fully understand this many-faceted, rapidly-changing market.

Subject Areas: Ridehailing; Ridesharing; Ridesourcing; Taxi; TNC

Title: Influence of Choice Experiment Designs on Eliciting Preferences for Autonomous Vehicles

Authors: Bansal, P. and Daziano, R.A.

Abstract: Due to potentially high initial purchase prices, automation is likely to hit the transportation market as on-demand autonomous taxis for short-term rentals. In this study, welfare measures associated with the use of autonomous taxis were estimated by conducting discrete choice experiments (DCEs) in New York City. Aiming at more realistic choice scenarios, a method for pivot-efficient designs is proposed and tested that exploits the distribution of attribute levels; however, analysis suggests the use of a simpler pivot-efficient design with average attributes of reference alternatives. In our sample New Yorkers were willing to pay on average $3 less per self-driven trip. This reduction in the willingness to pay is coming from the fact that in current conditions not having a driver may be perceived as a nuisance rather than a convenience.

Subject Areas: Discrete choice experiment; Pivot-efficient design; Willingness to pay

Title: Analyzing the Dynamic Ride-sharing Potential for Shared Autonomous Vehicle Fleets using Cellphone Data from Orlando, Florida

Authors: Gurumurthy, K.M. and Kockelman, K.M.

Abstract: Transportation network companies (TNCs) are regularly demonstrating the economic and operational viability of dynamic ride-sharing (DRS) to any destination within a city (e.g., uberPOOL or Lyft Line), thanks to real-time information from smartphones. In the foreseeable future, fleets of shared automated vehicles (SAVs) may largely eliminate the need for human drivers, while lowering per-mile operating costs and increasing the convenience of travel. This may dramatically reduce private vehicle ownership resulting in extensive use of SAVs. This study anticipates DRS matches across different travelers and identifies optimum fleet sizes required using AirSage’s cellphone-based trip tables across 1267 zones over 30 days. Assuming that the travel patterns do not change significantly in the future, the results suggest significant opportunities for DRS-enabled SAVs. Nearly 60% of the single-person trips could be shared with other individuals traveling solo and with less than 5 min of added travel time (to arrive at their destinations), and this value climbs to 80% for 15 to 30 min of added wait or travel time. 60,000 SAVs will be required to meet nearly 50% of Orlando’s 2.8 million single-traveler trips each day. With maximum ride-sharing delays of 15 minutes, and when focused on serving solo travelers, the average SAV is able to serve 25 person-trips per day, reducing parking demands while filling up passenger vehicle seats.

Subject Areas: Dynamic ride-sharing; Cellphone-based transportation data; Shared autonomous vehicles; Orlando; Florida

Title: Impacts of Renewable Hydrogen Production from Wind Energy in Electricity Markets on Potential Hydrogen Demand for Light-Duty Vehicles

Authors: Nagasawa K, Davidson FT, Lloyd AC, Webber ME.

Abstract: This work developed two methods to investigate the technical and economic potential of hydrogen demand and production: (1) estimating potential hydrogen demand for light-duty vehicles (LDVs) at the county-level using a first-order engineering model, and (2) quantifying temporal renewable hydrogen production from wind energy using a linear programming model. The potential hydrogen demand was primarily evaluated for three geographical regions: (1) the United States, (2) Texas, and (3) the Texas Triangle which is one of the nation’s most important mega-regions. The linear programming model compared marginal electricity and hydrogen prices to maximize revenue over the course of a year. The analysis primarily focused on the Electric Reliability Council of Texas (ERCOT), but also included other six U.S. electricity markets for hypothetical analysis. Results show that the potential hydrogen demand for LDVs in the United States, Texas, and the Texas Triangle are 53.3, 5.3, and 3.9 billion kg per year, respectively. Using the electrolyzer system energy efficiency of 75% and the marginal hydrogen price of $4/kg, the wind energy in Texas as of 2015 could produce nearly 0.84 billion kg of hydrogen, which could supply about 22% of the potential hydrogen demand for LDVs in the Texas Triangle. When the marginal hydrogen price is low (e.g. $1/kg), it is only favorable to produce hydrogen during early morning hours, especially, 1–6a.m., in ERCOT and other electricity markets except California’s market. These results could provide information for decision makers to better understand the holistic feasibility of a hydrogen economy in the United States.

Subject Areas: Renewable hydrogen production; Wind energy; Electricity markets; Potential hydrogen demand; Light-duty vehicles

Title: An Empirical Analysis of Post-work Grocery Shopping Activity Duration using Modified Accelerated Failure Time Model to differentiate Time-Dependent and Time-Independent Covariates

Authors: Wang K, Ye X, Ma J.

Abstract: In this paper, the accelerated failure time (AFT) model is modified to analyze post-work grocery shopping activity duration. Much previous shopping duration analysis was conducted using the proportional hazard (PH) modeling approach. Once the proportionality assumption was violated, the traditional accelerated failure time (TAFT) model was usually selected as an alternative modeling approach. However, a TAFT model only has covariates with non-proportional and time-dependent effects on the hazard overtime while a PH model only accommodates covariates with proportional and time-independent effects. Neither of them considers the possibility that some of covariates may have proportional and time-independent effects and some may have non-proportional and time-dependent effects on the hazard value in one model. To address this issue, the paper generalizes the TAFT model and develops a modified accelerated failure time (MAFT) model to accommodate both time-dependent and time-independent covariates for activity duration analysis. Checking on the proportionality assumption indicates that the assumption is not valid in the post-work grocery shopping activity data extracted from the 2017 National Household Travel Survey (NHTS) conducted by the U.S. Department of Transportation (USDOT). Both TAFT and MAFT models are developed for comparisons and analysis. The empirical and statistical results show that there do exist two different types of covariates affecting shopping activity duration, including covariates only with proportional and time-independent effects (i.e. working duration, commute travel time) and those with non-proportional and time-dependent effects. The MAFT model can capture the subtleties in various types of covariate effects and help better understand how those covariates affect activity duration overtime. This paper also shows the importance to develop a flexible duration model with both time-dependent and time-independent covariates for accurately evaluating travel demand management (TDM) policies, like flexible work hours.

Subject Areas: Post-work Grocery Shopping Activity; Shopping duration; Accelerated failure time (AFT) model;

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0207810
11.20. Title: The Interaction between E-Shopping and Store Shopping: Empirical Evidence from Nanjing, China

Authors: Xi, G., Zhen, F., Cao, X. and Xu, F.

Abstract: The rise of e-shopping significantly changes the way that people shop. Transportation planners have a keen interest in the substitution of e-shopping for store shopping and its impact on transportation systems. The literature offers mixed findings on the relationship between online and store shopping. Few studies have explored this relationship in China where e-shopping has proliferated and retail land use and transportation systems have evolved. Using data gathered from adult Internet users in Nanjing, this paper applies structural equation modeling to investigate the relationships among store shopping, online shopping, and online searching. The results show that online shopping and store shopping have a positive association, however, the effect is from the latter to the former. Online searching positively influences both online shopping and store shopping. These results imply that e-shopping as an information channel promotes store shopping.

Subject Areas: China; Information and Communication Technology; Internet Shopping; Online Shopping; Shopping Travel

Title: Age, Autos, and the Value of a Statistical Life

Author: O’Brien, J.

Abstract: The value of a statistical life (VSL) is used to assign a dollar value to the benefits of health and safety regulations. Many of those regulations disproportionately benefit older people, but most estimates of the VSL come from hedonic wage regressions with few older workers and no retirees. Using automobile purchase decisions, I estimate a VSL for individuals from the age of 18 up to the age of 85. Combining information on vehicle holdings and use, household attributes, used vehicle prices, crash test results, and yearly fatal accidents for each make, model, and vintage automobile, I calculate a separate willingness to pay for reduced mortality for different age groups. I find a significant inverted-U shape to the age-VSL function that ranges from $1.5 to $19.2 million (in 2009 dollars). The shape and magnitude of the vehicle-based age-VSL relationship corroborate labor market estimates and extend the age range of revealed preference evidence on the relationship between age and the VSL.

Subject Areas: Value of statistical life (VSL); Senior discount; Vehicle choice

Title: Transportation Infrastructures and Socioeconomic Statuses: A Spatial Regression Analysis at the County Level in the Continental United States, 1970–2010

Authors: Kasu, B.B. and Chi, G.

Abstract: There is a large body of literature examining transportation impacts on population and employment growth. However, the possible impacts that transportation infrastructures have on socioeconomic statuses are less clear. This study fills the gap in the literature by associating education and income—two socioeconomic status measures—with transportation infrastructures. In specific, this study examines the associations of railroads, highways, and airports collectively with high school, Bachelor’s degree, graduate degree, and income change in the continental United States for the period between 1970 and 2010. Data come from various sources, such as National Transportation Atlas Database, Decennial Census, Cartographic Boundary Shapefiles, and Land Developability Index. Standard regression and spatial analysis are conducted at decade levels and at the entire study period to test the consistency of the associations between transportation infrastructures and education and income. The study shows that railroads have a distributive and highways have a facilitative association with both education and income. Airports behave as a growth factor with education and as a facilitator with income. The findings clearly show the increased complexity of the roles performed by transportation infrastructures and do not show straightforward behaviors as has been considered for a long time. This study provides new insights into the role of transportation infrastructures for transportation planning and decision making.

Subject Areas: Infrastructure; Socioeconomic impact; Spatial association

Title: Quantifying the Benefits of the Introduction of the Hybrid Electric Vehicle

Authors: Langford, R.P. and Gillingham, K.

Abstract: This study models demand and supply in the market for new automobiles to estimate the economic benefits generated by the introduction of the hybrid electric vehicle. We estimate our model using all new vehicle registrations in California along with detailed demographic data. Our counterfactual analysis of the removal of hybrids reveals a gain in social surplus that peaks at just over $900 million in 2007, but environmental benefits make up less than 1% of the net benefits. We further show that all income groups benefit from the introduction of the hybrids due to the re-equilibration of prices in the market.

Subject Areas: Automobile markets, New products, Consumer benefits.

http://environment.yale.edu/gillingham/HybridsIntroduction.pdf
11.24. Title: Professional Sporting Events and Traffic: Evidence from U.S. Cities

Authors: Humphreys, B.R. and Pyun, H.

Abstract: Sporting events concentrate people at specific locations on game day. No empirical evidence currently exists linking sporting events to local traffic conditions. We analyze urban mobility data from 25 US metropolitan areas with MLB teams over the period 1990 to 2014 to assess the relationship between local traffic and Major League Baseball (MLB) games. Instrumental variable regression results indicate MLB attendance causes increases in local vehicle-miles traveled. At the sample average attendance of 2.8 million, average daily vehicle-miles traveled increases by about 6.9% in cities with MLB teams. Traffic congestion increases by 2%, suggesting that MLB games generate congestion externalities.

Subject Areas: Transportation, Traffic congestion, Vehicle-miles traveled, Major League Baseball

http://busecon.wvu.edu/phd_economics/pdf/17-05.pdf
11.25. Title: Time of Use Price based Vehicle to Grid Scheduling of Electric Vehicle Aggregator for Improved Market Operations

Authors: Sharma, S., Jain, P., Bhakar, R. and Gupta, P.P.

Abstract: Large-scale adoption of Electric Vehicles EVs would increase average electricity consumption and peak demand of electrical grid. In addition, uncoordinated charging of EV would make situation more severe and require network reinforcement. One of the potential solutions to this problem is peak load management through EVs coordinated charging. In this regard, this paper put forward Time-of-Use (TOU) price based Vehicle-to-Grid V2G scheduling strategy of EV Aggregator (EVA) with the aim to optimize EVs coordinated charging and earn monetary benefits for all stakeholders such as EV owners and System Operator (So). For this, Price-based Demand Response Program (PBDRP) is proposed to enhance the value of EV owners. State-of-Charge (SOC), TOU-PBDR and modulation of charging/discharging rate is considered for the pragmatic formulation of V2G scheduling problem of EVA. Simulation result highlights the effectiveness of the proposed model regarding peak load management and monetary benefits for all stakeholders. Moreover, this model offers regulation services to SO for supporting grid stability and thus avoid inevitable contingencies.

Subject Areas: Electric vehicle aggregator; Time-of-Use; Charging rate; Vehicle-to-grid

11.26. Title: From Census Tracts to Local Environments: An Egocentric Approach to Neighborhood Racial Change

Authors: Lee, B.A., Farrell, C.R., Reardon, S.F. and Matthews, S.A.

Abstract: Most quantitative studies of neighborhood racial change rely on census tracts as the unit of analysis. However, tracts are insensitive to variation in the geographic scale of the phenomenon under investigation and to proximity among a focal tract’s residents and those in nearby territory. Tracts may also align poorly with residents’ perceptions of their own neighborhood and with the spatial reach of their daily activities. To address these limitations, we propose that changes in racial structure (i.e., in overall diversity and group-specific proportions) be examined within multiple egocentric neighborhoods, a series of nested local environments surrounding each individual that approximate meaningful domains of experience. Our egocentric approach applies GIS procedures to census block data, using race-specific population densities to redistribute block counts of whites, blacks, Hispanics, and Asians across 50-meter by 50-meter cells. For each cell, we then compute the proximity-adjusted racial composition of four different-sized local environments based on the weighted average racial group counts in adjacent cells. The value of this approach is illustrated with 1990–2000 data from a previous study of 40 large metropolitan areas. We document exposure to increasing neighborhood racial diversity during the decade, although the magnitude of this increase in diversity—and of shifts in the particular races to which one is exposed—differs by local environment size and racial group membership. Changes in diversity exposure at the neighborhood level also depend on how diverse the metro area as a whole has become.

Subject Areas: Neighborhood change; Race-ethnicity; Spatial scale; Egocentric local environment; Entropy index Diversity profile

11.27. Title: Income Growth and the Distributional Effects of Urban Spatial Sorting

Authors: Couture, V., Gaubert, C., Handbury, J. and Hurst, E.

Abstract: We explore the link between rising nominal incomes at the top of the income distribution, within-city spatial sorting, and real income inequality. We develop and quantify a spatial model of a city with heterogeneous agents and non-homothetic preferences for endogenous differentiated private neighborhood amenities (e.g., restaurants and entertainment). As the rich get richer, their increased demand for such luxury amenities drives housing prices up in downtown areas, where amenity development is fueled by economies of density. The poor are made worse off, either being displaced or paying higher rents for amenities that they do not value as much. Using our model, we find that the neighborhood change within urban areas during the last two decades increased the welfare of richer households relative to that of poorer households by an additional two percentage points above and beyond the differential income growth. We conclude that welfare estimates of increased income inequality are understated if within-city spatial sorting responses are ignored.

Subject Areas: Income distribution; Spatial sorting

Title: Technology Adoption and Critical Mass: The Case of the U.S. Electric Vehicle Market

Authors: Zhou, Y. and Li, S.

Abstract: The interdependence between electric vehicle (EV) adoption and charging station deployment could lead to multiple equilibria. Under certain market conditions, the issue of critical mass arises and a market failing to overcome this hurdle would revert to a no-adoption outcome. Using panel data of EV sales and charging stations across U.S. Metropolitan Statistical Areas (MSA’s), we find that more than half of the MSA’s face critical mass constraints and that a subsidy policy targeting these critical mass-constrained MSA’s could be much more effective in promoting EV adoption than the current uniform policy.

Subject Areas: Electric vehicle (EV); Charging station; Market

Title: Measuring Long-Run Price Elasticities in Urban Travel Demand

Author: Donna, J.

Abstract: This paper develops a structural model of urban travel to estimate long-run price elasticities. A dynamic discrete choice demand model with switching costs is estimated, using a panel dataset with public market-level data on automobile and public transit use for Chicago. The estimated model shows that long-run own- (automobile) and cross- (transit) price elasticities are more elastic than short-run elasticities, and that elasticity estimates from static and myopic models are downward biased. The estimated model is used to evaluate the response to a gasoline tax. Static and myopic models mis-measure long-run substitution patterns, and could lead to incorrect policy decisions.

Subject Areas: Long-run price elasticities; Dynamic demand travel; Hysteresis

11.30. Title: US households are holding on to their vehicles longer

Author: Green Car Congress

Abstract: Blog

Subject Areas: Market Background; Fuel Efficiency; Behavior

11.31. Title: Average vehicle age rises; car shoppers buy used, delay new purchases

Author: Green Car Congress

Abstract: Blog

Subject Areas: Average vehicle age; decline demand of new car