The Traffic Jam of Robots: Implications of Autonomous Vehicles for Trip-Making and Society

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Vision of Future – Version 1
Current Reality
Future Reality

• Automation will improve efficiency and safety, but not enough to relieve congestion.

• Opposing trends
  – Increasing population (~30% increase in US by 2060 – census.gov)
  – Increasing urbanization (~30% increase in US by 2042 – usmayors.org;
    2 mega US cities of 10 million plus today, 5 mega cities in 2042, 9 in 2060;
    50 major US cities of 1 million plus today, 70 major cities in 2042)
  – Increasing vehicle miles traveled per capita
    (~50% increase in US since 1970—fhwa.dot.gov and dshort.com)

• Requires behavior change even under optimistic technology scenarios
  (Sager et al., 2011; Dray et al., 2012)
“Peak car ownership in the US will occur around 2020 and will drop quickly after that... Automated mobility services could capture 2/3 of the US mobility market in 15-20 years.” (2016)

“Transport-as-a-Service will provide 95% of the passenger miles traveled within 10 years of the widespread regulatory approval of AVs.” (2017)
COST?

CONVENIENCE?

FLEXIBILITY?
What do you imagine?
Actually... it’s worse because of ghost trips.
Vision of the Future – Version 3

Autonomous
+ Shared rides
+ Connected
+ Clean
+ Right-sized
+ Equitable
(+ Priced)
Vision of the Future – Version 3

+ P riced
+ A utonomous
+ C lean & C onnected
+ E quitable
+ R ight-sized
+ S hared rides
Critical Travel Behavior Research Questions

• Vehicle miles per person will increase ... by how much?
• Larger proportion of people won’t own cars ... how much larger?
• Higher proportion of trips will be shared rides ... how much more?
• Vehicles will change size (and function) ... smaller or larger?
• On demand delivery is escalating ... what traffic will this generate?
Predicting Travel Changes

• Rich transport behavior literature
  – Pricing, multitasking, parking, sharing vehicles and rides, travel budgets, modal attitudes, habits, social norms, car pride, ...

• Requires new behavioral experiments
  – Difficult as the technologies don’t exist

• Approaches
  – Simulation-based scenario analysis
  – Survey responses to hypothetical scenarios
  – Virtual reality and gaming
  – Field experiments using analogous modes & prototypes

“Hang on—I’ll Uber us a school bus.”
New Yorker, May 2016
Research Findings on AV impacts

• Drastically reduced vehicle fleet can serve demand (~10% of current) (Fagnant & Kockelman, 2014; Fagnant et al., 2015; OECD, 2015)

• But vehicle miles traveled increases
  8-10% vehicle relocation only (Fagnant & Kockelman 2014; Fagnant et al. 2015)
  4-15% multitasking, network efficiency (Gucwa, 2014)
  5-35% depending on penetration and level of automation (Fehr & Peers, 2014)
  6-90% depending on shared vehicles & rides, transit quality (OECD, 2015)

• People (today) are willing to pay for Automated Vehicles
  $4,900 on average; ranges from $0 - $10,000+ (Daziano et al., 2016)

• There’s hesitancy towards adoption and sharing
  52% in US say they’ll use an AV; 27% say they’ll use a shared AV (WEF/BCG, 2015)
Research Findings: Chauffeur Experiment
(Harb et al., 2017)

• 13 San Francisco Bay Area subjects
  
• More auto travel
  – 76% increase in VMT
  – 22% of increased VMT were ghost trips

• Change in activity patterns
  – 94% increase in # longer trips (over 20 miles)
  – 80% increase in # evening trips (after 6 pm)

• Bimodal impact on miles walked
  – Half decreased (-28% on average), half increased (+49% on average)

• Virtually no biking, transit, TNC use in the sample
Conclusion: Planning For the Future

• Don’t be naïve about behavior
  – Dangerous to underestimate attachment to one’s own car
  – All signs lead to significantly more vehicle miles traveled

• Policy needs
  – Now is the time to act
    • Once habits/norms are formed, hard to change
    • Once items are free, hard to charge
  – Systems thinking of public/private service
    • Public sector must intervene for equity
  – Guide dynamic evolution
    • Nudge towards shared vehicles & shared rides
    • Scale up shared rides to larger vehicles
    • Innovate high capacity vehicles
  – Embrace experimentation
  – Status quo won’t get us there;
    Requires strong (dis)incentives

Slow and steady push to P.A.C.E.R.S.