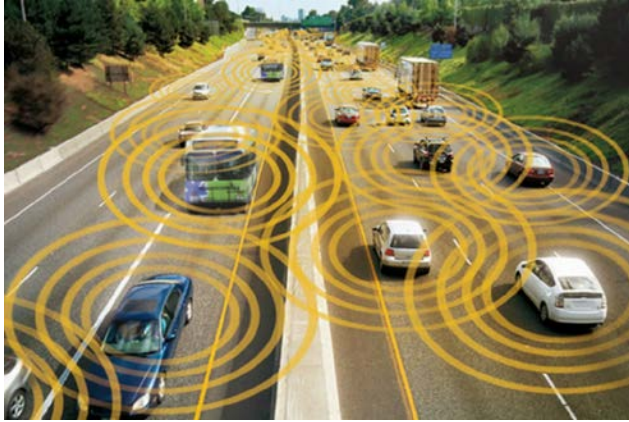# The Traffic Jam of Robots: Implications of Autonomous Vehicles for Trip-Making and Society

Joan Walker
University of California, Berkeley
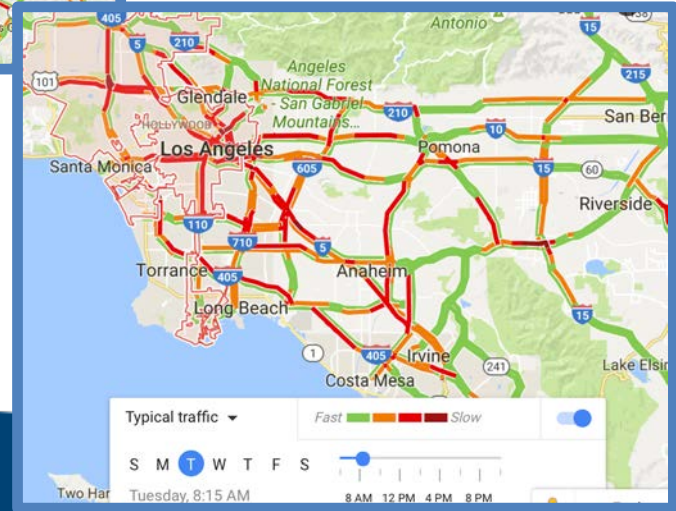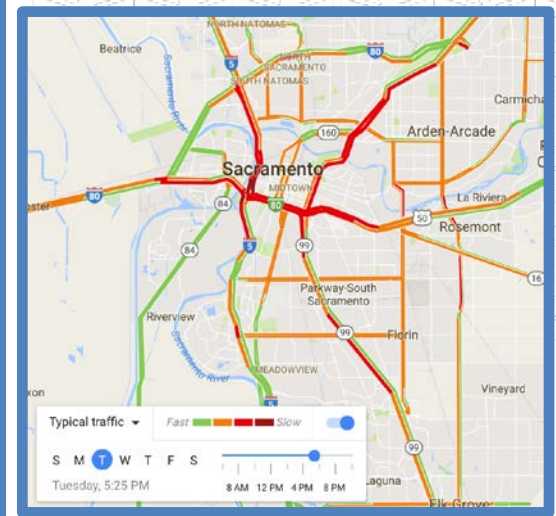
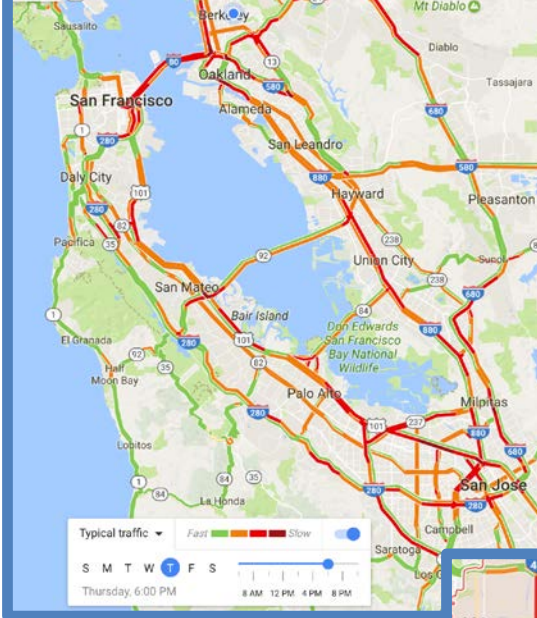ASILOMAR 2017

The 16TH Biennial Conference on Transportation and Energy

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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)

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Vision of Future – Version 2

"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)
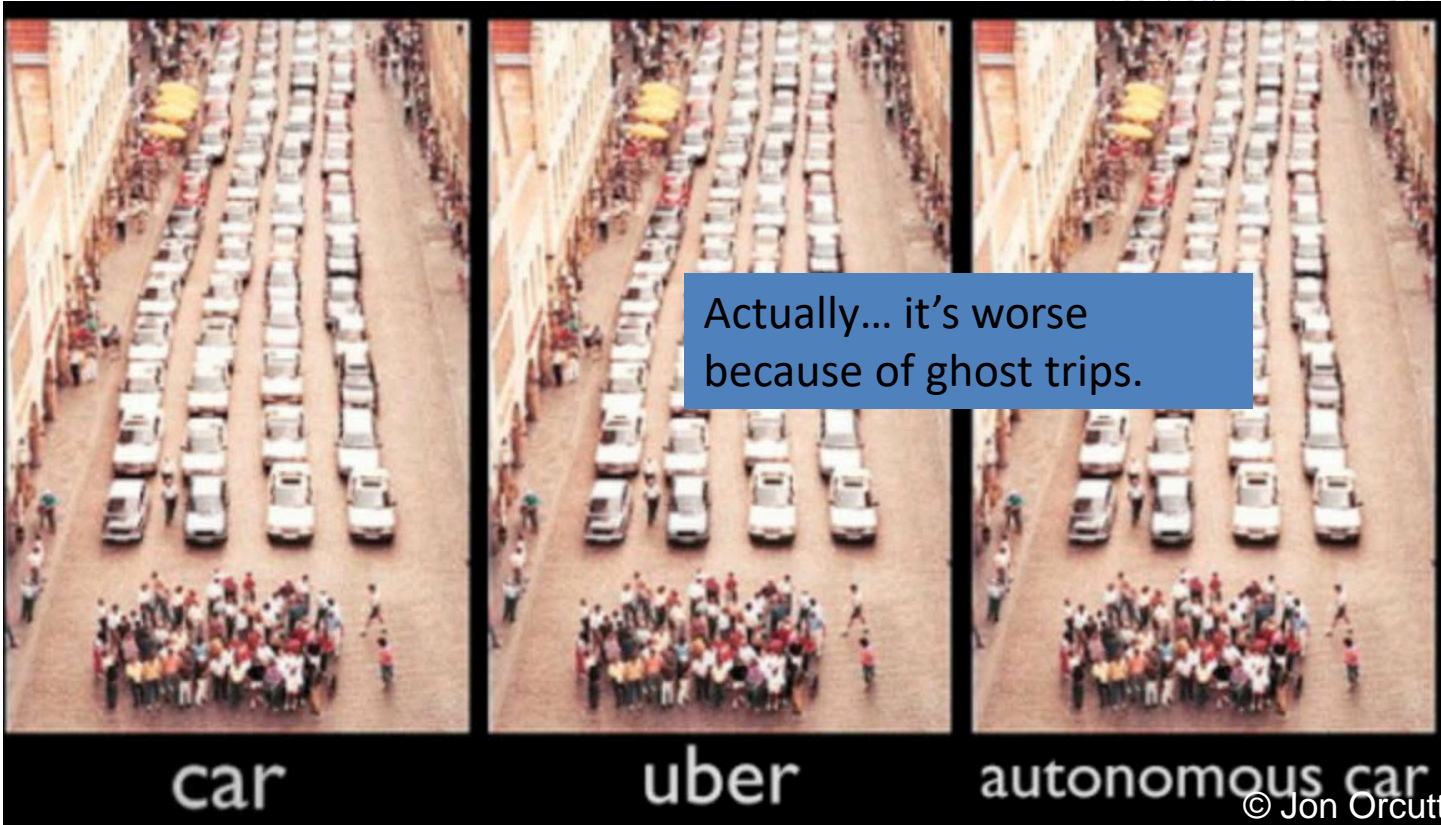
COST?

CONVENIENCE?

FLEXIBILITY?

PHOTO from www.seemoresystems.com

What do you imagine?

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Actually… it's worse because of ghost trips.

car   uber   autonomous car

© Jon Orcutt

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

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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?

Congestion?

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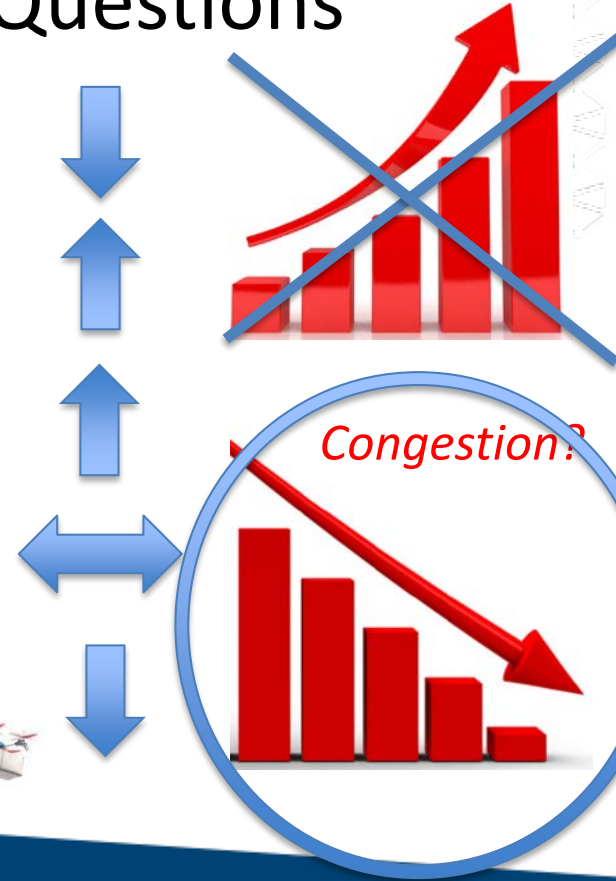
Predicting Travel Changes

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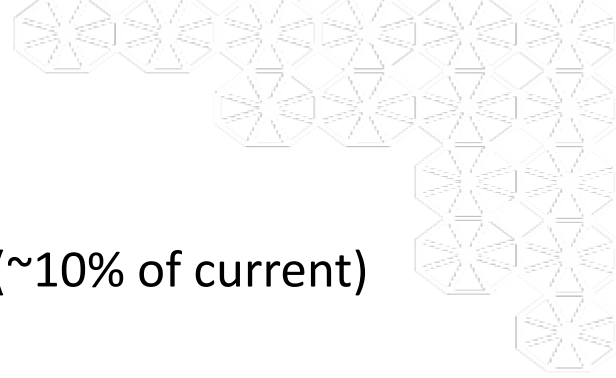
- Drastically reduced vehicle fleet can serve demand (~10% of current)
  (Fagnant & Kockelman, 2014; Fagnant et al., 2015; OECD, 2015)

- 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)
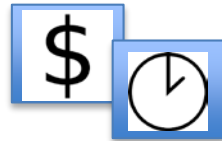
Research Findings: Chauffeur Experiment
(Harb et al., 2017)

- 13 San Francisco Bay Area subjects   *Cohorts: 4 Millennials, 4 Families, 5 Retirees*
- More auto travel
  - 76% increase in VMT   *Retirees increase most*
  - 22% of increased VMT were ghost trips   *Consistent across cohorts*
- Change in activity patterns
  - 94% increase in # longer trips (over 20 miles)
  - 80% increase in # evening trips (after 6 pm)   *Retirees increase most*
- Bimodal impact on miles walked   *Consistent across cohorts*
  - Half decreased (-28% on average), half increased (+49% on average)
- Virtually no biking, transit, TNC use in the sample   *Consistent across cohorts*

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.**