Title

The Impacts of Automated Vehicles on Center City Parking Demand, Congestion, and Emissions

Authors

Chai, Huajun
Rodier, Caroline
Song, Jeffery
et al.

Publication Date

2020-10-01

DOI

10.7922/G2445JSR

National Center for Sustainable Transportation

POLICY BRIEF

The Impacts of Automated Vehicles on Center City Parking Demand, Congestion, and Emissions

Huajun Chai, Caroline Rodier, Jeffery Song, and Michael Zhang
Institute of Transportation Studies, University of California, Davis

October 2020

Issue

Parking has long been an urban planning challenge. Providing parking in city centers is land-intensive and expensive. Moreover, drivers searching for scarce parking can increase congestion, vehicle miles traveled, and greenhouse gas emissions. Use of automated vehicles to drop off and pick up travelers could reduce the demand for parking, which could reduce vehicle miles traveled and associated emissions and allow urban spaces currently used for parking to be converted to more beneficial uses. However, automated vehicles could also have negative consequences. They could generate empty vehicle travel and more cross-traffic movements due to drop-offs and pick-ups which could increase congestion, vehicle miles traveled, and greenhouse gas emissions.

Researchers at the University of California, Davis modeled the travel effects of changes in drop-off and pick-up activity and parking supply that might be triggered by widespread automated vehicle use in San Francisco's city center. A primary goal of this research was to determine an optimal level of automated vehicle adoption that minimizes negative consequences. The researchers also modeled methods to control these negative consequences, including expanding drop-off and pick-up zones and imposing auto pricing policies to curb demand.

Key Findings

Automated vehicle adoption can reduce congestion in central cities. Congestion in downtown San Francisco dropped significantly in modeled scenarios as automated vehicle adoption increased, with most streets experiencing free-flow speeds even during peak commute periods as automated vehicle adoption reached 40%–50%. This was due to improvements in parking space utilization and decreases in searching for parking. While a parked vehicle typically occupies a space for two hours, an automated vehicle that drops off or picks up a passenger occupies a space for

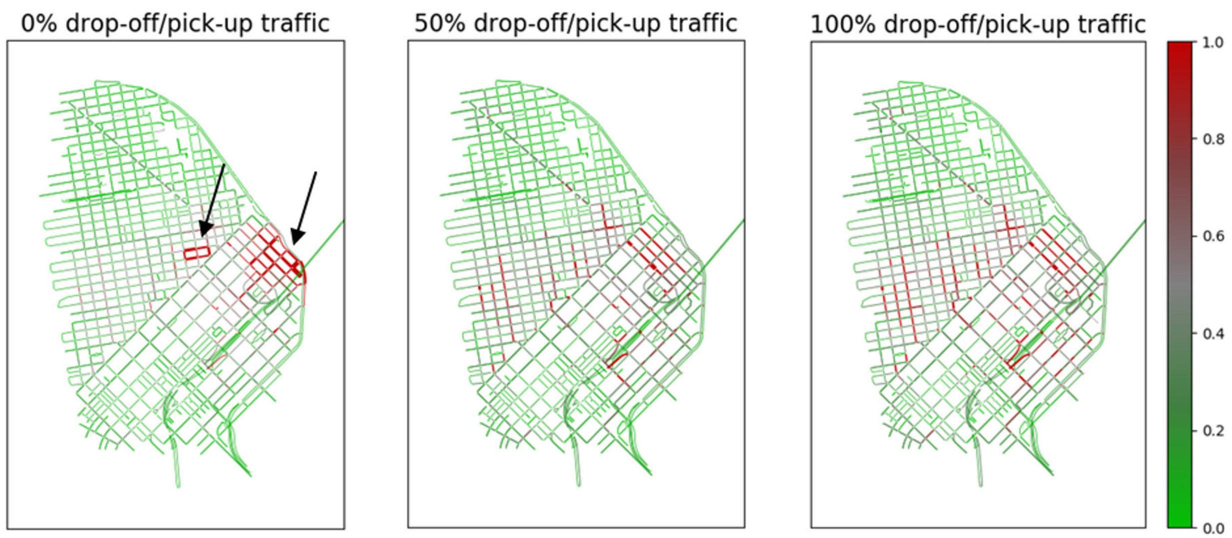

Figure 1. Average daily roadway occupancy results in downtown San Francisco. As the amount of automated vehicle drop-off/pick-up traffic increases, congestion improves in areas rich in off-street parking such as Union Square and portions of the Financial District (indicated by arrows) but worsens in other parts of the city.

only 20 seconds. However, the model did not account for the possibility of reduced congestion causing a rebound effect and incentivizing more trips.

Automated vehicles may also disperse congestion across the road network. Perhaps counter-intuitively, the researchers found that while extreme congestion was alleviated in the vicinity of large off-street parking facilities, congestion worsened moderately in popular drop-off and pick-up areas that were more widely dispersed across the city center (Figure 1).

Greenhouse gas emissions are minimized at a moderate level of automated vehicle adoption. However, the researchers found that once pick-up/drop-off traffic exceeded about 40%, improvements in congestion began to be offset by empty automated vehicle miles, and greenhouse gas emissions started to rise again (Figure 2).

Concentrating off-street parking in fewer locations worsens central city congestion. Automated vehicles can use parking space more efficiently and be more densely packed into off-street parking facilities, which could allow some parking lots and garages to be redeveloped for other purposes. However, the reduced number of off-street parking locations and the increased use of parking spaces at those remaining facilities are expected to cause localized increases in congestion associated with vehicle queuing.

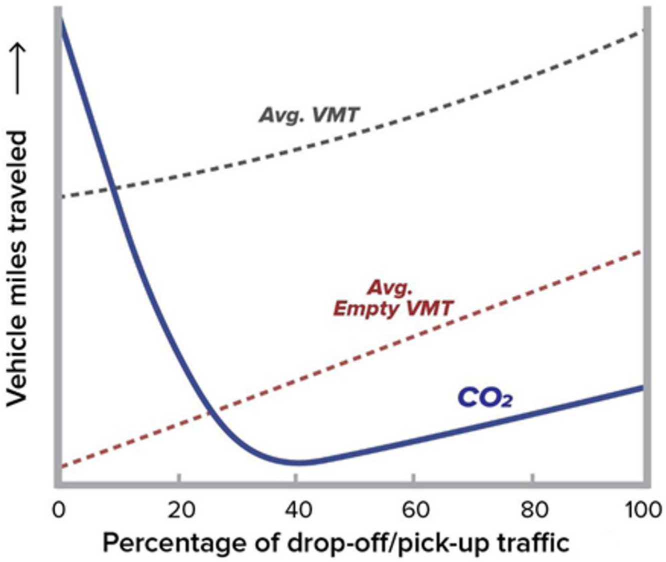

Figure 2. Generalized graph of average daily vehicle miles traveled, empty vehicle miles traveled, and CO_2 emissions at various ratios of automated vehicle drop-off/pick-up traffic. Findings indicate a minimum of CO_2 emissions when drop-off/pick-up traffic represents 40% of all trips.

Policy Implications

Matching the supply of curbside drop-off and pick-up space and the demand for drop-offs and pick-ups has the potential to reduce localized roadway traffic congestion and total vehicle miles traveled and associated emissions. However, these results show that the conversion of parking spaces must be street-specific and dynamic over time to adjust to changes in automated vehicle market shares. An over-allocation of drop-offs and pick-ups can increase parking search and empty vehicle travel, which can increase vehicle miles traveled and greenhouse gas emissions.

Effective matching of drop-off/pick-up traffic and associated curbside spaces requires continuous, detailed roadway monitoring and planning, which may be a challenge for many US cities. It may be possible to redress some negative traffic flow impacts from increasing shares of drop-offs and pick-ups, but planners should fine-tune the configuration of parking spaces dedicated to such activities as their impacts are better understood.

More Information

This policy brief is drawn from "The Impacts of Automated Vehicles on Center City Parking Demand," a report from the National Center for Sustainable Transportation, authored by Huajun Chai, Caroline Rodier, Jeffery Song, and Michael Zhang of the University of California, Davis. The full report can be found on the NCST website at https://ncst.ucdavis.edu/project/automated-vehicles-and-central-business-district-parking-effects-drop-travel-traffic-flow.

For more information about the findings presented in this brief, please contact Huajun Chai at hjchai@ucdavis.edu.

The National Center for Sustainable Transportation is a consortium of leading universities committed to advancing an environmentally sustainable transportation system through cutting-edge research, direct policy engagement, and education of our future leaders. Consortium members: University of California, Davis; University of California, Riverside; University of Southern California; California State University, Long Beach; Georgia Institute of Technology; and the University of Vermont.

Visit us at
ncst.ucdavis.edu

Follow us:

DOI:10.7922/G2445JSR