Title

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Authors

He, Yueshuai
Jiang, Qinhua
Ma, Jiaqi

Publication Date

2022-12-12

DOI

10.17610/T6NW2P

Institute of Transportation Studies | UNIVERSITY OF CALIFORNIA

Connected and Automated Vehicle Impacts in Southern California: Travel Behavior, Demand, and Transportation System Perspectives

Yueshuai He, Project Scientist, UCLA
Qinhua Jiang, PhD candidate, UCLA
Jiaqi Ma, Associate Professor, UCLA

December 2022

Issue

Connected and automated vehicle (CAV) technologies received extensive attention in the recent decade. CAVs are vehicles that can drive without a human driver (automated vehicle, or AV) and can communicate with other vehicles and infrastructures (connected vehicle, or CV). The technologies can benefit transportation systems in many aspects, including safety, economics, efficiency and convenience, and accessibility. While studies of CAV operations are accelerated by tons of data collected from on-road tests worldwide, the comprehensive impacts of CAVs on transportation systems are still unclear. These benefits might affect travel behavior fundamentally, which might induce more travel demand, while on the other hand, vehicle automation and connection would enhance roadway capacity. Ultimately, it's essential to evaluate the CAV impacts on transportation systems in the context of significantly changing travel demand and supply.

This study aims to answer the following questions: 1) how the deployment of CAVs impacts people's travel behaviors in Southern California; 2) to what extent the changes in people's travel behavior can affect the travel demand; 3) how well can the increased roadway capacity help alleviate the strain on the network with CAV deployment; and 4) will the CAV technologies contribute to the travel accessibility of underserved groups?

Key Findings

- More than half of the population in the Southern California Association of Governments region are potential CAV users. We conducted a stated preference survey in Southern California and the results indicate that 53% of the people in the SCAG area are willing to use CAVs for their daily travel. The CAV adoption rates vary across sociodemographic groups. People with higher levels of education or from larger households are more likely to use CAVs.
- The adoption of CAVs would change people's daily activity patterns. The model indicates that people's accepted commute time increases by 12 minutes on average. Besides, due to increased schedule flexibility with CAV, people with at least one non-mandatory activity (e.g., shopping, dining out, visiting friends) per day increases from 30% to 46%.
- CAVs would induce a large increase in travel demand. The total number of trips increased by 9%. Specifically, trips with higher priority, such as work trips, increased by 14%, and other trips, like household maintenance and personal discretionary trips, increased by 7% to 10%.
- The enhanced roadway capacity can't offset the pressure on the road network induced by travel demand. When CAVs are widely adopted, some freeways in Southern California may experience better traffic conditions, while congestion at the system level will be similar to the current status (See Figure 1).

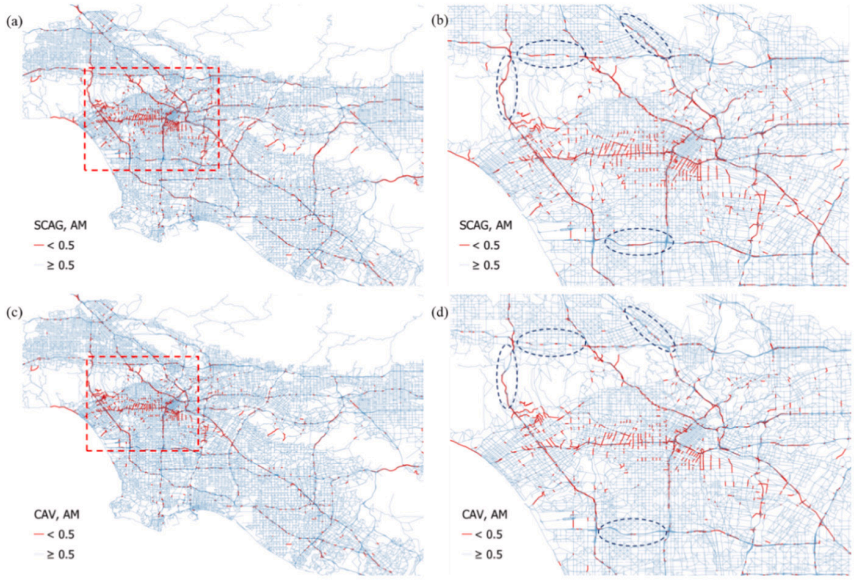

Figure 1. The ratio of mean speed to free-flow speed during morning peak hours: (a) SCAG; (b) Zoom-in view of SCAG; (c) CAV; and (d) Zoom-in view of CAV.

Conclusions

- The vehicle miles traveled (VMT) and greenhouse gas (GHG) emissions increase significantly with the deployment of CAVs. Compared with the base model, the travel demand predicted by the CAV model leads to a 9.1% increase in VMT and around a 9.6% to 10.4% increase in GHG emissions.
- The advanced CAV technology alone wouldn't directly benefit future transportation systems, and it is still critical to have appropriate policy interventions in place. Travel demand management strategies, such as parking pricing, remote work, auto trade-in, and transit fee subsidy, are necessary in response to the excessive growth of travel demand and can reduce the CAV-induced VMT and emission by 1% to 7%.
- The wide adoption of CAVs would cause both advantages and disadvantages to travel equity across sociodemographic groups. On the one hand, the use of CAVs in daily travel helps to reduce the gap in travel accessibility between lower- and upper-income households in mandatory trips such as work and school commutes. On the other hand, the model indicates that the disparity in travel accessibility and activity frequency gets worse across income groups in non-mandatory trips such as shopping and dining out. With that being said, supportive policies to lower-income groups, such as travel subsidies, are effective ways to enhance travel equity.

More Information

This policy brief is drawn from the "Developing Planning-level Analysis Tools for Connected Automated Vehicle Technologies and Services" research project by the UCLA Institute of Transportation Studies. The survey design and full work can be found at www.its.ucla.edu/project/developing-planning-level-analysis-tools-for-connected-automated-vehicle-technologies-and-services. For more information about the findings in this brief, contact Jiaqi Ma at jiaqima@ucla.edu.

Research presented in this policy brief was made possible through funding received by the University of California Institute of Transportation Studies (UC ITS) from the State of California through the Public Transportation Account and the Road Repair and Accountability Act of 2017 (Senate Bill 1). The UC ITS is a network of faculty, research and administrative staff, and students dedicated to advancing the state of the art in transportation engineering, planning, and policy for the people of California. Established by the Legislature in 1947, the UC ITS has branches at UC Berkeley, UC Davis, UC Irvine, and UCLA.

Project ID: UC-ITS-2021-64 | DOI: 10.17610/T6NW2P