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# If 2 New Yorkers Shared a Cab ...

By KENNETH CHANG and JOSHUA A. KRISCH SEPT. 1, 2014

It may be anathema to New Yorkers. But a team of mathematicians and engineers has calculated that if taxi riders were willing to share a cab, New York City could reduce the current fleet of 13,500 taxis up to 40 percent, in that way unclogging traffic, conserving fuel and fighting air pollution.

“The predicted economic and environmental savings are considerable,” said Steven Strogatz, a mathematician at Cornell and an author of a paper describing the findings, published Monday in *Proceedings of the National Academy of Sciences*.

The researchers wanted to know whether the principles of the “sharing economy” typified by services like Airbnb, in which people rent out their apartments like hotel rooms, could be applied to taxis.

“Think of how much spare capacity you have in taxis in New York City,” said another team member, Carlo Ratti, the director of the Senseable City Laboratory at the Massachusetts Institute of Technology. “You’re at a hotel, you’re going to J.F.K. Airport, and you take a taxi. And just minutes later, there’s somebody else taking another taxi, half empty, to J.F.K.”

To study ride-sharing scenarios, the researchers delved into a database compiled by the New York City Taxi and Limousine Commission that included information about each of the 172 million taxi rides in the city in 2011: where the passenger was picked up and dropped off, time of pickup and time of drop-off.

Then, applying a computational technique known as shareability networks, they combined trips that were headed in the same direction at

the same time without taking the passengers too far out of their way.

They found that sharing would reduce the number of trips, and the number of taxis, by 40 percent and that passengers would still arrive in the same amount of time, give or take a few minutes. (The analysis did not look at how many people were riding in each cab. Newer data does include the number of passengers.)

“You can think about the matching of two trips as a chemical reaction between two molecules, which is a function of their concentration,” Dr. Ratti said

The team acknowledged that such a system could not be implemented without changes in the way people hail taxis.

Much of the inefficiency in the current system results from a driver’s not knowing the destination until after the pickup. The same inefficiency occurs with elevators in office buildings, where some end up stopping at every floor while others speed to a single floor without interruption.

In some newer buildings, riders press the floor button in the lobby, and the elevator system can use computer algorithms to allocate the rides more efficiently. Similarly, if a taxi passenger specified a destination before being picked up, a sophisticated dispatching system could begin figuring out which rides could be shared.

Smartphone apps, already used by taxi services like Uber and Lyft, could make that possible. Indeed, both companies recently announced shared-ride services, named Uberpool and Lyft Line. Chelsea Wilson, a communications manager at Lyft, said its service was started after data showed that 90 percent of Lyft rides in San Francisco had someone else taking the same trip within five minutes.

“When you look at this on a map, it starts to look like a transit line,” she wrote in an email. “That’s what we are creating with Lyft Line: shared, personal transit.”

The authors of the new study have set up a website, hubcab.org, that allows anyone to explore the taxi ride database.

Dr. Ratti said that if self-driving cars ever came to pass, the transformation of cities could be “quite astonishing.”

In preliminary research not reported in the current paper, the

scientists looked at what would happen if most people combined self-driving cars with shared ridership. They concluded that four out of five cars in the city today could become superfluous.

The team also looked at a subset of the New York database and determined that ride sharing would provide environmental and cost benefits even in smaller cities.

Mason A. Porter, a professor of nonlinear and complex systems at the University of Oxford who was not involved with the research, praised the study, saying, “It definitely looks promising to use this perspective as one of the ways to examine the issue of transportation and ride-sharing.”

Others were more skeptical, noting that the researchers had not fine-tuned their calculations for some real-world complications. Luis M. A. Bettencourt, a professor at the Santa Fe Institute in New Mexico, said the study made sense “technically,” but he wondered about unintended consequences.

If ride sharing induced people to abandon subways and buses, it could actually worsen traffic and pollution, he said, adding that there would be debates about the potential of putting thousands of taxi drivers out of work.

“This is not to say that it should not be done,” Dr. Bettencourt said, “but one would have to think these through some more and try them out in practice, I think.”

On the streets of New York City, the skepticism sounded more like a Bronx cheer.

“The whole thing strikes me as silly, and it will be ignored,” said Gene Salomon, the author of the 2013 book “Confessions of a New York Taxi Driver.”

In his 36 years as a cabby, Mr. Salomon said he had watched many ride-sharing programs come and go. The problem, he went on, is that passengers would rather pay extra for a private ride than split a fare with someone they’ve never met.

“New Yorkers do not like to share cabs,” he said.

The Taxi and Limousine Commission has expressed concern that commercial ride-sharing programs, especially those that crowdsource to

recruit vehicles and drivers, may lack rigorous oversight.

“We have made our position quite clear. You must use T.L.C.-licensed drivers, in T.L.C.-licensed vehicles dispatched by licensed bases,” Allan Fromberg, the agency’s deputy commissioner for public affairs, wrote in an email.

The researchers acknowledge that many people have a visceral reluctance to hop into a taxi with strangers, but they said their work provided a numerical foundation for future debates. “People would need to know what the payoff would be,” Dr. Ratti said. “Then society could decide if it wants to go that way or not.”

Dr. Strogatz agreed. “These are tricky problems to think about,” he said, “and they’re not math problems, exactly.”

### ***Correction: September 3, 2014***

*Because of an editing error, an article on Tuesday about a study on the effects of taxi-ride sharing in New York City referred incorrectly at one point to an expert who commented on the findings. As the article noted elsewhere, the expert, Luis M. A. Bettencourt of the Santa Fe Institute in New Mexico, is a man — not “she.” And the caption for a map with the article, showing taxi pickups and drop-offs in the city, misstated the year the data was collected. It was 2011, not 2001.*

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