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Taking Rides With Strangers

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Imagine how much money could be saved, and how much traffic and pollution could be reduced, if people shared taxis with strangers.

Of course no one really wants to do that. It's inconvenient to go out of our way, and besides, who wants to spend twenty minutes trapped with a stranger? That's what buses and subways are for.

Although we haven't managed to solve the stranger problem, we have made inroads on the convenience problem. In a paper co-authored with our colleagues Paolo Santi, Giovanni Resta, Michael Szell and Stanislav Sobolevsky and published this week in the Proceedings of the National Academy of Sciences, we mined a massive dataset of 150 million taxi trips in and around New York City, made available by the Taxi and Limousine Commission. Using a new type of mathematical analysis, we were able to quantify the vast untapped potential of the city's fleet of more than 13,000 taxis.

The problem was conceptually challenging because cabs, like bicycles and cars, move around in time and space. That obvious but crucial fact makes sharing taxis -- or any other form of transportation -- trickier to coordinate than sharing immobile resources like parking spaces or spare bedrooms. Add to that dynamic complexity the enormous number of taxi trips we had to consider, and you can see why some Big Math was needed to make sense of our Big Data.

The new idea that made the problem tractable was to think of trips as dots or "nodes" in an abstract network. Two trips are defined to be "linked" (their dots are connected) if those trips could be shared without inconveniencing either rider by more than some minimal prescribed delay, say three minutes. The resulting "shareability network" is gargantuan: more than a hundred million dots and a hundred billion links. But it has the great advantage of being static. It's a frozen representation of everything that matters about the taxi dynamics.

This network's secrets can be readily unearthed. Standard algorithms of computer

The analysis shows that the total number of taxi trips in New York City could be reduced by 40 percent, fleet operation costs and pollution could be reduced by 30 percent, while overall service and timeliness would remain about the same. In other words, we could have a taxi system that takes everyone to their destination on time -- give or take a few minutes -- with a lot leaner infrastructure. Such a dramatic reduction in traffic would improve New York's overall environment and quality of life, from calmer streets to cleaner skies.

Furthermore, the results aren't restricted to New York City. Subsampling the initial dataset provides a model for cities with a lower density of taxis, and shows that shareability networks could potentially be applied in most urban areas around the world.

Nor do the results depend on an assumed universal willingness to share taxis. In the real world, some people may be too harried or feel it's not worth the sacrifice in privacy. Fortunately, substantial gains come even if only a fraction of would-be riders participate. Imagine an e-hailing app, where you have the option to request either a shared or private taxi. Our analysis shows that if you ask for a shared ride and only a quarter of the other customers do the same, you still have more than an 80 percent chance of being to able to share a cab (and thus split the cost), while keeping your added travel time below three minutes.

Of course, there's still that problem of the obnoxious stranger.

The answer may lie in other dimensions of the sharing economy. Guest room rental services like Airbnb show that the discomfort of allowing a stranger into your personal space is at least partially offset by the money earned, and by the opportunity to enrich your social circle.

And who knows? You just might meet someone nice in the back seat of that cab.