SocioTechnical Support for Ride Sharing

Paul Resnick
Associate Professor
University of Michigan, School of Information
presnick@umich.edu

I. Intro/Overview

In America, there is tremendous unused transportation capacity in the form of unoccupied seats in private vehicles. Not only would filling some of those seats reduce smog, congestion, and fuel consumption, but it also could create opportunities for increasing local social capital. The major barriers to ride sharing include coordination of routes and schedules, safety risks, social discomfort with sharing what are currently private spaces, and an imbalance of costs and benefits among the affected parties. Despite these barriers, ride sharing does occur, both in the form of recurring carpools and van pools. According to one estimate, more than twice as many people in America share a ride to work in a private vehicle as use public transportation to get there [ref.] In a few cities, there is even "instant" ride sharing among strangers.

Emerging changes in the technology infrastructure of our society may soon make it possible to reduce some of the barriers that have limited the appeal of instant ride sharing. The first change is the widespread deployment of cell phones and other mobile communication devices, with the prospect that they soon be integrated with a position-sensing infrastructure. The second is advances in computational power that may allow for dynamic route matching of drivers and riders. The third is the development of reputation systems on the Internet for maintaining trust among strangers. Research is need on how to leverage these developments to create a SocioTechnical infrastructure for instant ride sharing.

II. Scenario

Janine is new to instant ride-sharing. She is twenty-five and single. She's trying to save money and besides, it's such a hassle to park at the hospital where she works as a research assistant administering clinical trials. She sometimes stays late at work, so she never joined a carpool, but she's decided to try the new Ann Arbor/Ypsilanti instant carpool system. She was a little worried about taking rides with strange men, so she set her profile to only accept rides from women, or from men who had a history of giving at least 10 previous rides without any complaints from riders.

She logs onto the website and enters her address and her destination address. She finds that if she walks only to the corner of her current block, she'll have to wait an average of 15 minutes to get a ride, and sometimes much longer, but if she walks two blocks further, to a main street, she can usually get a ride within 3 minutes. She decides to walk the two blocks. This first morning, she's kind of curious about what kind of person picks up riders, so she checks off the box that indicates she's willing to converse the driver.

She's still a little nervous, so she doesn't allow any of her personal information (name, address, or interests) to be revealed to the driver. She's talked to other people who found people to play music with or got a ride all the way home by revealing some information, but she's decided to wait and see how the whole system works first.

As she walks out the door, she calls the number she had pre-programmed into her cell phone. The system tracks her progress as she walks to the main street and tells her that a blue Toyota Matrix is just three blocks away and that she should hold up her instant ride-share sign. It gives her a code that she's supposed to say to the driver, and a code that the driver is supposed to say to her. Sure enough, the car pulls up. The driver is a forty-something woman, smartly dressed with a white lab coat on the passenger seat. They exchange codes and Janine jumps in the back. The driver asks Janine what she does at the hospital and soon they discover that the driver and Janine's boss are good friends from way back, and tells a humorous story about her boss when he was first getting started in medical research. As they pull into a choice parking space at the hospital parking lot, reserved for multiple occupant vehicles, the driver smiles and says, "You saved me 5 minutes driving around and around in this lot. Thanks. Maybe I'll take you again some time, but my schedule's very irregular so I'm not sure when."

"Thank you!" says Janine as they walk off in different directions. As she walks away, she calls the ride sharing system again from her cell phone and presses a button to indicate that she arrived safely, that she would be happy to ride with that driver again, and that she recommends her to other passengers.

Current Status of Instant Ride Sharing

Instant ride sharing, also known as casual car pooling and a variety of other names, is already widespread in a few metropolitan regions. In each case, public policies encouraging multiple-occupancy vehicles were the impetus. For example, on the Bay Bridge connecting San Francisco and Oakland, traffic moves very slowly in rush hour except in the High Occupancy Vehicle (HOV) lane, which can only be used by vehicles with 3 or more occupants (2 for pickup trucks). In addition, HOVs do not pay tolls on the bridge. Just before the bridge, drivers pull of at a bus stop and pick up passengers in order to use the faster, cheaper lane. Similarly, in the DC area drivers (called "body snatchers" in the local lingo) pick up passengers (called "slugs") in order to use HOV lanes on highways. It happens in other cities as well.

To solve the coordination of routes problem, conventions have evolved among drivers and riders for pickup and dropoff points. Often, pickup points are at or near public transportation stops, so that riders can fall back on public transport if there are not enough drivers that day. Commuter parking lots along highways, originally designed to support regular car-pooling (Park 'n' Ride), are also popular pickup points. But sometimes restaurant parking lots are used, or indeed any place with space for cars to pull over that is convenient to an HOV entrance. There are a limited set of destinations and their meaning is well understood (e.g., "Pentagon" means …) so that drivers or riders can hold up signs or call out destinations that frequent participants will understand. Nearby, there

may be separate pickup lines for different destinations. Generally, there is no signage: regular users just know where to go.

Conventions have also developed to address the problems of safety risks and social discomfort. Generally, riders or drivers line up and are matched in order of arrival, but by convention either party can refuse the first rider or driver in line if they feel uncomfortable for any reason. In xxx, riders normally arrange not to leave a lone female rider behind waiting for a ride, allowing her to go ahead of the last male rider if necessary [ref.] To alleviate social discomfort, the illusion of private spaces is generally maintained. Riders are expected not to initiate any conversation, and need not respond to conversational overtures from the driver.

None of the news stories or web sites that I found reported any serious safety incidents such as rape, kidnapping, or murder. The system is not completely successful, however, in preventing unhappy matches. On a DC website, the most common story is a rider's tale of a bad ride: the driver didn't go to the promised destination, drove in an unsafe manner, or left something dirty on the seat that caused the rider's clothes to be ruined. Posted stories involving the breakdown of the illusion of private spaces are generally happier ones: reunions of long-lost friends or finding that driver and rider's high school social networks had significant overlaps.

It is doubtful that transportation planners in these metropolitan areas who wanted to encourage HOVs envisioned the instant matching that is occurring of riders and drivers who did not know each other. In fact, public officials sometimes discourage the practice. The meeting points can create congestion problems and slow down public bus service. Some of the passengers are siphoned off from using (and paying for) public transportation, which hurts the viability of that enterprise. In fact, the term "slug" for people seeking shared rides apparently was first coined by bus drivers who would pull over to pick up apparent bus riders only to be waived on, which they viewed as analogous to a bus rider putting using a fake coin, or slug, instead of paying a fare [ref.]. Police in Houston warn of safety risks from getting in a stranger's car [ref. and quote].

III. Research Agenda

To greatly expand the prospects of instant ride sharing, and to measure its impacts, research on a number of different topics, drawing on expertise from several fields, will be needed.

Location awareness devices

Instant ride sharing today is limited to a few standardized pickup and dropoff locations, as that is the only mechanism available for route coordination. But that severely limits the geographic areas and the set of people who will find it convenient to ride with others. A basic piece of infrastructure for more flexible pickup is for riders and drivers to have devices that can transmit their current location. Cell phone companies may be building this service, though triangulation among cell towers, in order to provide emergency response, or it may be provided through Global Positioning Systems. In order to be

useful, the location information would have to be fairly precise, at least identifying a single city block, for example.

User Interface design

Drivers will need a very convenient interface for specifying their destination and their route options. Riders will need a convenient interface for specifying their starting and ending points, and how much flexibility they have in either (for example, they can walk n blocks from current location in order to be picked up). They will need clear indications of when and where pickups should happen and how to recognize each other. Both drivers and riders will need convenient ways to specify their preferences about what information from their personal profile to reveal to the other party under what conditions. All of this will be especially challenging for drivers, who will have limited attention and limited ability to provide anything other than oral input while driving. A lot of research in user interface design will be needed in order to solve these problems.

Dynamic route matching algorithms

Another research challenge will be to match drivers and riders in real time. Drivers may have some flexibility about routes to take, so that calculating whether a driver and rider can be matched may involve quite complicated algorithms. The window of opportunity for making a match will typically be quite short, on the order of seconds, before a driver will pass the passenger pickup spot.

Algorithms to Estimate time-to-pickup based on historical data

When someone is considering whether to drive or get a ride for a particular trip, it will be useful to them to get an estimate of how long it would normally take to get picked up. Ideally, this estimate would include information not only about the mean waiting time but the distribution as well. If the rider has made the particular trip many times in the past, on the same day of the week at the same time, such summary statistics will be simple to provide. But for new trips, or trips at unusual times for that rider, it will be necessary to analyze logs of what drivers were available on similar days and times in the past.

Safety and Reputation System designs

The basic idea of the safety system will be to authenticate the rider and driver before making the match, so as to provide accountability after the fact, and to monitor arrival at the destination in order to detect an abduction if it occurs. Authentication based on device possession and knowledge of a password or PIN is a standard design. The details of destination monitoring would have to be worked out. One idea would be a protocol where the rider and driver are required to check in at the completion of the ride. If no check in is received, the system would automatically generate a call and, if the correct response were not received, it would notify police. Such a system might generate too many spurious calls to police, however, if device batteries ran down, for example. Further efforts will be needed to design a system that appropriately balances the risks of false alarms and missed incidents.

Far more likely than actual violence is the unpleasant ride. A passenger or driver is rude or hasn't showered recently. The driver doesn't take the rider to the agreed destination. The car makes the passenger dirty or vice versa. In online commerce systems involving strangers, such as eBay's auction system, feedback or reputation systems have proven to be useful, providing information about who to trust, incentives to act in a trustworthy manner [ref. CACM, NBER]. In this case, the system could automatically track some information about participants (e.g., are agreed ride matches carried out?). In addition, riders and drivers could leave feedback about each other after a ride, perhaps as simple as would ride/drive again with this partner, or not. Such feedback can influence not only whether the particular rider and driver are paired again, but also whether others are paired with them. There are many interesting design choices to be explored for a reputation system in this context. For example, reputations may be incorporated into rider matching algorithms in personalized ways: one driver may be willing to go two blocks out of his way to pick up a high reputation rider, but another driver may not.

Demand Estimation Methodology

In some but not all regions it will be cost effective to invest in infrastructure, distribution of devices, and advertising. How will a region decide? An individual's decision to participate in an instant ride-sharing system will depend on how many others are participating. Thus, demand estimation techniques will need to account for the feedback loop created by such network effects. If large-scale experiments are conducted in some regions, it will be important to gather data and develop methods of demand estimation from that data that can then be used in cost-benefit analyses for other regions.

Social capital impacts

One promise of instant ride sharing is the potential it has for creating new social connections. While riders and drivers will not always choose to talk, sometimes they will. System features such as announcing to both parties when there are matching items in their profiles may increase the frequency with which connections are made. This may be one way to compensate for declines in other forms of civic participation documented by Putnam in Bowling Alone [ref. BA]. It may even be a way to create some bridging ties across class, race, and religious lines that are not so likely to be crossed in more traditional forms of civic participation such as club meetings.

An important area of research will be to document whether use of instant ride sharing does create social connections and if so, whether those social connections provide social capital that individuals and the community as a whole can benefit from. For example, do people become more knowledgeable about local civic life? Do they have an enhance sense of community? Do people become more trusting (states where trust is higher do better on a variety of outcome measures such as health, crime, and education [ref. BA]). Do their social networks become more diverse? Survey techniques have been developed for measuring each of these indicators of social capital [e.g., ref. Saguaro community benchmarks; Sampson]. They should be applied to capture whether there are social capital side effects from ride sharing, for drivers, for riders, and even for non-participants.