International Journal of Communication 13(2019), 2793–2810 1932–8036/20190005

Mobile Canvassing: Individual Addressability and the Move Toward Automated Transportation

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This article develops the concept of mobile canvassing as an element in the eventual development of on-call driverless transportation. Mobile canvassing is the use of GPS-enabled smartphones to mediate a two-sided real-time interaction between itinerant actors in a meso-area—that is, the area beyond our ability to actually see another actor but not beyond a distance that can be traversed in a few minutes. The article develops the idea of the smartphone as a "meso-scope" (e.g., a device that gives us an overview of the activities, services, and possibilities that are in our proximate, but also somewhat distant, vicinity). The article examines the need for symmetrical criticality (the development of a critical mass on both sides of the interaction) in this development. Further, the article considers the use of mobile canvassing apps to facilitate the development of autonomous vehicles.

Keywords: itinerant, roving, nomadic, canvassing, smartphones, driverless transportation, meso-scope

Introduction

Aside from hailing a cab as it drives by, or calling a central dispatcher, the negotiation of taxi-based transportation is no longer bound to a specific location, namely the taxi stand. Rather, negotiation for transportation is done via mobile phones using ride-hailing platforms. This means that the riders are no longer bound to the taxi stand just as the taxis are able to seek and find customers from a larger area and find customers who are not necessarily at a recognized collection point (Bialik, Flowers, Fischer-Baum, & Mehta, 2015).

The Role of Fixed Location When Seeking Out Services

In this article, I examine the role of mobile communication in the interaction between those who are seeking and those who are offering geographically dynamic itinerant services using mobile-based canvassing. Mobile canvassing is the use of smartphone-based platforms that mediate real-time contact/interaction between itinerant actors in a two-sided negotiation operating in what can be called a meso-area. In the case of seeking a taxi, this is the space beyond our immediate sight but within a distance

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Date submitted: 2017–10–31

of, for example, 5–10 minutes, during which one actor can move to meet the other. The smartphone-based mediating platforms assume a real-time informational and transactional role in the interaction between the actors. As this framing suggests, this is particularly important when the people who are seeking and/or offering services are itinerant (such as with taxi-based transport). These considerations come into play in the eventual adoption and use of driverless cars, particularly if they are used in a taxi-like system of mobile-phone-based "on-call" driverless transportation devices.

There has been a shift in the ability to locate and book taxis. Until recently, there had been a very real need to establish a designated place where the taxi drivers and customers knew to meet one another. Although it has been possible for drivers and customers to randomly meet ad hoc while the taxis are roving in their immediate area (Townsend, 2000), there is an efficiency associated with the use of geographically fixed taxi stands (Wong, Szeto, & Wong, 2014; Wu, Ng, Krishnaswamy, & Sinha, 2012; Xi et al., 2015). These are often near popular restaurants, shopping centers, or well-visited sections of the city. The specific nature of a formal taxi stand is often subject to regulation[1] both in its location, with regard to the flow of traffic, and in the structure and signage associated with the location.

The taxi stand, as a commonly recognized fixed physical location, has been a nexus between customer and service provider where the purchase/sale of transportation services has been negotiated. In some cases, the driver might not want to drive in the direction requested by the customer—for example, when the driver is nearing the end of a shift and would want to move in a homeward direction. In some developing countries, where the price for a trip is open for negotiation, these dialogs often take place at the taxi stand. In this way, the taxi stand is a type of market. As with many markets (Callon, 1998), the actual transaction often takes place within geographical, cultural, and institutional boundaries. In the case of the taxis, the taxi stand is the geographically fixed element of this phenomenon. Both the customer and the service provider (the taxi driver) need to know where to find one another. This is particularly true when there is no way to extend the search for a cab into one's proximate, but not immediately visible, sphere. In this case, aside from the ability to flag down a driver ad hoc or to call a dispatcher, the taxi stand facilitates the successful functioning of the market.

If the density of eventual riders and taxis is high enough—as, for example, in the central boroughs of New York or central London—there is no need (or space) for taxi stands (Bialik et al., 2015). However, aside from these limited examples, taxi stands are a transportation marketplace where a service is negotiated. Indeed, they fulfill one of the traditional definitions of a market: namely, the public place where people meet to seek and sell goods and services.

Mobile-Based Ride-Hailing

Real-time, location-based technology has changed the process of getting a cab or a ride-hailing service. The geographically fixed system of taxi stands is at the point of becoming outmoded. Mobile-

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[1] See also https://www.lta.gov.sg/content/dam/ltaweb/corp/Industry/files/Attachments%20to%20Section%204.5_Taxi%20Shelter.pdf

mediated systems of hailing taxis or other ride-hailing services operate in one's meso-area. With the use of ride-hailing platforms, the meet-up between the taxi and the passenger can take place without the need for a fixed location. The ability to match drivers with passengers is a boon for people living in suburban locations where there is not necessarily the density of customers that would support a large number of taxi drivers.

The customer's phone provides the driver with his or her current location and desired destination. This allows the customer to avoid the taxi stand queue and also the need to work out whether the driver is willing to drive him or her. In some systems, there is also a ranking function so that the eventual passenger can determine the overall customer satisfaction accorded by the driver. In addition, the payment function of the apps means that there is no need to have cash, and the trip recording function also creates a clear record of the trip, along with the name and telephone number of the driver (if, for example, the rider forgot something).

Meso-Area Mobile Canvassing and the Smartphone as a Meso-Scope

From the perspective of both the drivers and the customers, this mediated form of interaction opens up a new way to assess possibilities. For the riders, it tells them how many cabs (and eventually informal "ride-hailing" based drivers) are available in the proximate vicinity. The drivers have the ability to canvass their local area for customers who are nearby, but not in sight. If, for example, a potential taxi is more than a few minutes distant, the customer can take this information and determine whether it is advantageous to seek out other alternatives.

The GPS functionality of the smartphone bridges the gap between the customer and the driver. This bridging, however, needs to have relatively precise geolocational coordinates. If, for example, the driver is given a location on the opposite side of a structure that blocks his or her vision of the customer, precision has not been adequate. In addition to GPS coordinates, the functioning of these ride-hailing platforms needs to take into consideration the actual visual spheres of both the customer and the service provider. These same issues will be a part of eventual driverless systems.

Abstracting this, ride-hailing platforms allow both actors in this transaction to canvass the possibilities in their immediate vicinity. The nexus has moved from face-to-face communication at, for example, a taxi stand, to interacting via mobile-based apps. Perhaps most important, this mediated interaction broadens the geographic scope into the area that is proximate but still beyond their ability visual sphere (e.g., their meso-scape).

To examine this somewhat more carefully, these services underscore the degree to which the GPS-enabled smartphone has become a platform through which we are able to broaden our sense of the services and possibilities that are available in our general area. The GPS-enabled mobile phone becomes what we might call (with a certain poetic license) a meso-scope. Where the micro-scope gives us a sense of very the small, and a tele-scope gives us the sense of the distant, the GPS-enabled smartphone gives us a sense of the activities, services, and possibilities that are in our proximate but somewhat distant vicinity—in our meso-scape. If, for example, we are in search of a café, a shoe store, or a flower shop, the GPS-enabled smartphone can provide us with that information and indeed guide us to that particular location. The metaphor of the meso-scope, however, is not exact. The notion of “scope” comes from Greek, meaning to look out, often referring to visual information. The sense here is not visual, but rather perceptual. Further, the smartphone facilitates reciprocal location sharing. We can transmit our location to others, just as they can transmit their location to us. I can transmit my location to a taxi, and it can come to me while I follow its progress on my smartphone. With the telescope and microscope, the stars and the amoeba are (it is hoped) not looking back at us. Nonetheless, the metaphor of a meso-scope evokes the idea that we can use the smartphone to gain an overview of a somewhat broader area around us.

Using their smartphones, customers seeking transport can canvass their nearby area for the best offer (perhaps surfing between different apps, e.g., Grab Taxi, Comfort, and Uber in the case of Singapore). Simultaneously, service providers can canvass eventual customers who best fit their needs. In all this, the smartphone affords a systemic integration that brings together the two sides of the exchange. This is different from, for example, de Souza e Silva and Frith’s (2013) notion of spatial trajectories, which carries the sense of using crowdsourced location information as a measure of popularity. There has been business and user-based analysis of ride-hailing apps; such studies include analysis of surge pricing (Castillo, Knoepfle, & Weyl, 2017), the transformation of stakeholder relationships (C. Li & Zhao, 2015), the effect of ride-hailing apps on the broader taxi industry (Y. Li, Xia, & Duan, 2014), and examination of user characteristics (Rayle, Shaheen, Chan, Dai, & Cervero, 2014).

The Goal of the Article

The goal of this article is to provide a conceptual framework with which to examine meso-area mobile-based canvassing when considering the eventual development of driverless cars and other dynamic itinerant, two-sided services. The concept of mobile canvassing is applicable to real-time two-sided interactions between itinerant actors who are proximate although not visually available to one another, but nonetheless connected via mobile-based platforms. In this way, mobile canvassing is a contribution to our understanding of this social phenomenon. The article will first examine the role of mobile telephony and the individual addressability it affords. It will consider this development vis-à-vis taxi-based transportation. There will then be a discussion of two-sided mediated markets and the need for a critical mass of both users and actors offering the service. Finally, these considerations will be examined in the case of autonomous vehicles.

Individual Addressability, Location Mediation, and Symmetrical Criticality

The foundation for mobile canvassing is in the individual accessibility (Ling, 2017a) inherent in the traditional mobile phone. GPS-enabled smartphones are also necessary. Without these two developments, it would not be possible to develop mobile canvassing systems (de Souza e Silva, 2016; Frith, 2015). In addition, there is the need for a critical mass of users to develop. The unique issue in the case of ride-hailing services is that the critical mass must be approximately symmetrical on both sides of the two-sided platform. These issues are discussed next.

Individual Addressability in Mobile Communication

Perhaps the most fundamental transition afforded by mobile phones was that they replaced the geographically fixed landline system with a communication channel that made us available to one another regardless of time or place. This transition changed the way that we organize logistics and interact socially. Indeed, the individual addressability afforded by the mobile phone (and now the smartphone) has enabled the development of dyadic microcoordination (Ling & Yttri, 2002) and, more recently, group-based interaction via apps (Ling & Lai, 2016).

Early versions of mobile telephony facilitated dyadic voice and text communication. Although users had the ability to send out, for example, the same SMS to several different individuals or to have a conference call, these functions were often reserved for the technically astute. The vast bulk of communication was dyadic. In addition, early mobile handsets had only limited functionality beyond their role as a text/voice communication device. There were often "stand-alone" calendars and address lists, and perhaps a calculator, a clock, and simple games, such as Nokia's Snake. Networked services were rarely supported on early mobile communication devices. Starting in the early 2000s, this began to change. The first popularly adopted networked mobile communication services were seen in Japan with DoCoMo's iMode (Agar, 2013; de Souza e Silva, 2016; Frith, 2015; Goggin, 2006). This gave the user access to Web-based services such as email, news, weather, games, and a variety of other cloud-based services. Eventually, the development of the so-called third generation network (3G), and, in 2007, the iPhone, facilitated the development of a broader repertoire of services. The first GPS-enabled phones came as early as 1999,[2] but the first 3G smartphones had only limited location-based functionality. However, GPS soon became a standard function that was further enhanced with the development of location-based apps such as Google Maps (Frith, 2015).

The final element needed for the development of mobile canvassing was the ability to receive and share cloud-based information to distributed users—this again was facilitated by GPS-enabled smartphones. This functionality began to be seen in applications such as the Kenyan crowdsourced application Ushahidi,[3] developed in 2007 to map voter intimidation. It was also seen in the Israeli crowdsourced traffic app Waze,[4] created in 2006. In these applications, individuals can gain an overview of the broader context based on the information pooled in the cloud-based system. Similar functionality is seen in ride-hailing apps such as Uber, Lyft, or Grab, where pooled information from the perspective of both the driver and those seeking a ride from a driver is shared via the app.

Location Mediation

The second element required for the development of a mobile canvassing system is location mediation. This functionality was first done verbally through the use of voice calls and texts. This developed into a one-sided cartel-like system discussed next. With the development of third-generation mobile

[2] See also https://www.gsmarena.com/benefon_esc!-44.php
[3] See also https://www.ushahidi.com/
[4] See also https://www.waze.com/

communication, smartphones, and embedded GPS functionality, this location mediation became automated. This resulted in the two-sided canvassing, examined at the end of this section.

One-Sided Cartel-Based Canvassing

The development of mobile telephony has affected the organization of taxis from early in the commercialization of the devices. Townsend (2000), for example, described the transition away from centrally dispatched taxis in Boston to a more mobile system that was not geographically bound and that enabled a peer-based system of alerting fellow drivers as to where they could find new fares. Although there was still a central dispatching system through which customers could order taxis, the mobile phone allowed a parallel (and informal) system where the drivers were individually available to one another. This meant that drivers could call to other cab drivers (who were often friends) when they saw groups of people in search of a cab. In some cases, they would form a type of syndicate (Ling, Oreglia, Aricat, Panchapakesan, & Lwin, 2015) among themselves to take advantage of the short-term situation. One of Townsend's (2000) informants said,

> Last night, I was driving in Fenway after I drop[ped] off a fare. My friend tells me there are a dozen people standing outside Sofia's. By the time I get there, I am picking up the last ones. None of them ever called the dispatch, but they did not have to wait 10 minutes either. . . . All the cabbies tell each other on the phone. They call their friends and their relatives that drive taxis when there is work. (p. 11)

The circumvention of the central dispatcher (and eventual taxi stands) made the system more efficient. The order for the taxi did not have to go through the central dispatch; instead, it was transmitted in real time to the other drivers. This lowered the response time and provided quicker service to the customers.

The downside was that it was an informal ad hoc cartel among a limited group of drivers. It is an example of a more responsive group of drivers who informally agreed to call one another, exploiting the individual addressability afforded by mobile communication. In this way, they could out-compete the centrally dispatched drivers. The drivers from one family, one neighborhood, or one ethnic group could, in effect, establish a cartel that had an advantage over the other drivers.

In the case described by Townsend (2000), the information on eventual customers was informally pooled. The central dispatcher, whose task it was to dispatch drivers in response to calls from customers, might have had a general sense of where the different drivers were, but there was only loose central control. However, because the situation could be quite dynamic, and there was no platform for the dispatcher that could keep him or her updated on the availability of drivers, the ad hoc system developed among smaller groups of drivers. In addition, the information was only being shared on one side of the market. On their side, the customers were not privy to the relative location/availability of the different drivers.

Two-Sided Canvassing Information

The commercialization of 3G mobile systems and smartphones facilitated the development of cloud-based information on the real-time location of taxis (Virrantaus et al., 2001). It meant that both the individuals offering transportation services and those requesting it were using the same system and had access to mutually useful location information. The role of these service platforms was as a mediator between supply and demand. These ride-sharing services provide tailored information to those offering the transport and those requesting it. They allow both sides of the market to see the potential that is available in their proximate meso-area.

The real-time map in ride-hailing applications means that those who are seeking these services and the proximate providers can, in most cases, locate one another. This development replaced the cartel-like situation described by Townsend (2000) with a system available to all drivers who joined this more formalized approach. On the side of the drivers, this meant that they received information on the location of eventual customers and could choose whether to offer them their service. These real-time systems also can include information on local traffic flow, giving the drivers better insight as to whether it is possible to "bid" on a particular passenger based on the distance from their current location and the eventual traffic flow (Yuan, Zheng, Zhang, & Xie, 2013).

For their part, the customers could also follow on their smartphones the location of cabs/ride-hailing drivers available at any given time. They could track the driver who had offered them a ride and eventually cancel the offer should another, better one become available. Further, the payment for the service could be carried out via the cloud-based system. No cash is involved.

All of this is mediated via the smartphone. The interaction between taxis and the customers is facilitated by a centralized coordination system (e.g., Uber) that allows both partners to canvass a local area and facilitates the offering/providing of transportation. On both sides of the equation, the platform allows a broader overview of the needs/offerings for transportation in a particular area. In the case of taxis and ride-hailing drivers, the system can be calibrated to, for example, only show drivers/customers who are within a 5-minute range. In sum, these mobile-based applications form a real-time two-sided market network (Parker & Van Alstyne, 2005).

The comparison between the previous regime of taxi stands and the newly established regime of app-based systems suggests that app-based canvassing is more efficient than the traditional methods for hailing taxis. According to an analysis by the San Francisco County Transportation Authority (2017), the more direct interaction between drivers and customers had several advantages. According to this report, the app-based transportation companies provide broader coverage because they make obvious the customers, wherever they might be, to drivers in search of fares. In addition, the "out of service" miles (e.g., miles driven without a customer) for the drivers using ride-hailing platforms were half what traditional taxi drivers reported. This means that the drivers were making more efficient use of their driving time, broader coverage was provided, fewer miles were needed to serve the people needing transportation, and finally, there was a consequent reduction in pollution.

Symmetrical Criticality

A third element needed for the development of a mobile-based canvassing system is a "critical mass" of users on both sides of the exchange (Ling & Canright, 2013). Until this develops, a particular platform will only be a niche phenomenon.

If, for example, a driver has the perception that there are not many customers using a particular system, there will be little incentive for adoption. If the driver does not feel that there is a critical mass of users, he or she will not, for example, be willing to purchase the terminals, pay the subscriptions, and go through the process of becoming an active user. Similarly, from their perspective, customers will not adopt a system if they have the perception that no drivers use a particular platform.

Networked technologies have particular dynamics regarding the need for critical mass. In the case of stand-alone technologies, the behavior of other actors does not have a significant influence on our individual adoption decisions. The decision by my colleague or academic collaborator to buy, for example, a refrigerator does not have any significant network externalities associated with my choice of kitchen appliances. By contrast, networked technologies (e.g., fax machines, teleconferencing, email) are useless unless there are others who are also users. In this case, the decision of my colleague or collaborator to choose one type of mediation platform has implications for our mutual ability to work together. Our willingness to adopt networked platforms such as ride-hailing systems relies on our sense that others with whom we are interested in interacting via the platform are also users. We need to have the perception that a certain proportion of our ties are also users (Lim, Choi, & Park, 2003; Ling, 2017b).

The dynamics of networked critical mass are captured in Rogers' (2003) discussion of fax machine adoption in the 1980s. Using the work of Wärneryd and Holmlöv (1990), Rogers noted that the use of fax machines lagged until the late 1980s, when users gained the sense that there was a critical mass of users. Starting in approximately 1987, people began to assume that others had a fax machine. The common assumption emerged that messages could be faxed and that not having a fax machine left one out of the loop (Markus, 1987; Rogers, 2003). This point of adoption constitutes what we might call the preliminary critical mass. At this point, however, the preexisting system often exists in parallel with the newly adopted networked technology. In the case of fax machines, the postal system of paper-based letters still existed in parallel with the newer fax-based system. However, the second waypoint is when the new system becomes structured into interactions to the degree that, both physically and mentally, the previous system is not tenable. Again, using the example of the fax machine, there was the growing assumption that documents need not take several days to transmit through the postal system, but rather a few minutes. The production and distribution of time-critical documents increasingly were arranged according to "fax time," as opposed to "postal time" (Ling, 2017b). A contract needed in a remote office did not need to be sent several days beforehand, but only a short time before it was needed. Thus, the conceptualization of how to transmit documents was increasingly structured in a fax paradigm.

There is an interesting twist to issue of critical mass in two-sided markets, such as is the case with ride-hailing apps. Namely, there are divergent needs for the actors on both sides of the platform. In the words of Evans and Schmalensee (2010), there is the need to "get both sides on board." Customers need to develop the sense that there are enough drivers using platform X to make it worth their while. The decision to download an app, and indeed to begin to use the service, requires that we learn of the service, go through the slightly laborious process of installing the app (including entering credit card information in some cases), and then develop the routines and habits of using the service when we need a ride. The motivation to start using the app may come from advertising or other types of marketing, just as our friends may also recommend that we use the service. Regardless, a central motivation for adoption is undoubtedly the sense that there is an adequate pool of drivers who stand ready to respond to our request. Short of that, there is no reason to become a user.

A parallel process holds for the drivers. To be motivated to clear the various hurdles of becoming a driver for a ride-hailing service (e.g., the driver must have a newer car, insurance, and a driving record free of recent accidents), drivers need to have the impression that adoption will give them access to a pool of customers who are actively using the service.

Interestingly, there is not a specific tipping point; rather, both groups need to mutually perceive that the pool of drivers/customers is nearing or has achieved criticality. In the nascent stages of development, there is often only the perception that it is in place. If this perception gains a position in the mind of the user, he or she will have the sense that there are more drivers available and that this will play through to a shorter waiting time and better service. In a similar way, perception on the part of the drivers (and prospective drivers) that there are many riders will encourage adoption of the system in spite of the barriers to adoption (Parker & Van Alstyne, 2005). The reciprocal perception of a critical mass of users/drivers is essential (Markus, 1987; Shen, Cheung, & Lee, 2013). It is in this way that social practices can shape adoption, and eventually, criticality, of an application (Centola, 2010; Centola & Macy, 2007; Ling, 2017b; Romero, Meeder, & Kleinberg, 2011).

Usually only a few ride-hailing options are available in a given area. These often become the de facto applications. As of this writing, they include, for example, Uber in many locations; Lyft in the United States; Grab in Asia; Didi Chuxing in China, among other places; Go Jek in Indonesia; and (formerly) GoCatch in Australia. This situation is in flux to some degree because of the ebb and flow of regulation, the fortunes of the different platform operators, and the arrival of new entrants. That said, the situation is also likely to jell around a small number of platforms in each location precisely because of the critical mass issue.

Moving to future transportation forms, if driverless cars develop as shared rather than personally owned vehicles, the dispatching of driverless cars using ride-hailing platforms would be the most efficient approach to matching customers with vehicles. In this case, the riders would need to have the sense that there is a critical mass of vehicles available before they choose one or another service. Similarly, the operator of a driverless fleet of vehicles would necessarily calibrate fleet size according to the operator’s sense of the user base; this sense would be supplemented by information on the need for transportation in various quarters of the city based on historical data and the inclusion of irregular events such as large sporting events, concerts, etc.

Driverless Vehicles and Changes in the Social Ecology of Transportation

The Social Ecology of the Driverless Transportation System

The adoption of driverless vehicles will occasion adjustments in the social ecology of the transportation system (Ling, 2012; Stokols, 1992). Indeed, we have seen these transitions before. When thinking of, for example, the shift from horse-based to automobile-based transportation, there was a restructuring of a variety of social institutions. Livery stables morphed into garages and gas stations; parking lots replaced tying rails. The increased speed and radius of the car meant that roads, signage, and maps were developed where none had existed. In addition, new laws, regulatory systems, and forms of insurance were created. Eventually, there were also changes in shopping, housing and work patterns. As the technical system of the car gained purchase in society, it imposed its logic in the form of various social structures.

With the development of ride-hailing platforms and driverless cars, there is also the need to consider the restructuring of transportation's social ecology. For example, the regulation of the taxi industry will be affected (Curtis, 2015). On the one hand, those supporting contemporary regulation suggest that the quality of the service offered by ride-hailing services can be questionable[5] and that it undercuts the ability of licensed drivers to make a living. They suggest that without the guarantee of service quality implied by licensing, riders will pay more, receive poor service, and be at the mercy of nonbonded drivers. Indeed, in some cases, the rise of alternative transportation systems such as Uber has calculatedly been disruptive vis-à-vis existing transportation actors as well as regulators (Dudley, Banister, & Schwanen, 2017; Posen, 2015; Townsend, 2014). Because of issues such as this, ride-hailing systems imply the need for new forms of regulation (Casey & Niblett, 2015). The work done by the San Francisco Land Transportation Authority (2017) indicates, however, that people may vote with their feet and that ride-hailing and, eventually, driverless transportation will make other alternatives obsolete.

The interaction between well-developed ride-hailing services (with or without drivers) and subsidizing of public transportation is another area where there could be adjustments to the social ecology. For fixed rail systems, the sunken investment, their capacity to transport large numbers of people, and the fixity of the routes means that they will likely continue to have a similar role in the transportation ecology for some time. However, the same might not be true of buses and bus routes. For example, driverless, on-call minibuses that can be beckoned by several riders who are moving in a similar direction could represent a fine-tuning of the existing system of fixed-route buses. The use of canvassing-based systems and their eventual use with autonomous vehicles can also be seen in carpooling (e.g., Bla Bla Car[6] and Via[7]) that facilitates transport between, for example, bedroom communities and central business districts. These are often less expensive than individual taxi-like transportation systems because they fulfill the needs of several riders with somewhat different pickup and destination points. They are also more efficient, flexible, and convenient than fixed-route/fixed-schedule buses. Ride-hailing platforms for driverless vehicles could further automate these and increase their efficiency.

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[5] See also http://www.whosdrivingyou.org/history-repeating-itself

[6] See also https://www.blablacar.in/

[7] See also https://ridewithvia.com/

Driverless Transportation Systems

Autonomous vehicles clearly have many advantages. These include the elimination of driver error as a cause of accidents (Bertoncello & Wee, 2015) and the reduction of congestion and pollution (International Transport Forum, 2017).[8] A well-developed driverless system would occasion the reengineering of the road system and a thorough restructuring of the ancillary elements of transportation (e.g., signage, land use, access to commercial locations). One particularly striking adjustment would be the effect on parking. According to Thompson, autonomous vehicles would reduce the need for parking. In the United States, for example, there are about 1 billion parking spaces, about four spaces for every car and truck covering an area approximately the size of Connecticut. Adequate parking is key for shopping malls, workplaces, and suburban homes. "Prowling" for parking in city centers results in excess driving. It is estimated that more than 1.5 million excess kilometers (950,000 excess miles) per year are driven in Westwood Village, California, alone. As many as 75% of all cars on the road in Freiburg, Germany, are simply prowling for parking spaces.[9] Parking is a major investment in time and public resources that could be reduced if autonomous cars could be summoned, as needed, using mobile-based ride-hailing apps (Chester, Horvath, & Madanat, 2011).

While there are many obvious advantages to the development of canvassing-based autonomous vehicles, there are also disadvantages. Liability and the legal framework associated with their adoption is unclear (Fagnant & Kockelman, 2015; Geistfeld, 2017). There would also be the disruption of jobs. There are an estimated 8.7 million trucking-related jobs, in addition to the ancillary industries developed to support truckers (e.g., restaurants, truck stops). It is a relatively easy profession to enter and moderately well paid.[10] Truck and taxi driving jobs have often gone to new immigrants and low-education workers (Thompson, 2016). In some locations, up to 9% of working people operate some vehicle as a central part of their job. Thus, it is the lifeblood of a significant portion of the population. The realignment that will eventually arise from the adoption of autonomous freight vehicles can play through to increased unemployment and social displacement. Poulsen et al. (2016) showed that app-based cabs are already displacing the existing taxi market in New York.

Perhaps not surprisingly, there is wariness among users with regard to the adoption of autonomous vehicles. Indeed, more than half of the respondents in a survey carried out by Gartner[11] said that they would not consider riding in a completely autonomous vehicle. There was the sense that the technology could not handle unexpected situations as well as human operators. The volatile attitude toward driverless cars has been further inflamed in the case of a well-publicized event that appeared to reveal a flaw in the system

[8] See also https://theconversation.com/driverless-cars-will-change-the-way-we-think-of-car-ownership-50125

[9] See also https://www.economist.com/news/leaders/21720281-average-car-moves-just-5-time-improve-cities-focus-other-95-perilous

[10] See also https://medium.com/basic-income/self-driving-trucks-are-going-to-hit-us-like-a-human-driven-truck-b8507d9c5961

[11] See also https://www.gartner.com/newsroom/id/3790963

(Hutchinson, 2016). This can be seen in the press attention afforded to Joshua Brown, who was the first person killed while riding in a driverless Tesla.

Canvassing Apps in the Era of Driverless Vehicles

As with the current ride-hailing systems, in a world of driverless vehicles, customers in need of a ride would be able to find a driverless transportation alternative (perhaps a taxi, a shared ride, a minibus, etc.) using a canvassing platform. The development of integrated transport-hailing platforms is also possible. In this case, rather than directly dealing with one or another ride-hailing platform, the customer would subscribe to an "agent" platform that would have a record of the individual's preferences (e.g., whether to carpool, whether to a stop at a drive-through coffee shop). It could determine the current location and the destination of the customer, and, based on this, the agent would canvass the area to find the offer that best matches the needs of the customer. One day it might be Driverless Taxi Company A, and the next day, because of high traffic, the customer may need to compromise on some of his or her criteria—for example, including second riders and taking Mini-Bus B.

One can also imagine the development of canvassing platforms that would, in effect, allow customers to bid on the possible taxis. In this case, during peak demand periods, a customer (or his or her canvassing agent) might bid on driverless taxis with particular characteristics. Bids would be placed by several potential customers for the transport offering that was the fastest, the best appointed, etc. The opposite is also possible, whereby the organizations offering the rides would bid on the most attractive customers.

In the current system of ride-hailing platforms, the driver has a role in determining whether he or she is interested in a particular customer. With the move to fleets of driverless vehicles, this decision making would become the prerogative of the fleet operator. From this perspective, algorithms could be used to weigh the profitability of particular customers against other possible fares. If the customer, for example, was a "bonus member," then he or she might receive preference. If, however, the customer had a poor payment record, had a legacy of ordering and then canceling rides, lived in a dodgy part of town, or was requesting a difficult route with little payoff, the algorithm could put the request lower in the queue in favor of other possibilities.

Such potential developments would become the gist of regulatory activity. Would there be a type of customer neutrality as a part of the regulatory regime, or could there be algorithmic biases in the ride-hailing platforms that would augur in the direction of fleet profitability? Could fleet operators "red line" portions of a city in their platforms if they are less profitable or riskier? To what degree are such driverless ride-hailing platforms public services, and to what degree are they profit-driven enterprises? Is it a good idea to have surge pricing?[12] The development of algorithmically driven ride-hailing platforms would sharpen this question in a way that has not been possible heretofore.

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[12] See also https://medium.freecodecamp.org/how-uber-was-made-da3c631066d0

Even if future driverless systems develop using the personally owned approach that is currently common, canvassing systems would still have a role. One can imagine that after our private car has delivered us to, for example, work, it will need to find a parking location. In this case, the car could canvass nearby parking spaces that need not be immediately outside the building. This is, in effect, the car canvassing the meso-scape. When we need the car again, we could summon it from its parking location. Similarly, it would be possible to rent out the extra capacity of a privately owned driverless car.

Conclusion

This article has developed the concept of real-time mobile canvassing—that is, the two-sided negotiation of transportation between itinerant actors in a meso-area—and considered it vis-à-vis driverless cars. The use of mobile communication to organize personal transportation has already disrupted the traditional system of taxi procurement. The point of this article has been to think through the conceptual issues associated with the development of meso-area mobile-based canvassing. The development of these ride-hailing platforms has required mobile-based individual addressability, location-based functionality, and cloud-based platforms with which to mediate the interaction between actors on both sides of a real-time two-sided market. Finally, there has been the need for symmetrical criticality among drivers and customers. In the case of two-sided platforms such as those discussed here, criticality becomes more complex than with systems such as traditional networked technologies—including fax, teleconferencing, and email—because each side of the interaction has somewhat different needs.

In these developments, the smartphone is a key link for both the customer and the taxi driver. It functions as a type of meso-scope, allowing both sides of the interaction an extended view of their proximate space. Indeed, it expedites the connection between the two parties. In addition, it allows for the development of mediating platforms through which the negotiation of rides can take place. As noted, the need for a physical space in which to negotiate a ride (taxi stand, street-side hailing) has been couped by the new platforms.

Canvassing systems will be a part of the coming fleets of driverless taxis. Customers may use some type of transportation agent platform that seeks out the best alternative in a given situation. On the side of fleet operators, there may be the algorithmic systems that are tuned to ensure profitability but may privilege certain customers over others. Clearly, there are policy and regulatory issues in these developments.

Interestingly, the notion of mobile canvassing can also be applied to other domains where there are itinerant actors using smartphone-mediated interaction. In the area of transportation, it is possible to see, for example, the use of mobile canvassing in the organization of freight transportation for traditional long-haul freight (e.g., Cargomatic, Truckloads, Convoy, Transfix and Uber Freight) and for smaller scale local transport (Buddytruck, Lugg, Deliv, Dolly, Roadie, On My Way, and Postmates). There are even nascent "driverless" freight transport systems such as Dispatch,[13] a "last mile" delivery system for smaller packages.

[13] See also https://techcrunch.com/2016/04/06/self-driving-delivery-vehicle-startup-dispatch-raises-2-million-seed-round-led-by-andreessen-horowitz/

Mobile canvassing can be seen in the development of so-called dockless bicycle sharing, where the person in need of a bicycle can use an app to canvass his or her local area for available bicycles and eventually reserve one for a short period while walking to the bike. Interestingly, the notion of mobile canvassing-apps can also be applied to dating apps such as Tinder, Bumble, and Grindr (Frith, 2015; Licoppe, Rivière, & Morel, 2016). Indeed, as with ride-hailing platforms, dating apps facilitate real-time mobile canvassing for two-sided negotiations between proximate itinerant actors. The issues of the symmetrical critical mass and locating the other actor in a meso-scape are similar for both Uber and Tinder.

We are on the cusp of a new transportation era. The current transportation system arose from city planning that was oriented toward steam trains for longer distances and horses to cover shorter distances. The automobile era saw the rise of limited access highways, suburbs, and parking lots. The era of driverless transportation, organized using various types of canvassing platforms, will also see the transition of how we transport ourselves. The notion of mobile canvassing platforms provides a way to conceptualize the nexus between the customer and current and future transportation systems.

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