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Can Ridesharing Help the Disadvantaged Get Moving?

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FINAL RESEARCH REPORT

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Introduction

In many cities and towns throughout the United States, citizens with lower levels of education and skill confront challenges when seeking employment. The jobs best suited for their skills may be located in a different part of the metro area from their homes, and the existing public transportation system may not provide them with a practical way of interviewing for these jobs or commuting to them on a long-term basis. The rapid rise of ride sharing services, like Uber and Lyft, may provide a new opportunity to address these longstanding needs in a more cost-effective way. To examine the effectiveness of this new technology in expanding the mobility of citizens with special transportation needs, the PI is engaged in a multi-year effort to combine a large-scale field experiment with sophisticated data analysis to evaluate the impact of ridesharing on individual mobility, employment outcomes, and access to training and social services. Project #170 funded efforts to develop smartphone applications and an information system that could enable such a field experiment and then field-tested them with a small group of individuals from the target population. These efforts were successful, enabling us to scale-up to full-scale field experiment over the next several months.

Study Justification: Transportation Frictions and Low Incomes

The labor force participation rate in the United States among the poorly educated is very low. For adults aged 25 and over, it is less than 60% among those with a high school degree, and less than 50% among those without a high school education. One contributing factor to low participation in the labor market is relatively high transportation costs. At least since the classic work of Oi (1976), economists have understood that labor force participation can be sensitive to quasi-fixed costs, such as transportation costs, and there is a small but important empirical literature reinforcing this idea. However, this is a literature with many open questions. Researchers seeking to estimate a causal impact of transportation costs on labor supply face a daunting challenge. The ideal empirical design would be a quasi-experiment in which transportation costs decline for some (treatment) individuals, while remaining fixed for other (control) individuals, and while holding all other factors fixed. As a counter-example, consider an investment in a city's public transportation system. It is likely that the investment will reduce transportation costs more in some neighborhoods than in other neighborhoods, but because of equilibrium effects, many of which are anticipated, it is exceedingly difficult to tease out the causal impact of the change in transportation costs on labor supply. For instance, property values of homes near new convenient transportation hubs will likely increase, perhaps even before the completion of the new transportation project, as individuals with a high propensity to work relocate to those locations.

As is emphasized in the expansive and longstanding "spatial mismatch" literature, transportation costs are likely to be particularly burdensome for lower-paid poorly-educated workers, because these individuals often cannot afford housing near job opportunities. Prior research suggests this burden is likely to be especially intense for lower-income mothers with children at home, for whom the opportunity cost of time in transit may be especially high, given their parental responsibilities. For these individuals in particular, then, it seems likely that an exogenous decline in transportation costs might increase labor force participation.

Against this backdrop, we seek to conduct a field experiment of moderate duration (6 months), in which we reduce the transportation cost for a treatment group, and compare labor force outcomes to a control group. In our proposed experiment, the reduction in transportation cost will be implemented via an innovative treatment that has high potential policy relevance—the provision of services from a ride-hailing service, Uber. We are excited by this particular intervention because of the possibility that future directions in public urban transportation may include technology-enabled individualized transportation services as an integral part of a broader transportation system—possibly a system that integrates smaller shared cars or vans (even small self-driving vehicles) into a public transportation system that will also continue to rely on traditional rail and bus lines.

Research Design for a Field Experiment

Our eventual goal is to recruit 650 mothers into the study—325 into the treatment group and 325 into the control group. To be included in the study, the subjects must have a smartphone and lack regular access to a car.

In our full scale study, “treatment” will be a six-month intervention, as follows: Individuals will be set up with an Uber account. In Month 1 of the study individuals will be provided with $200 of ride-hailing credits, and will be told that these credits are intended “to help with job interviews, if you are looking for a new job or looking to change your job, and to help with transportation to work.” In Months 2-6, individuals will continue to receive the $200 credits. Notice that this design is intended to mimic a policy intervention that specifically reduces the quasi-fixed transportation component for workers. Obviously, $200 per month would not be sufficient to offset the full cost of a long-distance daily commute that relied solely on Uber, but it would allow participants to supplement mass transit services with “first mile / last mile” transportation, and could also provide our participants with an alternative to mass transit or carpooling on days when time was short, the bus was running late, or typical carpooling arrangements were not feasible. In short it would provide substantial increased flexibility, which we hypothesize might be very valuable for these workers. A transit search app, described below, will facilitate the ability of our participants to combine ride-hailing and other transportation options.

A job-search “tool” will be made available. This tool, accessible from a smartphone or a laptop, will link individuals to free services available to job seekers in the Pittsburgh area through Careerlink, a state-run program designed to connect job seekers to open jobs, thereby providing modest assistance to individuals seeking to find a job or move to a new job. An app will be installed on smartphones that will allow us to conduct a very short monthly survey in which we ask about labor market activity—hours worked, wages, commute times, and job search activities. Individuals will receive $10 per month (in the form of an electronic transfer to a pre-paid card) for survey completion. The same mobile app will also allow us to track locations via GPS. This is an important and innovative feature of our study. The tracker provides location data at 8-15 minute intervals, which gives us a means of verifying self-reports about employment and transportation times. The same mobile app also provides a transit-search tool that will enable our participants to make the most of their access to free ride-hailing by combining it with other transportation options. This novel component of our app will make it possible for our study participants to search for all possible transit options, including mass transit (bus/subway), ride-hailing (Uber), biking, walking, or any mixed combination of these transit options, between two geographic locations. The transit search tool will make it easier for participants venturing outside their neighborhoods to combine an Uber ride with mass transit or other options, getting much farther on their limited monthly allocation of ride-hailing credits.

Individuals randomly assigned to the control group will receive the same benefits as the treatment group, except they will not be provided transportation assistance in Months 2 through 6.

Successful Systems Development to Support the Field Experiment

As envisioned above, the field experiment requires the creation of a project-specific information system to manage enrollment, track location, and communicate with project participations. It also requires the development of a suite of smartphone apps, engineered for both the iPhone and Android phones, can fulfill the functions described above.

To accomplish this, a group of research assistants were hired to undertake this development process under the supervision of co-PI Beibei Li, an associate professor of information systems and management at CMU's Heinz College. This group included Xuechun Luo, Thamar Bailey, Saumya Lahera, Simran Handa, Mengjia Ren, Ria Maheshwari, and Harshal Parekh. Over the course of several months, the research team produced an iPhone app and an Android app with the necessary features and was able to get each app approved for distribution via Apples' "App Store" the "Google Play" website, respectively. The apps were tested and integrated with a cloud-based information system that ensures reliable communication and location tracking.

Successful Roll-Out of a Pilot Study

After initial testing, a small group of eligible mothers in Allegheny County was invited to participate in the study, in order to ensure that our systems worked reliably under field conditions. This pilot study began in September, with initial enrollments in October.

Successful deployment of our system on a small scale over the past 3+ months shows that our participants are able to successfully hail Uber rides, charge those rides to our study, respond to surveys, and use the other features of our smartphone "apps." We have also demonstrated our ability to track the mobility of our participants reliably and securely. Based on successful development and field-testing, we are now ready to scale-up our study over the next several months.

Early Results: The Impact on Participant Mobility

The very small sample of participating mothers and the short duration of our pilot study so far make it effectively impossible to come to any determination about the impact of our mobility intervention on income, employment, or other longer-term socioeconomic outcomes. However, the high frequency with which we have collected GPS data makes it possible for us to detect an impact of our intervention on mobility.

As we enroll women in our study, we first induct them into a "trail group," in which they are given a nominal amount of ridesharing credits. During this period, we collect GPS data and ask the new participants to make sure they can actually hail an Uber using our system. Once this is demonstrated to be the case, we move them into the appropriate control or treatment condition. This means that we observe individuals before and after they receive their $200 in credits, and we can compare individuals in the treatment and control groups, in terms of their mobility. For our longer-term study to have any validity, it should be the case that induction into our study enhances mobility. This is, in fact, the case.

The rapidly developing literature on mobility, based on GPS data from smartphones, has begun to identify a standard set of mobility metrics. A brief explanatory table, shown below, illustrates and defines some of the most frequently used and popular of these metrics.

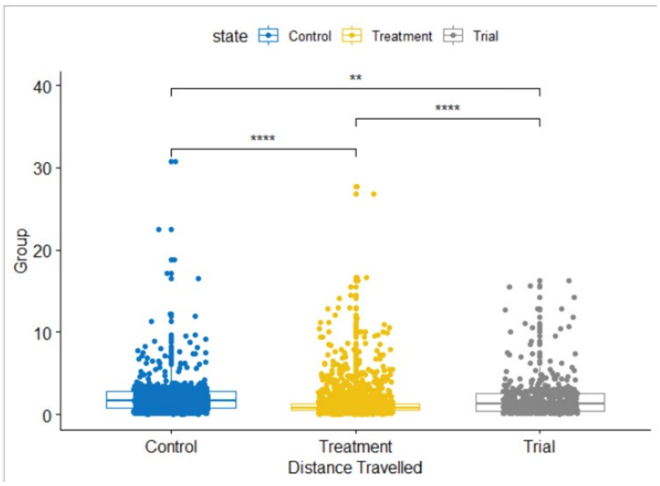
Table 1 Common Mobility Metrics

Feature	Description
total_locations	Total number of locations for a mom.
total_ulocations	Total number of unique locations for a mom.
average_distance	Distance travelled by a consumer to visit locations
average_dwell	Time spent at locations by a mom.
max_distance (Williams et al. 2015)	Maximum distance travelled by a mom.
freq_rog, time_rog, dist_rog (Gonzalez et al. 2008)	Radius of gyrations is the characteristic distance traveled by an individual. $rog_i = \sqrt{\frac{1}{\lvert T_i \rvert} \sum_{j=1}^{\lvert T_i \rvert} w_{ij}(l_{ij} - l^i_{cm})^2}$ $l^i_{cm} = \frac{1}{\lvert T_i \rvert} \sum_{j=1}^{j=\lvert T_i \rvert} l_{ij}$, l_{ij} are the geographical coordinates l^i_{cm} is the center of mass of the consumer w_{ij} are weights obtained based on frequency, time & distance w.r.t to l_{ij}
freq_entropy, time_entropy, dist_entropy (Eagle and Pentland 2009)	Mobility entropy measures the predictability of consumer trajectory. $E_i = -\sum_{j=1}^{\lvert T_i \rvert} p_{ij} log_2 p_{ij}$, p_{ij} computed from w_{ij} for time, frequency & distance.

With the granularity and accuracy of GPS data being transmitted to our information system, we can actually measure and compare these statistics across time, individuals, and study conditions.

For instance, for illustrative purposes, we can compare average distance traveled for all individuals in the treatment and control groups. Results show statistically significant differences between these groups, even though the sample size in terms of enrolled participants remains very small.

Figure 1 Differences in Distance Travelled



In results we do not show here (in order to safeguard the privacy of our participants), we can also see the mobility metrics of particular individuals shift as they move from the trial group to the treatment or control groups.

The Next Stage: Recruitment for the Full-Scale Field Experiment

Having developed and field-tested our systems, we now look forward to inducting a much larger number of participants, with the support of our research partners at the Allegheny County Department of Human Services (DHS), which has built an impressive database on county residents that can help us identify eligible participants. DHS has access to Allegheny County birth records that will allow us to identify mothers whose children are in the appropriate age range (under 18) at the time of our study's inception. DHS can match these data to current addresses, phone numbers, and email addresses. DHS already has detailed information on the degree to which neighborhoods in the county are served by public transportation, providing us with the ability to oversample poor neighborhoods that have limited access to bus and rail lines. Thanks to a data cooperation agreement with Commonwealth of Pennsylvania's Department of Labor and Industry, DHS can also match in state administrative records on hours and wages from the unemployment insurance system, providing us with a direct measure of poverty. DHS can supplement these already-rich data with information on receipt of TANF. Using all these data, we will identify a stratified random sample of poor mothers in our region, and DHS can use email contact information to inform these women of our study. Screening and randomization can be done via a website to expedite the efficiency of the recruitment process (with a phone-based screening for those who prefer that option). Our ultimate goal is to recruit 650 women into the study—325 into the treatment group and 325 into the control group. This will likely be done in phases (i.e., replicate groups) of about 50-100 per month.