Understanding the Impact of New Service Features on Ridesharing Uptake in Emerging Markets: A Case Study of Israel.

Dr. Adam Weiss[1]

Aymeric Punel[2]

Jason Soria[2]

Dr. Eran Ben Elia[3]

Prof. Yoram Shiftan[1]

Prof. Amanda Stathopoulos[2]

[1] Faculty of Civil and Environmental Engineering, the Technion, Israel.
[2] Department of Civil and Environmental Engineering, Northwestern University
[3] Department of Geography and Environmental Development, Ben-Gurion University of the Negev, Israel.

Motivation

New mobility on-demand shared (MODS) services like Uber, Lyft, Chariot and Via are growing worldwide. There has been considerable focus on understanding what the impact of these services is on travel behaviour and what factors influence travelers to use these services over conventional modality options (e.g. Dias et al. 2017). These services are constantly evolving to allow new solutions for sharing, on-demand scheduling and digitization (Wong et al. 2017). with this growth and service differentiation, further segmentations of level of services is also expected to offer tailored pricing for different segments of the population with regards to their willingness to pay and trade-off of various characteristics of the service. In recent years MODS services are transitioning into service models that are a hybrid between transit and door-to-door ride-hailing. The new generation of services require customers to share their ride with more users, walk to a pick-up location, schedule the service ahead of time and potentially travel for longer due to multi-customer pick-ups. This reorganization requires operators to strike a balance between customer expectations for door-to-door services and the operational changes.

From the service providers' point of view, having an advanced reservation system enables better planning and scheduling of trip routing. This promises more efficient and price-competitive services for the users. Asking passengers to walk a few minutes to a more "on the route" pick-up point can further make the service more efficient and quicker, while simultaneously decreasing the 'door-to-door' service, creating a middle ground between conventional MODS and transit. These changes to the service provision will allow MODS service providers to reduce costs, which can then be passed on to the users as a means of compensating for the inconvenience of

pre-booking or walking to a more route-efficient pick up point. Important societal mobility questions have remained unanswered, including mapping out the acceptance of new MODS-Transit hybrid services, the optimal operations and behavioral frameworks, and the competition and ultimately the impact of these novel options on the overall mobility systems.

Research Question

How consumers will react to evolving MODS services is not yet well understood. Further systematic investigation of consumer choices is of outmost importance to explore mode substitution, future MODS-Transit collaboration, and for understanding how new services attributes will impact our transportation systems moving forward.

This paper focuses on customers' willingness to adopt a new MODS service in Israel. The analysis focuses on adoption as a function of the main emerging service elements that have not been explored systematically in the literature so far. Two shared ride options are presented to car-commuting respondents to examine the compensation between different levels of service in terms of reservations, sharing with others and walking/waiting time to pick-up points. The services are designed to trade off lowered attribute standards for lower prices, to pinpoint important measures of acceptance-of sharing and reaching a nearby pickup point. The paper presents the analysis of a preliminary study looking at the competition between MODS services and single occupancy vehicle (SOV) travel. The results of this analysis provide key insights into the tradeoffs travelers make between these alternatives and assists in the development of plans to collect further data based on the initial results from the preliminary data with a focus on the competition between traditional transit and MODS paratransit type services.

Experimental design, social orientation, certainty and attitudes

The initial survey presents a pivoted stated preference survey of shared ride-sourcing mobility services, relative to the current commute, with the service characteristics presented in Table 1.

Table 1. Overview of SP Attributes and Levels

	Current commute	**Shared ride**	**Shared ride Van**
Cost of one-way commute (per day)	**Reported [input] inc. parking**	**-10/-20/-30% relative to recorded input from RP**	**-15/-30/-45% relative to recorded input from RP**
Duration of one-way commute	**Reported [input]**	**-5%/+0/+10% relative to recorded input from RP**	**+0/+10/+20% relative to recorded input from RP**
Vehicle capacity	**As current**	**SUV shared with 1-2 others / 3-4 others**	**Van shared with 1-2 others / 3-4 others / 5-10 others**
Reservation in advance	**No reservation**	**up to 30 min before/ less than 15 min before departure**	**up to 30 min before / less than 15 min before departure**
Maximum waiting time for pick up.	**No waiting**	**1-5 min / 5-10 min**	**1-5 min / 5-10 min**
Walking to pickup	**As current**	**No walking / 5 min**	**No walking / 5 min**

		walk / 10 min walk	**walk / 10 min walk**
Wifi on-board	**Not applicable**	**Yes / no**	**Yes / no**
1. Which option will you choose for your next commute?		[ ]	[ ]
2. How certain are you about your choice		1 unsure to 10 completely sure	1 unsure to 10 completely sure
3. Which options do you find acceptable?		Tick	Tick

In each of the stated preference questions the respondent can choose between their current commute (in a private car), travelling in a rideshare service in a family car/SUV with up to 4 passengers, or take a rideshare service in a van with up to 10 passengers (analogous to the shared van rides offered by the ride share company Via). From a policy perspective, the societal benefit of these ride share services will be maximized if SOV commuting will be replaced by shared rides. This shift away from SOV trips to shared ride trips will increase the average vehicle occupancy, the survey only targets car drivers living in the Tel Aviv Metropolitan Area who drive to work (or another major activity) at least 3 times a week and more than 10 minutes per direction). The choice scenarios are followed up with a question to examine how confident the respondent is about his/her reply and which option(s) they are willing to consider. These types of questions allow for parametrization of the scale in the discrete choice model based on certainty and the modelling the choice set formation process. The survey also includes attitudinal questions related to time management styles (e.g. promptness vs. spontaneity) as well as attitudes towards shared economy values more generally. We also measure the Social Value Orientation index (the propensity to share potential gains; Murphy et al., 2011) and the inclusion of Other in the Self (IOS) Scale (as a measure of closeness; Aron et al., 1992). An initial internet panel survey was distributed in Israel during February of 2018, collecting 302 usable responses.

Exploratory analysis

The collected data set contains a rich and significant amount of information. A subsection of the data has been used to understand factors influencing choice certainty (Soria et al. 2019). This short paper will focus instead on the analysis of the behavioral modal choices from the collected SP data. The modelling results use a multinomial logit structure from the collected survey data presented in table 2. While various model formulations were explored, this is the structure that provided the best overall fit to the data with reasonable variable statistical significance.

Table 2: Preliminary Model Results

Name	Value	Std err	t-test
ASCs			
Car	0	---	---
Rideshare (family car)	-1.71	0.338	-5.06
Shuttle (Van)	-1.13	0.361	-3.14
Time and Costs			
Rideshare Cost	-0.0281	0.00595	-4.73

Shuttle Cost	-0.0341	0.00739	-4.62
In Vehicle Time Car	-0.0113	0.00459	-2.45
In Vehicle Time Rideshare and Shuttle Interacted with Male Dummy	-0.0156	0.00337	-4.63
Wait Time Shuttle	-0.0537	0.0194	-2.77
Walk Time Rideshare and Shuttle Interacted with Male Dummy	0.511	0.122	4.20
Other Service Features			
Dummy for Rideshare Sharing with 1 Or 2 Other Travellers	-0.275	0.139	-1.97
Dummy for Shuttle Sharing with 3 Or 4 Other Travellers	0.390	0.177	2.20
Dummy for Shortest Booking Time for Rideshare and Shuttle	-0.0026	0.00098	-2.68
Dummy for Wifi on Rideshare	0.213	0.101	2.10
Socio-demographics			
Low Income Dummy Variable for Rideshare and Shuttle	0.270	0.134	2.01
Medium income Dummy Variable for Rideshare and Shuttle	-0.332	0.129	-2.6
Male Dummy Variable for Rideshare	0.493	0.151	3.26
Age Less Than 44 Dummy Variable for Rideshare and Shuttle	0.265	0.134	1.98
Dummy Variable for Being Born in Israel for Shuttle	0.418	0.17	2.46
Lives in Tel Aviv (core) Dummy Variable for Rideshare	0.336	0.144	2.33
Dummy for If Transit Takes Under 30 Minutes for Rideshare and Shuttle	0.433	0.19	2.28
Dummy Variable for Highly Educated for Rideshare	0.382	0.173	2.21
Attitudinal			
Pro Social Attitude	0.268	0.12	2.23
Religious Traditional for Rideshare	-0.397	0.19	-2.1
Started Driving Less to Work in The Past Year for Shuttle	-0.649	0.289	-2.3
Had A Child in The Last Year for Rideshare	0.426	0.169	2.52
Maximum Travel Time Respondent Would Be Willing to Use a Ride Hail Service for Both Shuttle and Rideshare	-0.889	0.142	-6.3
Dummy for Flexible to End Work Day Early for Rideshare	-0.990	0.355	-2.8
Dummy for Flexible to End Work Day Late for Rideshare and Shuttle	0.372	0.139	2.69
Dummy for Flexible to Start Work Day Early for Shuttle	0.649	0.194	3.35
Dummy for Planning to Change Home or Work Location in the Next Year Rideshare	0.268	0.137	1.95
Dummy for Planning to Have a Child in the Next Year for Rideshare and Shuttle	-0.358	0.146	-2.5
Inclusion of Other in Self Metric Rideshare	0.111	0.0392	2.83
Inclusion of Other in Self Metric Shuttle	0.0795	0.0363	2.19
Overall Goodness of fit (Rho Squared)	0.204		
Overall Goodness of fit (Adjusted Rho Squared)	0.187		

In general, this model provides reasonable parameter significance and relative magnitude. As expected, cost sensitivity is higher for the shuttle, suggesting that these services may be more attractive to lower income individuals. The dummy variables for higher transit accessibility to work, living in the more urban Tel Aviv core, being under the age of 44 and being highly

educated are all key factors influencing the willingness to adopt these new mobility services. Furthermore, the inclusion of the attitudinal variables provides some preliminary insights into the level of flexibility and how this impacts the choice to use MODS services, suggesting further investigation into how activity scheduling flexibility influences the use of ride share services.

It should be noted that this model is limited in several key ways. In vehicle and walk travel time for the ride hailing services (both shared car and the shuttle) is interacted with a male gender dummy variable. This was done as including this variable without interaction resulted in an insignificant and positive coefficient estimate for travel time variables. More generally, many of the other attributes included in the SP design were only significant with the interaction and inclusion of socio demographic variables and attitudinal responses. Service attributes are not significant across both ride hailing modal options. The coefficient for the shortest pre-booking time has a counter intuitive sign (negative relative to a longer pre-book in advance time) though relatively low magnitude relative to the other dummies suggesting minimal impact on the overall attractiveness of this feature on the travelers decision. These limitations present significant motivation for further data collection moving forward.

Revised exploration: Micro-transit analysis

Based on the results of the analysis presented above, our research agenda moving forward aims to expand on the results of the analysis. In order to obtain a more complete understanding of MODS services in the Israeli context we plan to collect more data that will provide further context to the results collected thus far.

Competition with Public Transit
The original case study was developed to provide insight into the positive aspects that MODS services might have by examining current driver's propensity to switch from driving trips to MODS trips. Conversely, there is evidence that these new MODS services may also attract current transit users, and as a result will have an undesired negative impact on transit modal share. As we are anticipating collecting a larger sample for this stage of the project, we aim to include both drivers and transit users in the new survey. This will provide us with greater insight into both the positive (reduction of SOV modal share) and negative (reduction of transit modal share) impacts that MODS services may have.

Changing MODS Service Attributes
Based on the analysis done thus far, we have chosen to remove the wifi variable from the new design due to the prevalence of affordable mobile phone data plans. We replace this variable with an attribute for a designated pick up area with a shelter versus a designated pick up area with no shelter. We are also adding in a context related question regarding the importance of timely arrival to one's destination at the start of each SP scenario (important to arrive on time versus flexible arrival time). These changes will provide greater insight into the importance of flexibility on the decision to adopt MODS services while gaining greater insight into the factors service providers can implement to improve their attractiveness.

Experimental Design Upgrade

We have chosen to move towards a Bayesian efficient design technique as suggested by Walker et al. (2018), who recommend using wide parameter distributions to control for uncertainty associated with prior parameter estimates. We have chosen to forgo using the priors from the model in Table 2 due to challenges with the large number of socio demographics and interactions required for parameter significance. In their place we have chosen to use a naïve Bayesian efficient design approach with wide distributions and assumed parameter signs and relative magnitudes. This decision is supported by the introduction of transit as we do not have priors for time and cost for this mode. The same is true for the inclusion of new MODS service attributes.

Beyond these plans, the rich information gathered in the survey underpins two main modelling efforts. Firstly, willingness to adopt analysis will use segmentation via the hybrid discrete choice framework. The analysis focuses on how time management and other factors drive preference for new MODS features such as scheduling. Second, an analysis of willingness-to-consider a mobility option will be carried out. This analysis focuses on identifying the features serving as filters in the consideration process (e.g. walking to a pick-up point may be a significant filter for a user with low sharing system values). Third, we are hopeful that we can apply similar surveys to other international contexts, focusing on regions where MODS services are more mature and firmly part of the transportation ecosystem. By comparing the results from the initial study in Israel to the new data collected elsewhere, we will study the impact of cultural differences, familiarity with the mobility technology and stated certainty on the choice and consideration processes.

Contribution summary

MODS services are readily available across the world, though in many markets these services have not yet been introduced due to regulation and legislation blocking their operation for a variety of reasons. As these services grow more popular, their deployment will grow more wide spread. By focusing on a market where these services have yet to be widely deployed, the proposed analysis aims to gain an understanding of how these services will impact travel patterns in early phases of adoption. This provides an opportunity to gain insight into what the potential impacts of these services will be when they are allowed into the market place. From a policy perspective, these insights may allow policy makers to better control the introduction of these services in a way that will maximize positive policy benefits.

The main contribution of the paper is that it examines several frontier features and model perspectives related to a new generation of MODS services. These feature more options for sharing, scheduling and pricing that balances the convenience of the operator with preferences of the consumer. This will enrich earlier efforts to study demand for innovative shared services (e.g. Al-Ayyah 2016, Kruger 2016, Clewlow & Mishra 2017, Shaheen et al. 2017). This analysis from the full dataset will provide policy makers and potential providers with tools to evaluate the demand for such on-demand services and tailor the novel features of these services to the needs of the consumers.

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