A Study of Travel Behaviour of Transportation Disadvantaged In Montreal

Murtaza Haider, Ph.D.
Wing Sze Siu
Rahel Merissa

McGill

SALUTE systematic analysis of land-use transportation & equity

Outline

- Acknowledgements
- Why equity matters?
- Interactions between poverty, disability, safety, ageing, and racial disadvantages
- Theoretical background
- Descriptive analysis of travel behaviour of elderly and women in Montreal
- Econometric models of travel behaviour
- Summary of Findings

McGill
SALUTE systematic analysis of land-use transportation & equity

SSHRC's MCRI: Equity of Accessibility

- Access to activities and services in Urban Canada: Behavioural processes that condition equity and sustainability
  - PI: Martin Lee-Gosselin (Université Laval)
- This project focuses on identifying and assessing the mobility needs of transportation disadvantaged groups and to propose measures to improve accessibility of individuals whose mobility options are limited due to age, gender, physical or mental handicap, income or other resource constraints.
- In addition, this project critically evaluates the current data collection methods and travel demand modelling/urban simulation techniques for their ability to assess the needs of transportation disadvantaged groups.

McGill
SALUTE systematic analysis of land-use transportation & equity

Why Equity Matters?

- The role of an urban transportation system is to serve the mobility needs of all segments of the society and to help achieve socially desirable land uses.
  - This also includes fulfilling the needs of those segments of the society whose mobility choices (in terms of modes, routes, and destinations) are constrained. Similarly, the role of public transit is to provide a viable alternative to personal motorised travel for ALL.

McGill
SALUTE systematic analysis of land-use transportation & equity

Why Equity Matters?

- When the existing transportation infrastructure, and the services it provides, does not fulfil the mobility needs of all segments of the society, the principles of equity and justice are violated.
- Thus there arises the need to provide new transportation infrastructure and services to help those who are transportation disadvantaged.

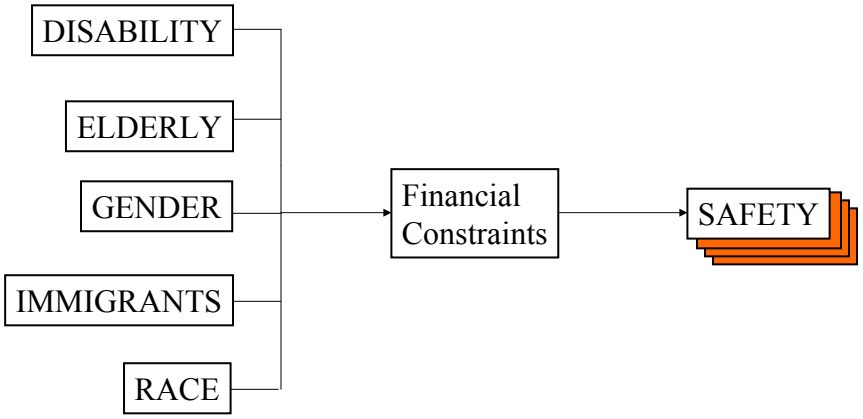
McGill
SALUT systematic analysis of land-use transportation & equity

Disadvantaged Groups

- McGuire (1976) defines the transportation disadvantaged as "those groups whose same opportunities for development have been hindered, either by omission or commission, by deficiencies in the transportation system."
  - a) Disabled (temporary and permanent disability)
  - b) Elderly
  - c) New immigrants (location and mobility)
  - d) Female (affordability and mode/location choice)
  - e) Poor (location / mode / affordability)

McGill
SALUT systematic analysis of land-use transportation & equity

Interactions



McGill
SALUTE systematic analysis of land-use transportation & equity

Transportation Systems Performance

- System performance measures should be defined to provide information to the decision-making performance
- Level of service (LOS)
- Measures, such as
  - Congestion
  - Emissions
  - Carrying capacity of the system and the actual loads
- Performance in terms of **EQUITY**

McGill
SALUTE systematic analysis of land-use transportation & equity

Data

- The 1998 Origin-destination survey (OD survey) for Montreal was obtained from the Ministry of Transport (Quebec)
- The data comprised 65,227 households (164,075 individuals) and 384,945 trips.
- Disaggregate travel data are used at the census tract level.
- All the trips have origins and destinations within the CMA.
- The OD data attributes basically can be divided into three categories:
  - household attributes
  - person attributes
  - trip attributes

McGill
SALUTE systematic analysis of land-use transportation & equity

Transportation Disadvantaged in Montreal

- Seniors
- Immobile
- Users of para transit
- Women
- Racial Minorities
  - (Haider & Spurr, 2004; Spurr and Merissa, 2004)
- One-person households

McGill
SALUTE systematic analysis of land-use transportation & equity

Immobile Population

- The Immobile population consists of those who older than 5 years and who reported no trips on the day that OD survey took place.
- 22, 901 persons did not travel on the date of the survey, which is 14% of the sample.
- The survey did not inquire about the reason for not traveling.
  - One reason could be that they are having difficulties or problems traveling.
  - Another reason could be they did not need to travel anywhere on that particular day.

McGill
SALUTE systematic analysis of land-use transportation & equity

No. of persons/household

No of person in household	General population % of total	Aged over 64 % of total	Immobile population % of total	Handicapped transport % of total
1	29	52.4	39.8	65.1
2	32.3	41	34.3	18.8
3	16.6	5.1	12	8.3
4	15.4	1.1	9	5
5 or more	6.8	0.4	4.8	2.9
Total	100	100	100	100

McGill
SALUTE systematic analysis of land-use transportation & equity

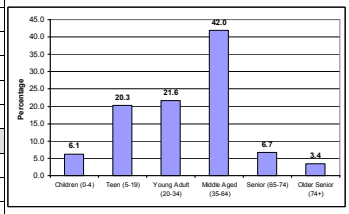
Auto-ownership Levels

No of vehicles in household	General population % of total	Aged over 64 % of total	Immobile population % of total	Handicapped transport % of total	1 person household % of total
0	22.1	41.7	40.6	71.7	45.1
1	45.4	48.2	42.8	18.2	51.4
2	27	8.9	14	5.9	3.0
3	4.3	0.9	2	4.3	0.3
4	0.9	0.1	0.4	0	0.04
5 or more	0.3	0.1	0.2	0	0.1
Total	100	100	100	100	100

McGill
SALUTE systematic analysis of land-use transportation & equity

Trip Distances

	Male	Female	Total
General population	6.753	5.573	6.164
Teen	3.661	3.728	3.693
Young Adult	7.862	6.712	7.286
Middle Aged	8.215	6.223	7.219
Senior	4.829	4.096	4.447
Older Senior	3.837	3.311	3.548
car driver	8.725	7.22	8.09
car passenger	5.678	5.926	5.839
transit	5.668	5.418	5.526
walk & bike	1.192	0.993	1.086
full time worker	8.753	7.353	8.15
part time worker	6.423	5.608	5.859
student	4.123	4.195	4.159
retired	4.67	4.15	4.392
other	4.71	4.195	4.332
Trips with origin within CBD	6.96	6.9	6.93
Trips with origin outside CBD	6.28	5.23	5.76
Trips with destination within CBD	6.82	6.75	6.78
Trips with destination outside CBD	6.29	5.24	5.77



Location Decisions!

???

???

McGill
SALUTE systematic analysis of land-use transportation & equity

Modesplit

Mode choice	Aged Over 64 % of Total	Aged Over 74 % of Total	Female over 64 % of Total	Female over 74 % of Total	Female all ages % of Total	Male all ages % of Total	General population % of Total
Car driver	40.9	28.4	22.4	13.0	40.5	56.8	48.2
Car passenger	15.6	14.6	24.5	19.8	17.9	9.6	13.7
Transit	9.7	10.4	12.8	12.4	14.0	9.5	12.3
On foot & bike	12.3	15.2	14.0	17.2	13.0	11.2	12.4
Other	21.6	31.5	16.3	37.6	14.6	12.9	13.4
Total	100	100	100	100	100	100.0	100

McGill
SALUTE systematic analysis of land-use transportation & equity

Possession of Driver's License

Possession of driver's license	Yes	No
General population		
Male	90.07	9.93
Female	78.59	21.41
Aged 20-34		
Male	88.60	11.40
Female	81.23	18.77
Aged 35-64		
Male	94.17	5.83
Female	80.87	19.13
Aged over 64		
Male	79.89	20.11
Female	37.12	62.88
Aged over 74		
Male	65.78	34.22
Female	20.88	79.12

McGill
SALUTE systematic analysis of land-use transportation & equity

Trip Purpose

Trip purpose	General population % of Total	Aged over 64 % of Total	Aged over 74 % of Total	Male % of Total	Female % of Total
work	16.8	2.6	1.01	18.91	15.08
business meeting	1.1	1.3	0.97	1.39	0.80
on the road	1	0.3	0.10	1.80	0.38
school	9.9	0.2	0.14	10.12	10.04
shopping	9.3	24.4	26.24 ◆	7.38	10.82
pleasure	5.3	9.5	9.33	5.36	5.09
visit to friends/parents	3.2	5.1	5.08	3.03	3.28
health	1.1	3.4	4.51 ◆	0.83	1.40
serve passenger trips	3	2	1.38	2.77	3.42 ◆
looking for someone	2.5	1.3	0.74	2.21	2.96
returning home	43.8	44.8	45.31	43.69	43.86
other	2.7	5.2	5.19	2.52	2.87
Total	100	100	100	100	100

McGill
SALUT systematic analysis of land-use transportation & equity

Demographics of Immobile Population

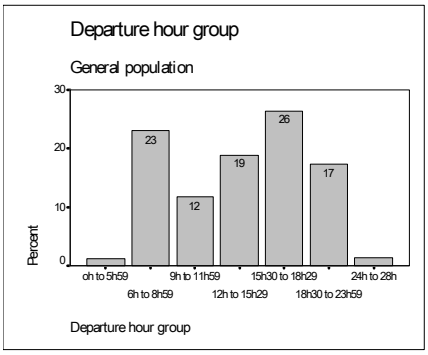
Sex	Average age	% of total immobile population
Male	46.96	38.00%
Female	50.24	62.00%
Total	48.99	100.00%

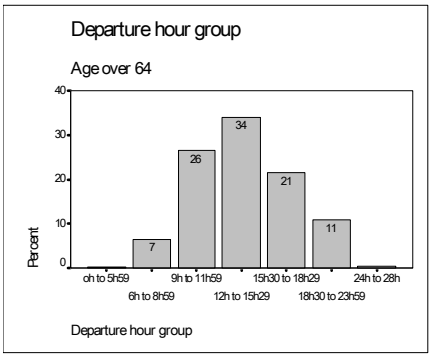
Occupation	Immobile population % of Total	General population % of Total
Full time worker	18.4	43.81
Part time worker	4.3	5.04
Student	13.5	25.70
Retired	37	14.36
Other	26.8	11.09
Total	100	100.00

Age groups	% of Total
Teen	10.8
Young Adult	17.1
Middle Aged	42.5
Senior	17
Older Senior	12.6
Total	100

McGill
SALUT systematic analysis of land-use transportation & equity

Trip Start Time





McGill
SALUTE systematic analysis of land-use transportation & equity

Models

- Econometric Models of Trip Distance as a function of socio-economic attributes of the trip maker
  - Income constraints might influence location choices, thus influencing trip distances
- Multinomial Logit models of mode choice to explain travel behaviour as a function of socio-economic attributes

McGill
SALUTE systematic analysis of land-use transportation & equity

Multinomial Logit Highlights - 1

- The variable representing households with or without an automobile has the most dramatic impact in all selected models.
  - In the general population model, members of households with at least 1 automobile are almost 38 times more likely to be car drivers, 3 times more likely to be car passengers, and are less likely to be transit users, as compared to households without automobiles.
- The odds of being auto drivers are lower for ones who are not full time workers.
- Trips with origins and destinations outside the CBD increase the odds for the auto-drive mode and decrease the odds for public transit.

Modelling Framework

- Logistic regression: $Prob(Y_i = j) = \frac{e^{\beta_j' x_i}}{\sum_{k=0}^{J} e^{\beta_k' x_i}}$
- J log-odds ratios: $\ln\left[\frac{P_{ij}}{P_{i0}}\right] = \beta_j' x_i$
- Wald Statistics: $\left(\frac{Coefficient}{SE}\right)^2$
- McFadden's Rho-squared: $R^2_{McFadden} = \frac{l(0)-l(B)}{l(0)} = 1 - \frac{l(B)}{l(0)}$
  - Where *l(0)* is the kernel of the log-likelihood of the intercept-only model (only information in the model are sample shares), while *l(B)* is the kernel of the log-likelihood of the final model.

Multinomial Logit Highlights - 2

- Trips with origins outside the CBD increase the odds ratios for being car drivers ranges from the highest of 4.16 times in the female population model to 3.33 times in the male population.
- Alternatively, trips with destinations outside the CBD increase the odds ratios for being car drivers ranges from the highest of 3.33 times in the elderly over 64 population model to 3.08 times in the male population model.
- Trips with origins and destinations outside the CBD increase 1-2 times more when they are car passengers and the odds ratios ranges from 0.4 to 0.6 for public transit users.

Multinomial Logit Highlights - 3

- The odds of being an auto driver for men and women not living in one-person households are 1.28 and 0.4 respectively.
  - Men living in households of size > 1 are more likely to be auto drivers.
  - On the other hand, the odds of women being car drivers when they live in households with more than 1 person will decrease.

Summary of Findings - 1

- More than 50% of elderly households are 1-person households.
- Over 40% of the elderly households do not possess an automobile.
- Proportion of drivers among seniors drops from 41% at age 64 to 28% at age 74 and over.
- Most trips by seniors are registered between noon and 3:30 pm.
- Women travel for shorter distances than men do in general.

McGill
SALUTE systematic analysis of land-use transportation & equity

Summary of Findings - 2

- Only a small percentage of elderly females possess driver's license.
- Almost 14% of the surveyed individuals did not travel at all on the day the survey was conducted.
- Almost 40% of households with immobile individuals did not own an automobile.
- One-third of the immobile individuals were over 64-years old.
- Approximately 65% of those who use handicapped transportation live alone.
- Nearly 72% of the households using handicapped transport do not own an automobile.

McGill
SALUTE systematic analysis of land-use transportation & equity

Summary of Findings - 3

- Unique socio-demographic make-up of transportation disadvantaged groups may require special planning interventions
  - Elderly females are more dependent on modes other than private automobile than elderly males
  - We need to determine the reasons behind the lack of mobility of immobile population

McGill
SALUTE systematic analysis of land-use transportation & equity