Representing Pedestrian Tours in Contemporary Travel Forecasting Models

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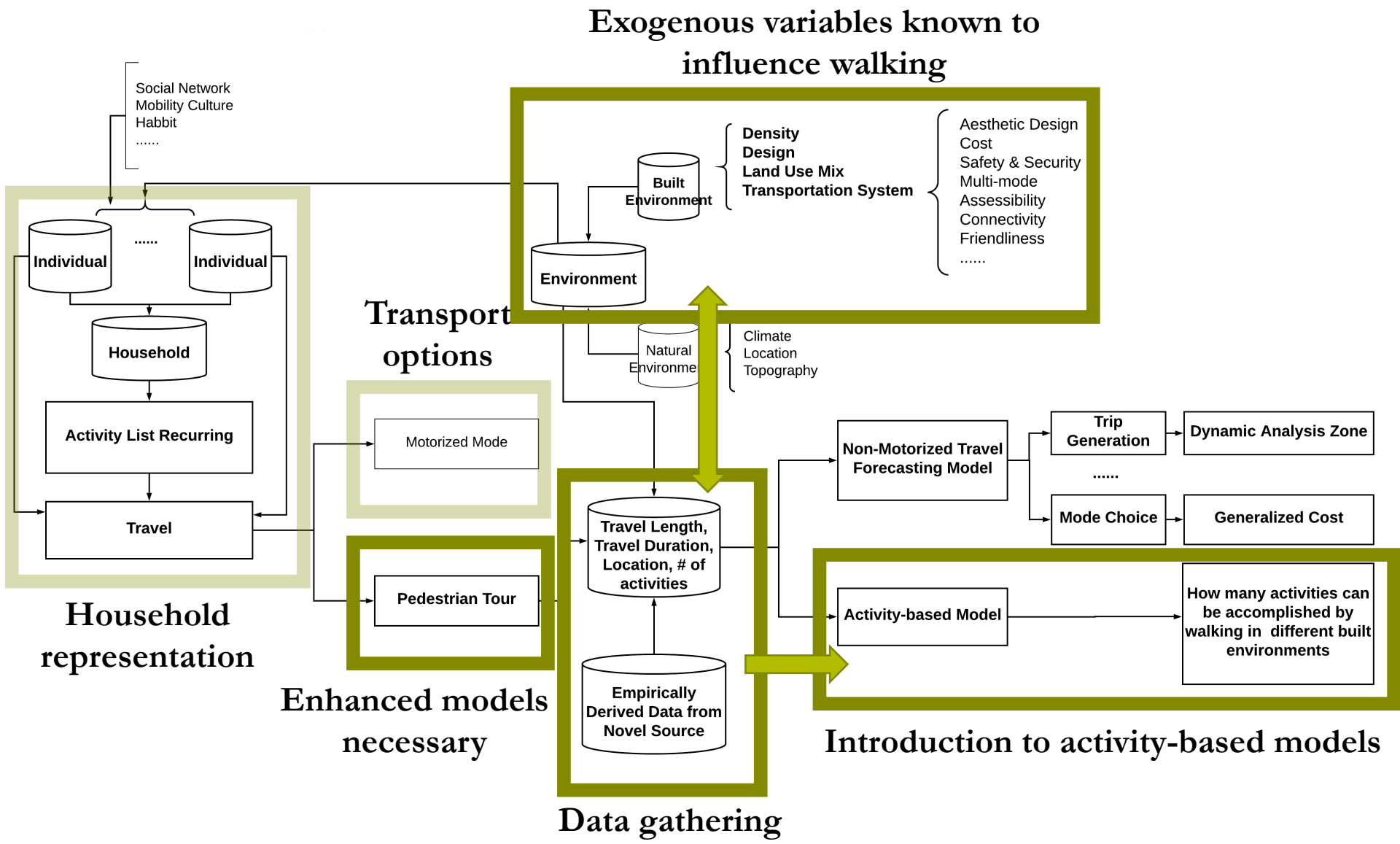
Presentation Outline

1. Structure of Concepts and Background
2. Evolution of Travel Forecasting Models
3. Pedestrian Tours: Typology, Complexity, and Costs
4. Characteristics Influencing Walking Decisions
5. Primary Obstacles to Improve Pedestrian Models
6. Future Work

Structure of Concepts



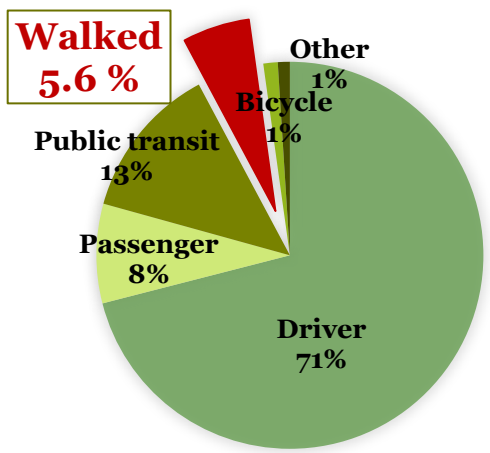
Some Facts: Mode of Transportation to Work

Province	Walked (%) 2006	Walked (%) 2016
Canada	6.4	5.5
N.L.	7.7	4.9
P.E.I.	6.6	5.4
N.S.	8.2	6.3
N.B.	6.6	4.6
Que.	6.6	5.6
Ont.	5.6	5.3
Man.	7.4	5.6
Sask.	8.1	5.6
Alta.	5.9	4.5
B.C.	6.9	6.8

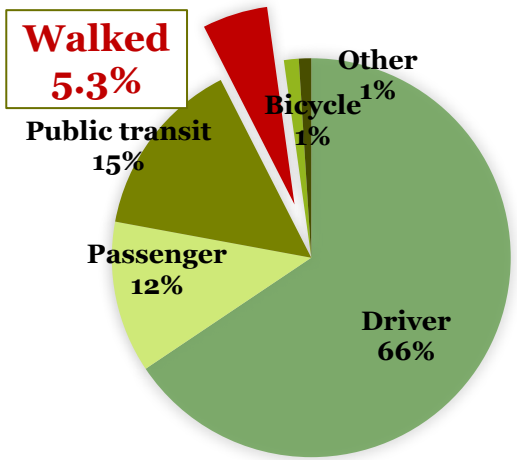
Lowest

Lowest

SOURCE: Statistics Canada 2006, 2016



Ontario 2006



Ontario 2016

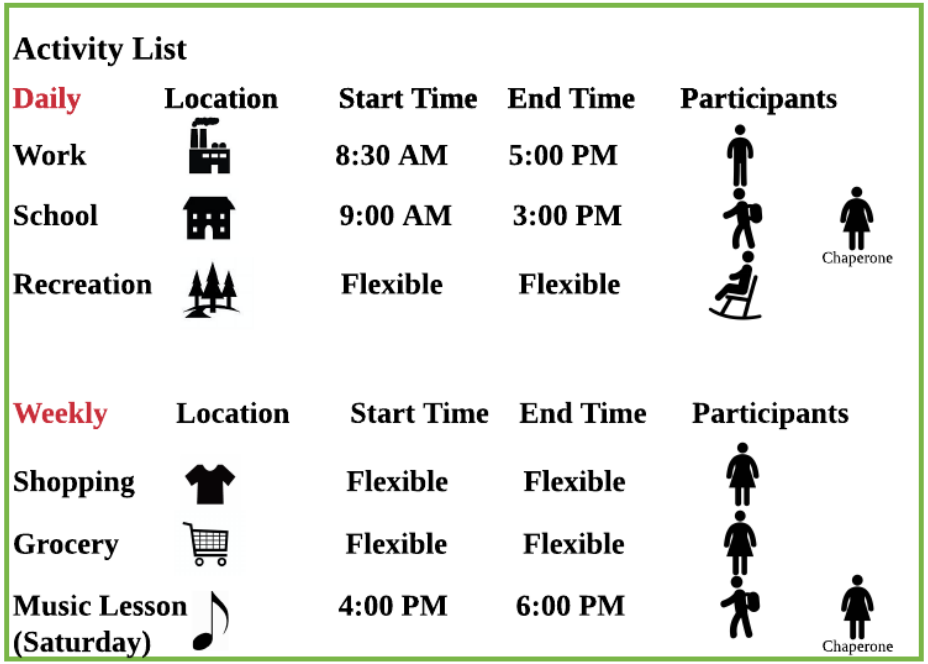
SOURCE: Ontario Census 2016; Statistics Canada 2006

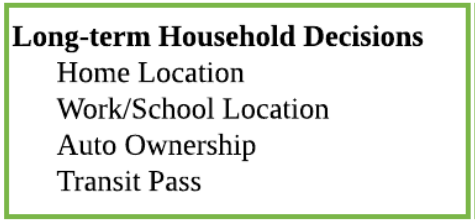
KW Region	2006 (%)	2016 (%)
Car, Truck or Van (Driver)	78.7	81.0
Car, Truck or Van (Passenger)	9.3	6.7
Public Transit	4.6	5.9
Walked	5.1	4.4
Bicycle	1.6	1.1
Other	0.8	0.8

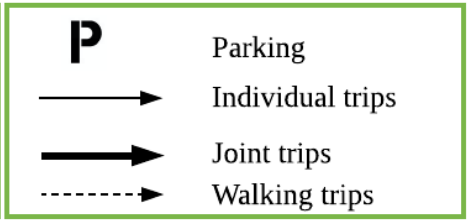
Decreasing

SOURCE: Region of Waterloo Census 2016, Place of work and commuting to work

Behavioral Representation in Models

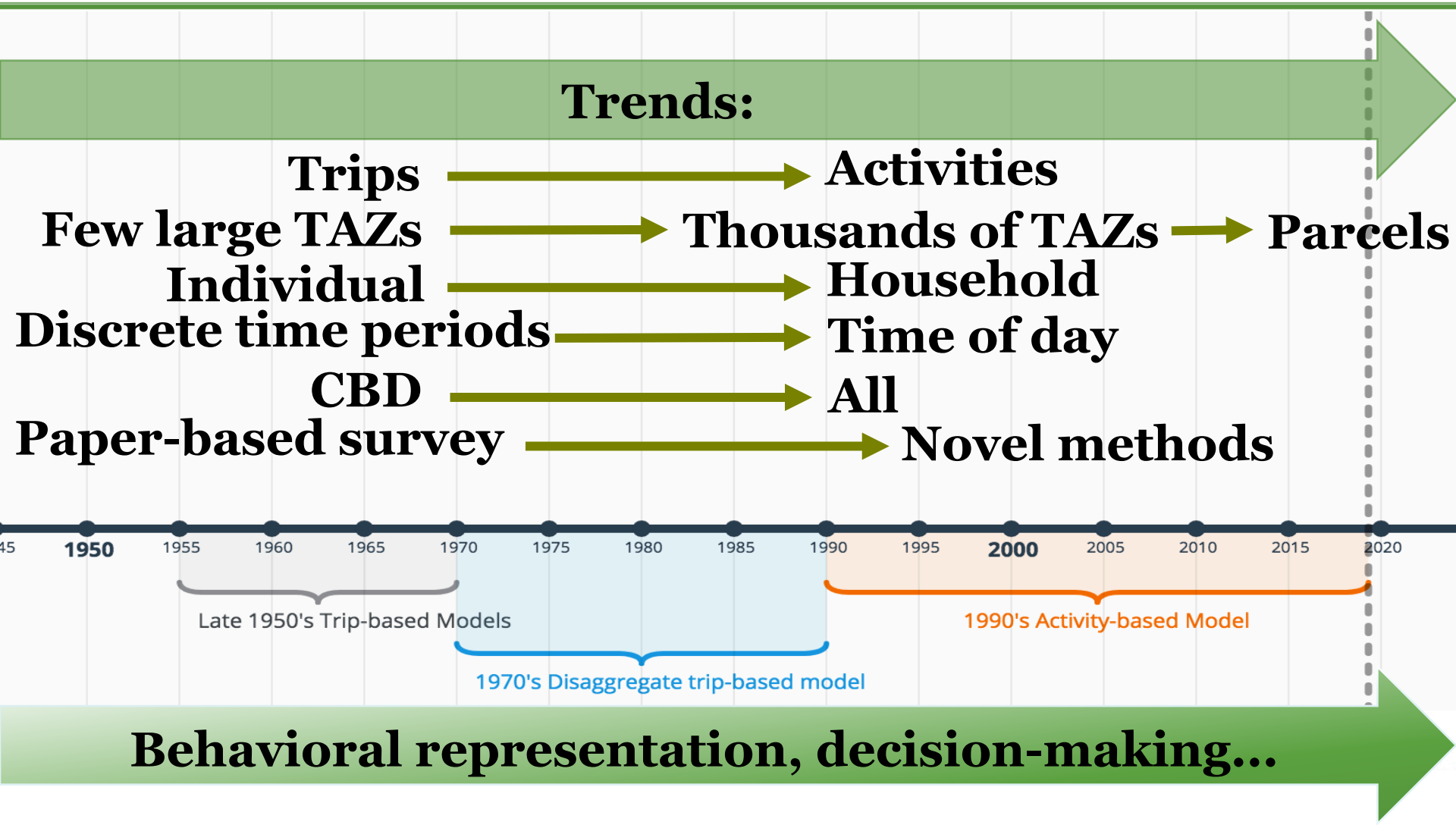






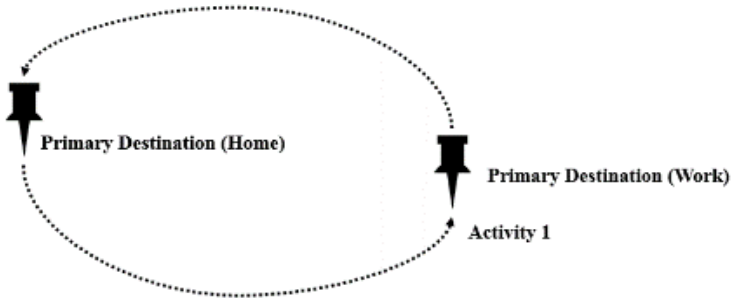
- **Household Travel:**
  - **Decision-making: long-term; mid-term; short-term**
  - **Generate different types of activities**
  - **Share resources and experiences**
  - **Budget: Money/Time/Resources/Chauffer**

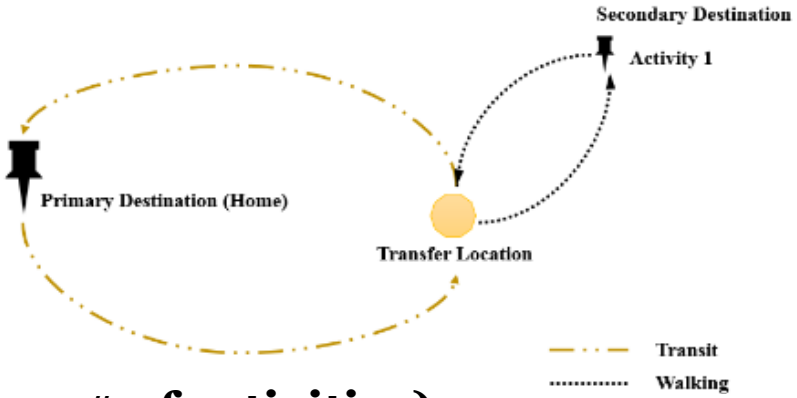
Evolution of Travel Forecasting Models



Typology and Complexity of Pedestrian Tours

- **Typology (Purpose & Access Mode)**
  - Recreational and Utilitarian (Mokhtarian & Salomon, 2001)
  - Unimodal and Multimodal (access modes)

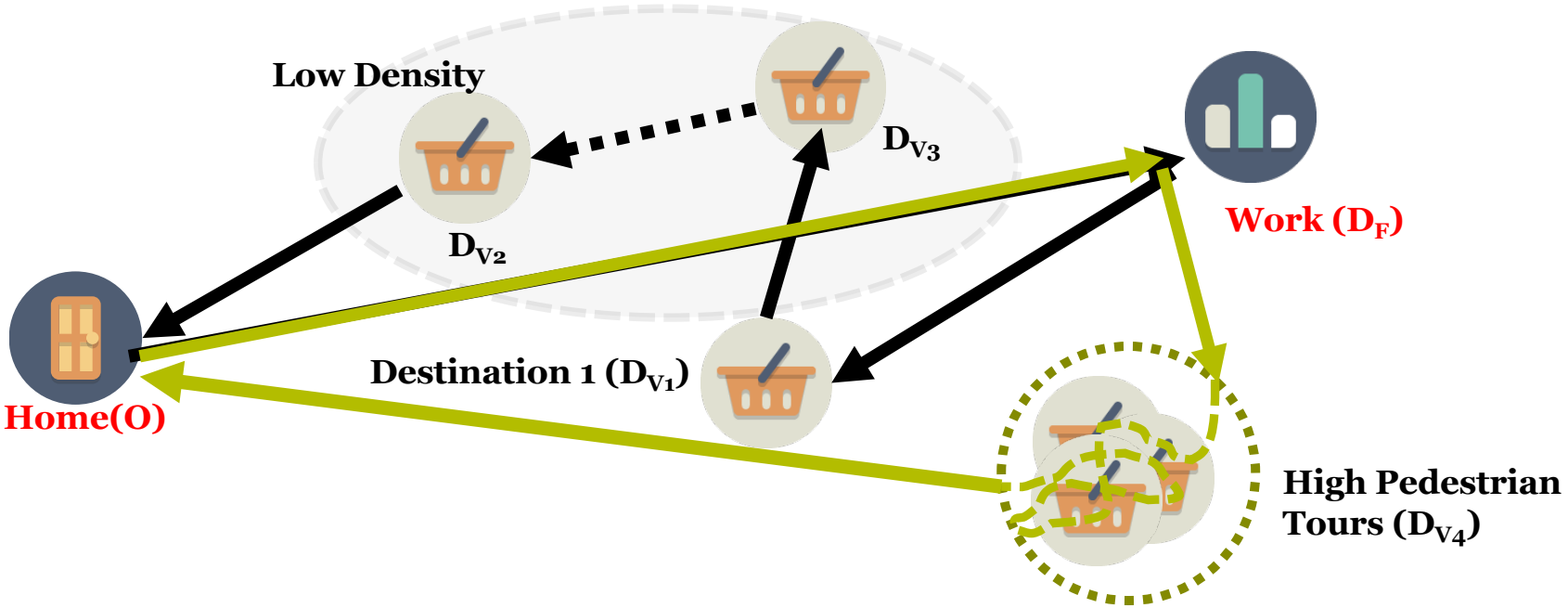




- **Complexity (Distribution of destinations, # of activities)** (Ho & Mulley, 2013)

	Single Purpose	Multiple Purposes
Single Destination	✓	✓
Multiple Destinations	NA	✓

Costs of Individual Tours (Total)



Case 1 — **Case 1 Total Cost = $\sum TT + \sum AT = OD_F + D_F D_{V1} + AT_1 + D_{V1} D_{V3} + \ldots$**

Case 2 — **Case 2 Total Cost = $\sum TT + \sum AT = OD_F + D_F D_{V4} + AT_4 + D_{V4} O$**

Maximize HUF = H (u_1, u_2)

Choose **pedestrian tour's utility > auto tour's utility**

Social Impacts: Case 2> Case 1

HH Characteristics Influencing Walking Decisions

Recreational Walking		Utilitarian Walking	
Factors	**Influence**	**Factors**	**Influence**
HH Composition: Presence of children	+	**Car Ownership**: 0 # of drivers > vehicles	+ +
Age: 65+	+	**Age:** 65+ < 30	- +
Gender: men	-	**Gender**	=
Income: <$30k	+	**Income:** >$30k	-
Education: higher	+	**Education:** higher	+

Locational Attributes Influencing Walking

Strategic level

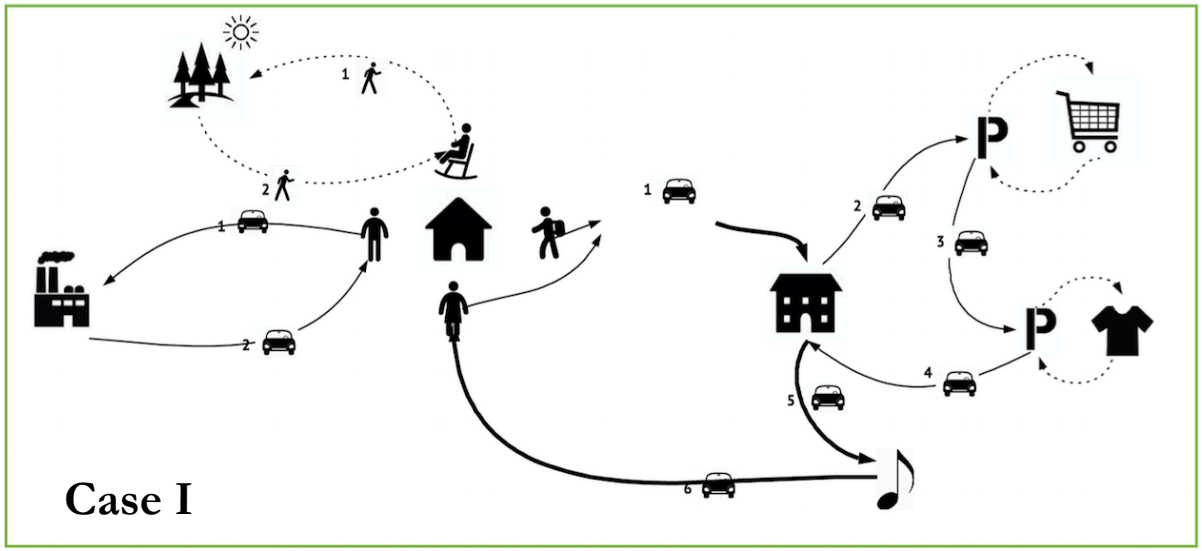
Tactical Level

	Factors	Influence
Utilitarian	Higher densities, compact, and a mix of uses	+
	Proximity to non-residential destinations/transit	+
	Land use diversity	+
	Density of destinations	+
Recreational	Quality and proximity to natural facilities such as parks	+
Route	Shorter distance between destinations	+
	Sidewalk (more important in commercial areas)	+
	Visually interesting and attractive landscaping and building features (Aesthetic)	+
	High traffic volume/noise/poor lighting	-

(Saelens & Handy, 2010; Cervero & Kockelman, 1997)

Locational Attributes Influence Walking

- **Residential and work area attributes**:
  - High utility destination area (support MPSD), but different desirable functions
  - Within energy expenditure
  - Accessibility to destinations
  - Diversity and density of land uses
  - Safe neighborhood
  - Within time budget
  - Comfort and pleasure design



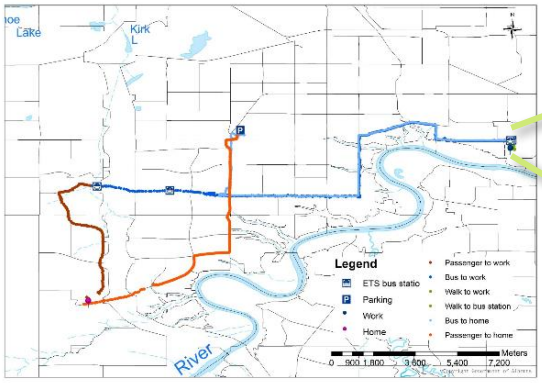
Case I

Case II

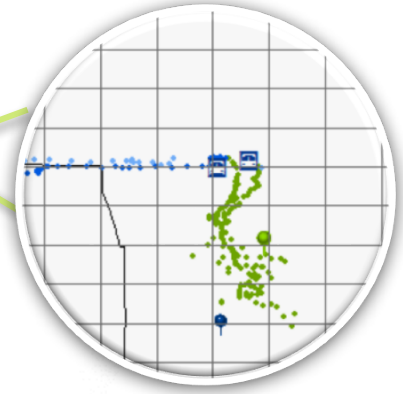
Primary Obstacles to Improve Pedestrian Models

- A lack of empirical data (Singleton et al., 2018;)
- Inappropriate travel survey design/methods (Harding, et al., 2018)
- Inappropriate zonal structure (Iacono, 2010; Clifton, 2016)
- Failure to consider pedestrian tours in satisfying activities
- Failure to develop appropriate cost representation for pedestrians

TAZs



PAZs



Tour Segments /Trips	Mode	Time	Zone	Location	Activity
1	Transit	7:09	221	Home	
		7:13	312	Location 1	Activity 1
2	Transit	7:17	312	Location 1	
		7:35	342	Location 2	Activity 2
3	Walk	1:56	342	Location 2	
		1:59	432	Location 3	Activity 3
4	Walk	2:07	432	Location 3	
		2:10	342	Location 2	Activity 2
5	Transit	7:12	342	Location 2	
		7:33	221	Home	

Missing short walking trips in models

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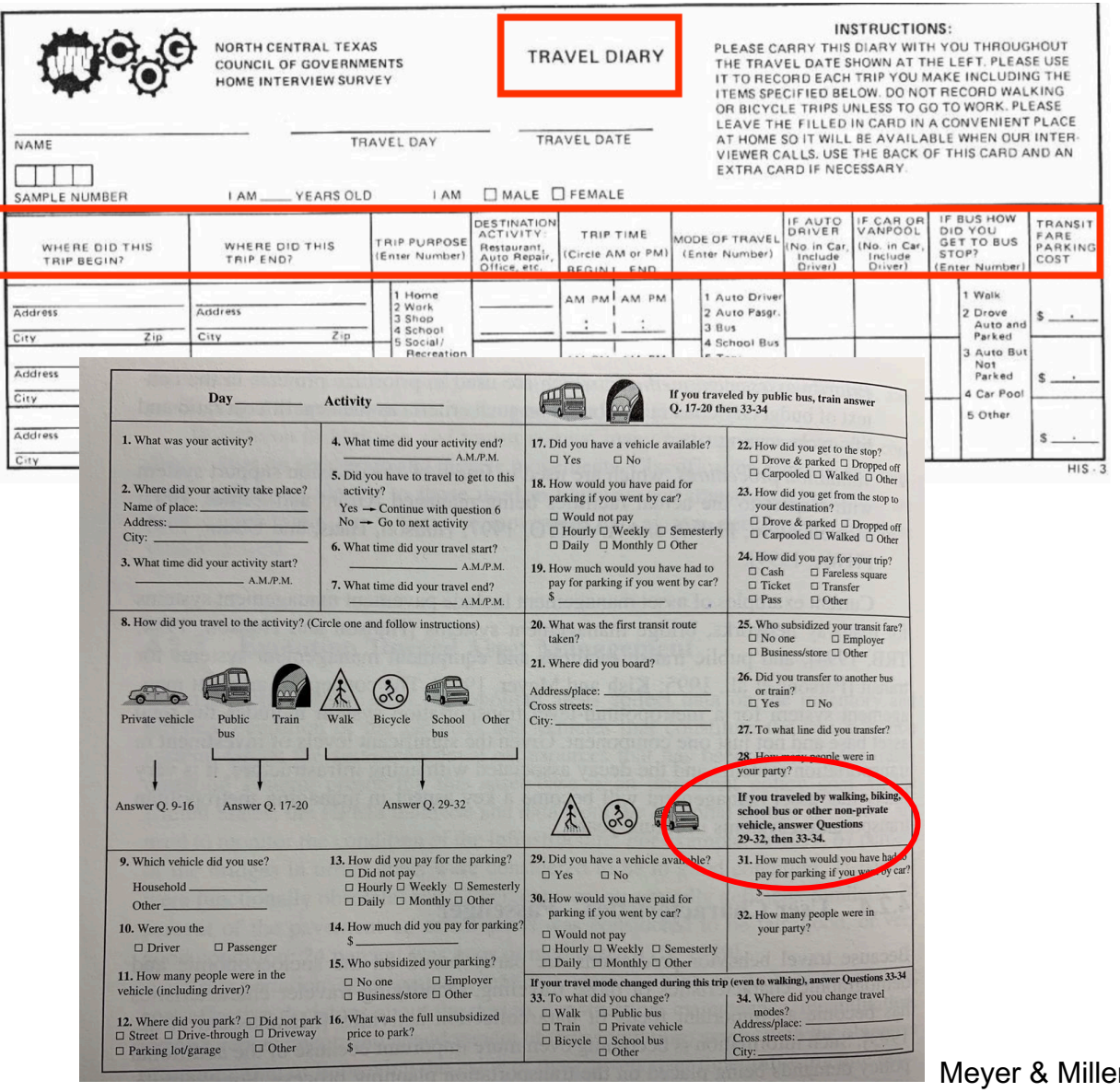
Advancing Transit Solutions through Research

Data Collection Methods: Travel Survey



NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS
HOME INTERVIEW SURVEY

TRAVEL DIARY

INSTRUCTIONS:
PLEASE CARRY THIS DIARY WITH YOU THROUGHOUT THE TRAVEL DATE SHOWN AT THE LEFT. PLEASE USE IT TO RECORD EACH TRIP YOU MAKE INCLUDING THE ITEMS SPECIFIED BELOW. DO NOT RECORD WALKING OR BICYCLE TRIPS UNLESS TO GO TO WORK. PLEASE LEAVE THE FILLED IN CARD IN A CONVENIENT PLACE AT HOME SO IT WILL BE AVAILABLE WHEN OUR INTERVIEWER CALLS. USE THE BACK OF THIS CARD AND AN EXTRA CARD IF NECESSARY.

NAME _____ TRAVEL DAY _____ TRAVEL DATE _____

SAMPLE NUMBER ☐☐☐☐ I AM ___ YEARS OLD I AM ☐ MALE ☐ FEMALE

WHERE DID THIS TRIP BEGIN?	WHERE DID THIS TRIP END?	TRIP PURPOSE (Enter Number)	DESTINATION ACTIVITY: Restaurant, Auto Repair, Office, etc.	TRIP TIME (Circle AM or PM) BEGIN / END	MODE OF TRAVEL (Enter Number)	IF AUTO DRIVER (No. in Car, Include Driver)	IF CAR OR VANPOOL (No. in Car, Include Driver)	IF BUS HOW DID YOU GET TO BUS STOP? (Enter Number)	TRANSIT FARE PARKING COST
Address / City / Zip	Address / City / Zip	1 Home 2 Work 3 Shop 4 School 5 Social/ Recreation		AM PM / AM PM	1 Auto Driver 2 Auto Pasgr. 3 Bus 4 School Bus			1 Walk 2 Drove Auto and Parked 3 Auto But Not Parked 4 Car Pool 5 Other	$.

HIS - 3

Day _____ **Activity** _____

1. What was your activity?
2. Where did your activity take place?
   Name of place: _____
   Address: _____
   City: _____
3. What time did your activity start? _____ A.M./P.M.
4. What time did your activity end? _____ A.M./P.M.
5. Did you have to travel to get to this activity?
   Yes → Continue with question 6
   No → Go to next activity
6. What time did your travel start? _____ A.M./P.M.
7. What time did your travel end? _____ A.M./P.M.

8. How did you travel to the activity? (Circle one and follow instructions)

Private vehicle | Public bus | Train | Walk | Bicycle | School bus | Other

Answer Q. 9-16 | Answer Q. 17-20 | Answer Q. 29-32

If you traveled by public bus, train answer Q. 17-20 then 33-34

17. Did you have a vehicle available? ☐ Yes ☐ No
18. How would you have paid for parking if you went by car?
    ☐ Would not pay
    ☐ Hourly ☐ Weekly ☐ Semesterly
    ☐ Daily ☐ Monthly ☐ Other
19. How much would you have had to pay for parking if you went by car? $ _____
20. What was the first transit route taken?
21. Where did you board?
    Address/place: _____
    Cross streets: _____
    City: _____
22. How did you get to the stop?
    ☐ Drove & parked ☐ Dropped off
    ☐ Carpooled ☐ Walked ☐ Other
23. How did you get from the stop to your destination?
    ☐ Drove & parked ☐ Dropped off
    ☐ Carpooled ☐ Walked ☐ Other
24. How did you pay for your trip?
    ☐ Cash ☐ Fareless square
    ☐ Ticket ☐ Transfer
    ☐ Pass ☐ Other
25. Who subsidized your transit fare?
    ☐ No one ☐ Employer
    ☐ Business/store ☐ Other
26. Did you transfer to another bus or train?
    ☐ Yes ☐ No
27. To what line did you transfer?
28. How many people were in your party?

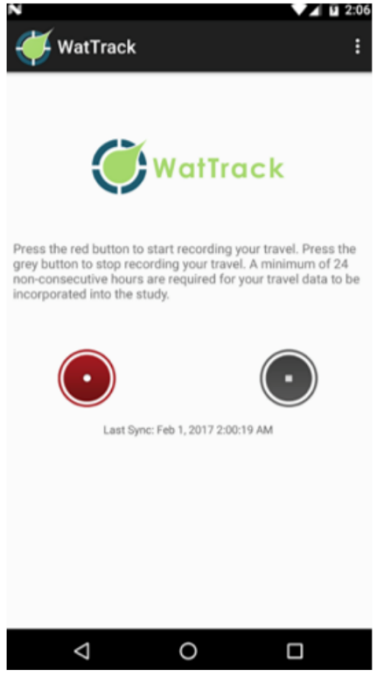
If you traveled by walking, biking, school bus or other non-private vehicle, answer Questions 29-32, then 33-34.

29. Did you have a vehicle available? ☐ Yes ☐ No
30. How would you have paid for parking if you went by car?
    ☐ Would not pay
    ☐ Hourly ☐ Weekly ☐ Semesterly
    ☐ Daily ☐ Monthly ☐ Other
31. How much would you have had to pay for parking if you went by car? $ _____
32. How many people were in your party?

9. Which vehicle did you use?
   Household _____
   Other _____
10. Were you the
    ☐ Driver ☐ Passenger
11. How many people were in the vehicle (including driver)?
12. Where did you park? ☐ Did not park
    ☐ Street ☐ Drive-through ☐ Driveway
    ☐ Parking lot/garage ☐ Other
13. How did you pay for the parking?
    ☐ Did not pay
    ☐ Hourly ☐ Weekly ☐ Semesterly
    ☐ Daily ☐ Monthly ☐ Other
14. How much did you pay for parking? $ _____
15. Who subsidized your parking?
    ☐ No one ☐ Employer
    ☐ Business/store ☐ Other
16. What was the full unsubsidized price to park? $ _____

If your travel mode changed during this trip (even to walking), answer Questions 33-34

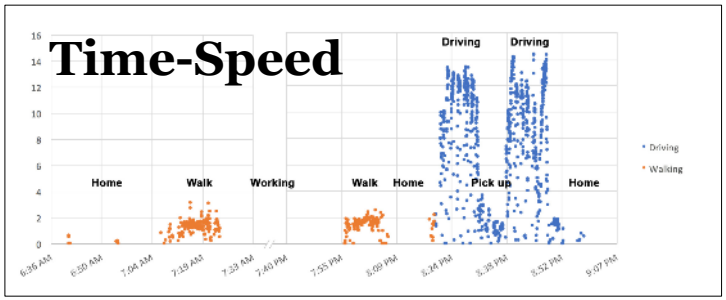
33. To what did you change?
    ☐ Walk ☐ Public bus
    ☐ Train ☐ Private vehicle
    ☐ Bicycle ☐ School bus
    ☐ Other
34. Where did you change travel modes?
    Address/place: _____
    Cross streets: _____
    City: _____

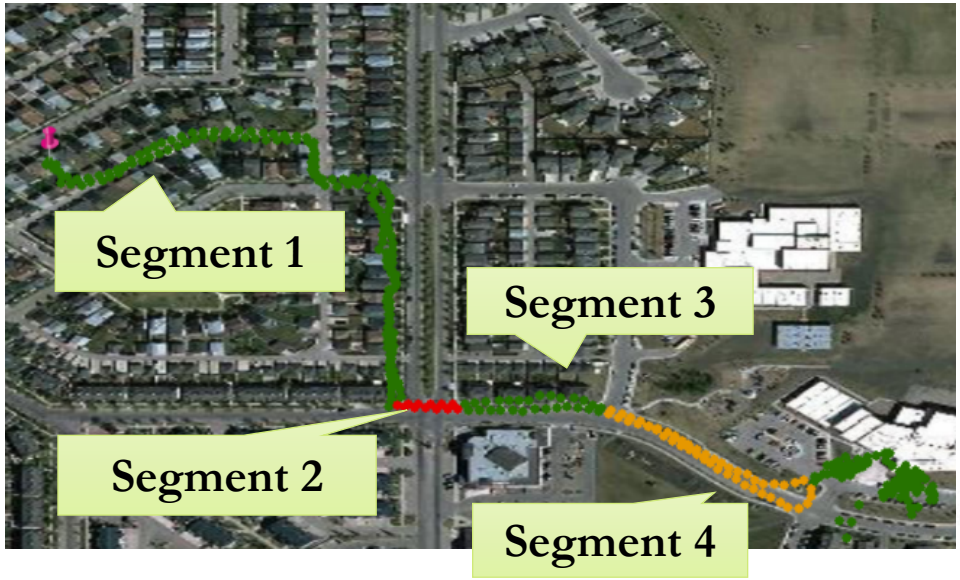


Meyer & Miller, 2001 p. 192

Future Work

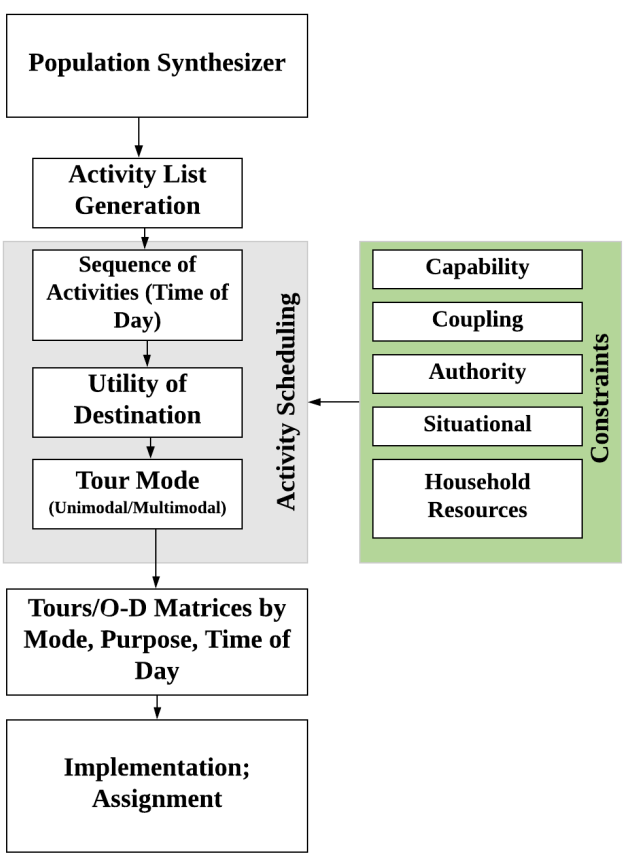
- Appropriate zonal structure
- Novel data collection methods (smartphone-based passive data collection)
- Tactical level pedestrian behavior and route choice
- Segment level pedestrian environment measurement

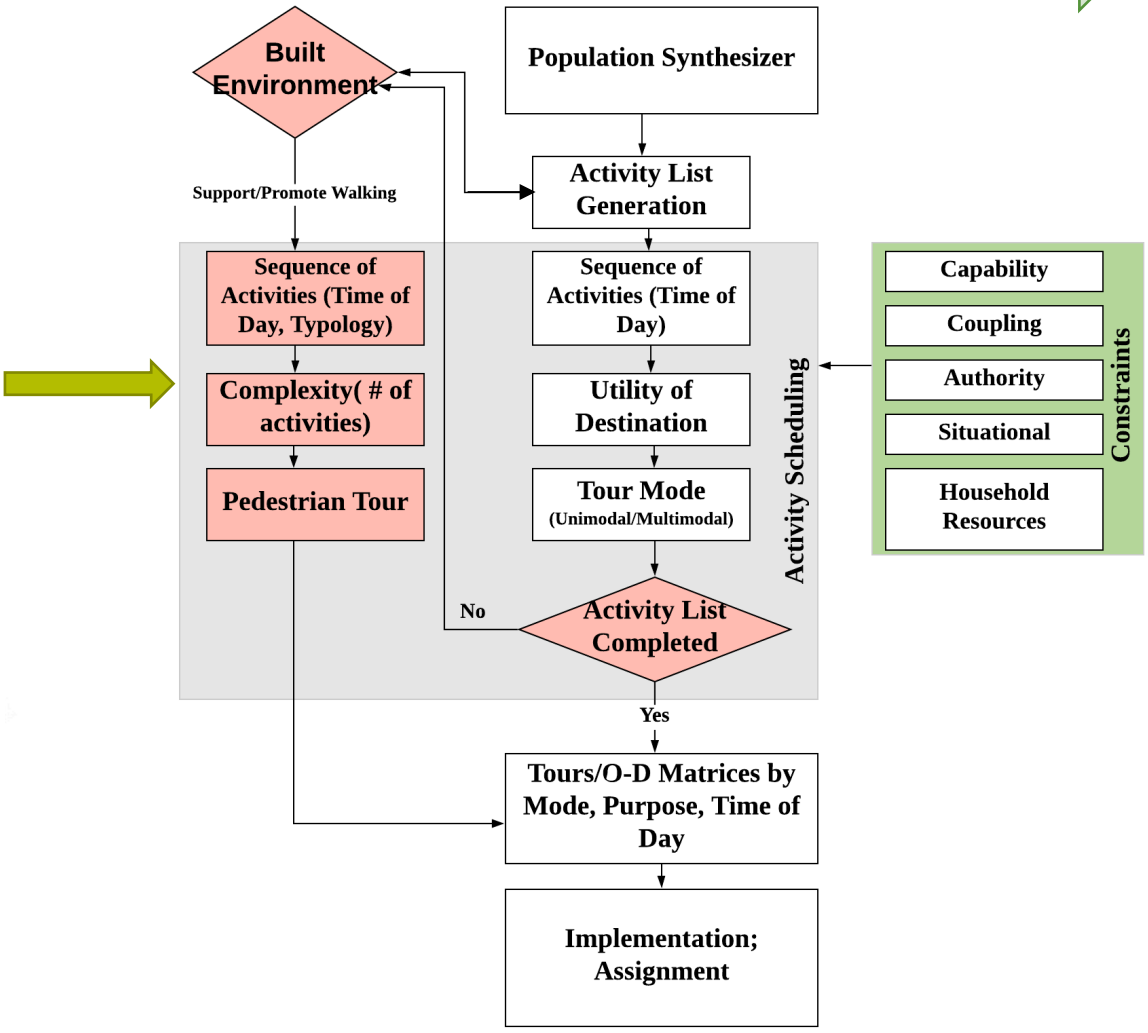




Future Work: Key Elements in Activity-based Model

Better Representation of Pedestrian Behaviors





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Waterloo Public Transportation Initiative

https://uwaterloo.ca/waterloo-public-transportation-initiative/

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