Analysis of Dependent-Serving Activity/Travel Behavior

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Presentation Outline

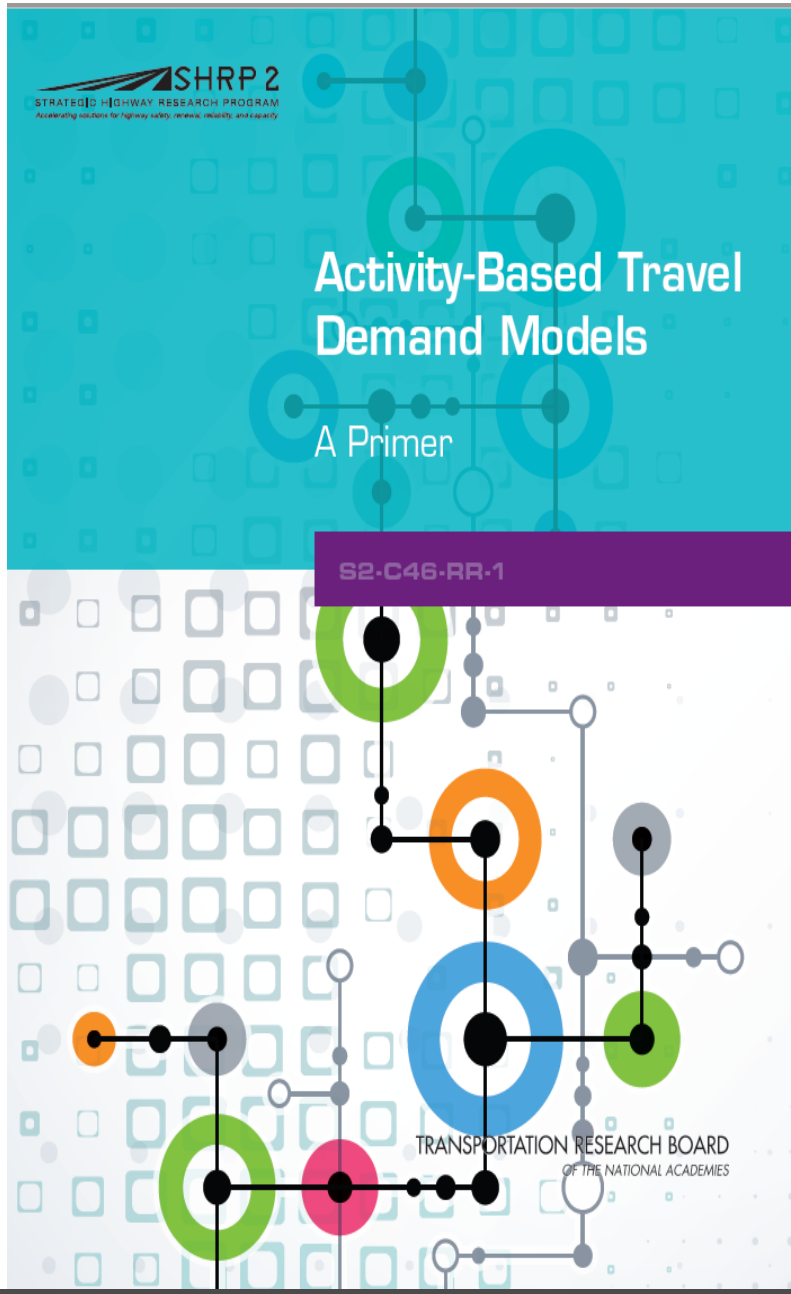
- Why activity-based modeling?
- What is an activity–based model?
- Activity scheduling
- Serve dependents
- Toronto activity-based model
- Analysis of serve dependents activity schedules
- Example
- Integration to Toronto activity-based modeling framework

Why activity-based modeling (ABM)

- Travel is a derived demand – people travel to participate in out-of-home activities.
- Thus, the motivation and utility of travel derives largely from activity participation, as does the frequency, timing and location of trip-making.

What is an activity-based model?

- An activity-based model is one in which out-of-home activity participation is explicitly modelled, with trips being the emergent outcome of the need to travel to these out-of-home locations (and to eventually return home again).
- Activity-based modelling recognizes that:
  - A fundamental part of decision-making is not just where to travel but the "why", "when" and "how long" of out-of-home activities.
  - Travel needs to be understood within the context of daily activity patterns and the tours (trip-chains) used to engage in these activities, not just isolated, unconnected trips.
  - Activity & travel are constrained in a variety of ways: time, space, personal capabilities & resources, etc. that can only be understood within a holistic activity-based approach.



Activity Scheduling

- Most critical and challenging component of activity-based travel models
- Function of activity type and intra-household interactions
- Most activity-based models classify activities as mandatory and discretionary activities
- Mandatory activities: Pre-planned with fixed locations. e.g., work
- Discretionary activities: Flexible schedules. e.g., shopping & leisure

Serve Dependents

- Helping or serving a dependent household member
- A dependent is a person who is unable to undertake certain activities unassisted and/or cannot be left unattended due to factors such as age and disability
- Decisions concerning dependents' activity participation are also taken by independent family members.
- Often neglected in activity-based models

Serve Dependent Tasks

- Supervision of the dependent
- Chauffeuring the dependent
- Participation in activities with the dependent
- Attending to the dependent's needs

Why Serve Dependent Activity Modeling?

- Impact activity scheduling of independent household members
  - Constraints on activity schedule
- Involves complex household interactions
- Some serve dependent activities can also be classified as mandatory activities. e.g., daycare, evening school sports class
- Impacts participation in other types of activities

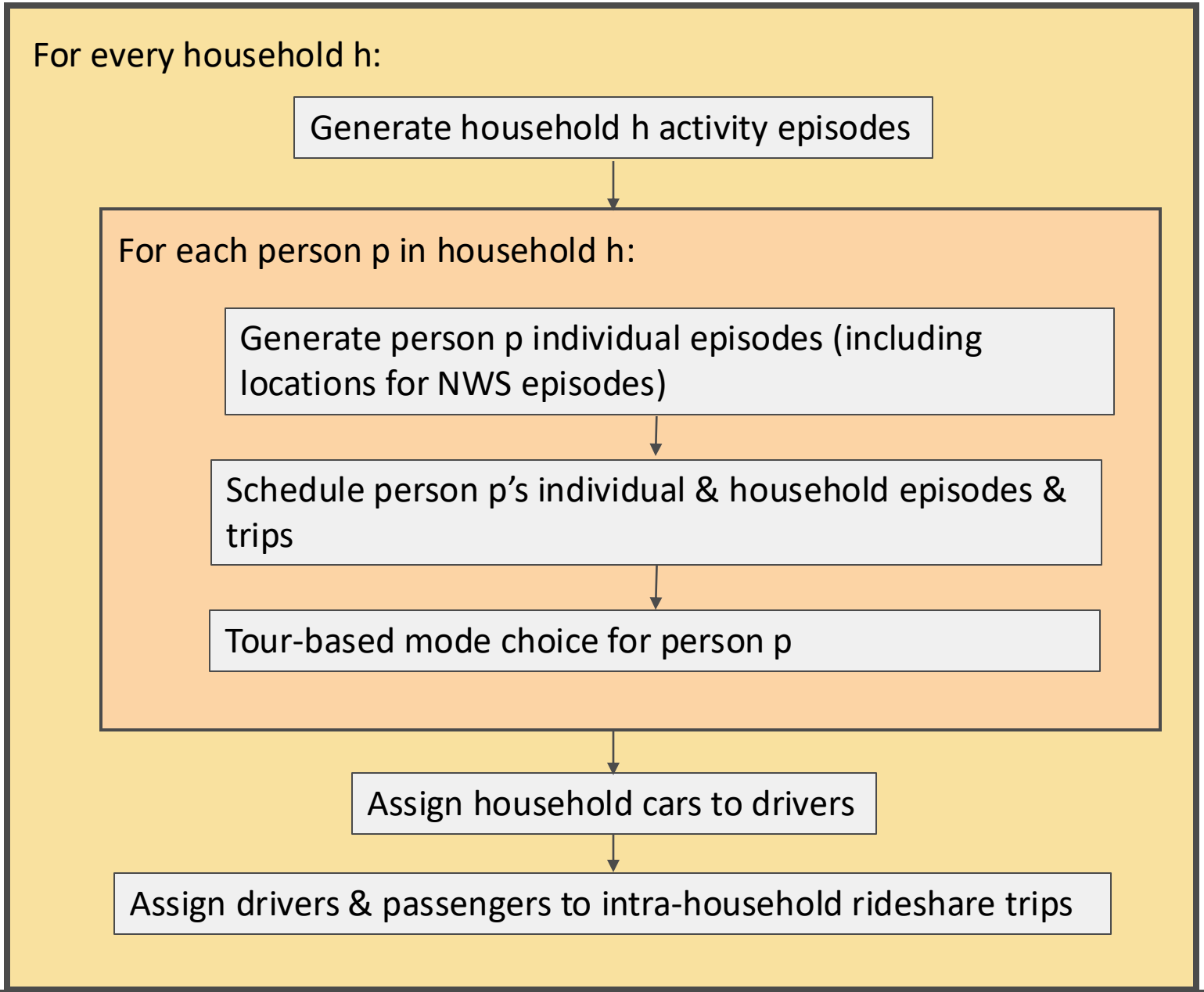
Study Objectives

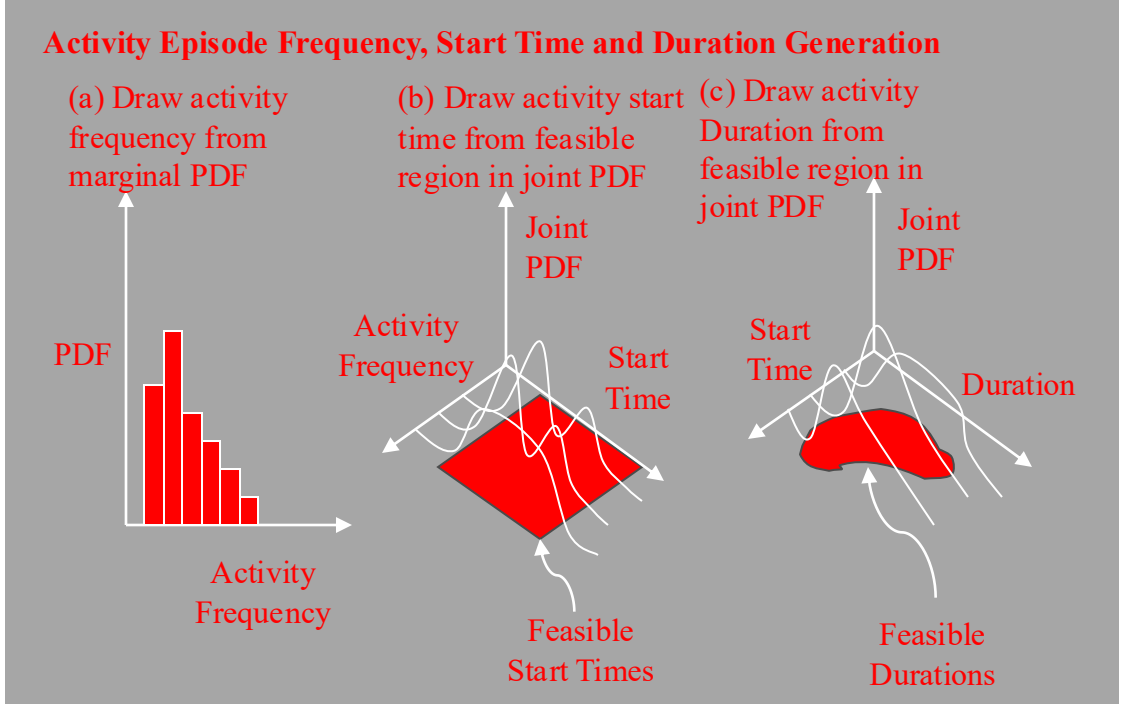
- Analyze activity behavior of serve dependents and its related household interactions
- Young children as a case study
- Framework to model these activities and household interactions in the activity-based travel demand model of Toronto

TASHA: Travel/Activity Scheduler for Household Agents

- Activity-based: explicit activity scheduling.
- Agent-based: both persons & households interactively determine behaviour.
- Household-based: first operational household-based model system.
- Project-based: all activities are generated by the agent's projects, which encapsulate the agent's goals, preferences, etc.
- Fully microsimulation-based.
- Continuous time modelling for a 24-hour typical weekday.
  - Currently investigating extending to a week-long version.
- Tour-based.
  - Fully multi-modal tours generated, with a strong emphasis on transit modelling.
- Computationally efficient.
- Implementable using standard household travel survey data.

TASHA Computational Structure

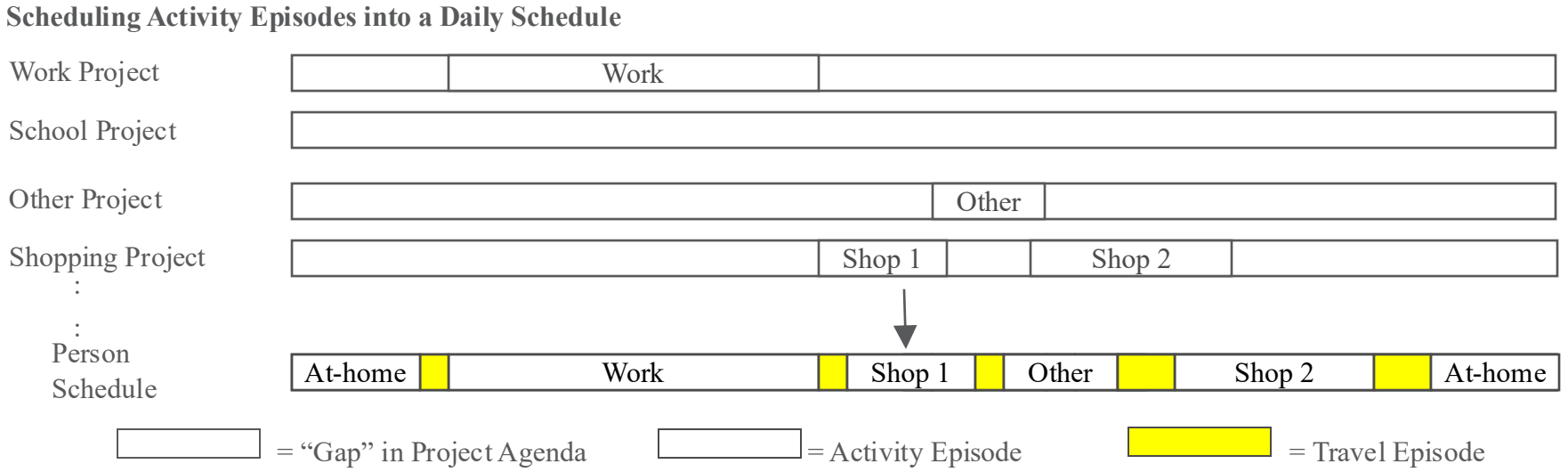




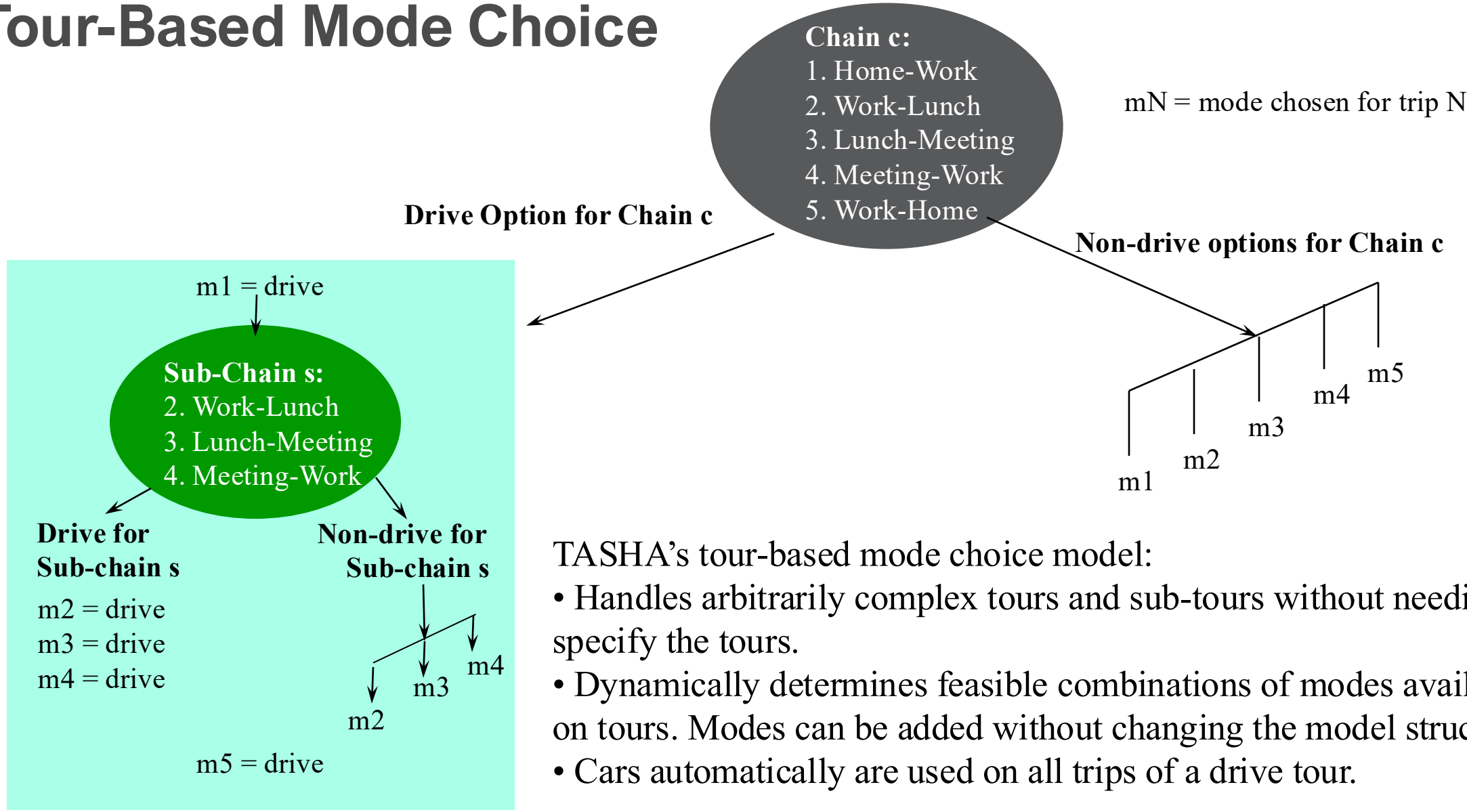
TASHA generates the number of activity episodes from a set of "projects" that a person (or household) might engage in during a typical weekday. It also generates the desired start time and duration of each episode.

It then builds each person's daily schedule, adjusting start times and durations to ensure feasibility.

Travel episodes are inserted as part of the scheduling process.



Tour-Based Mode Choice

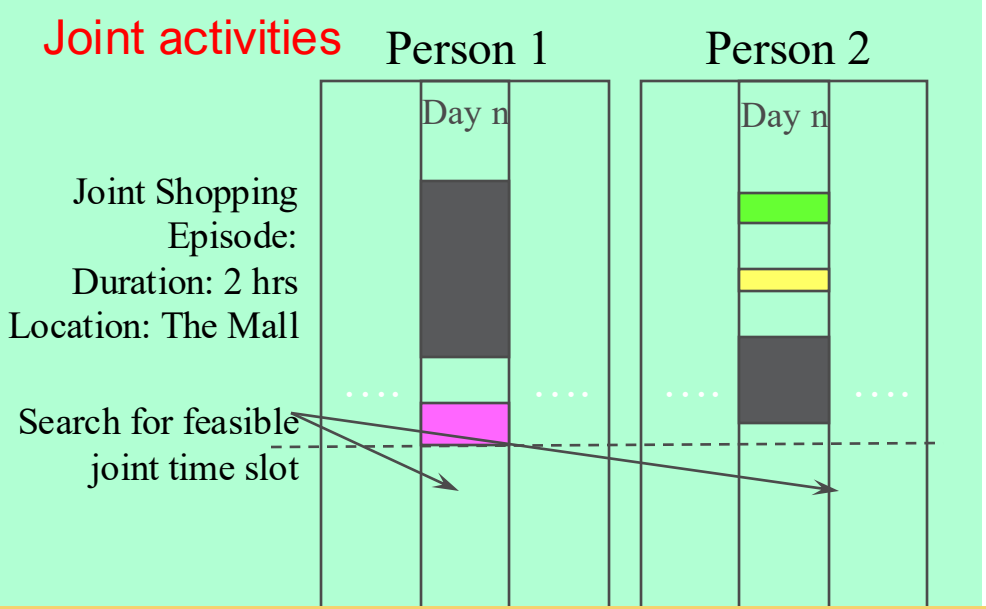


TASHA's tour-based mode choice model:

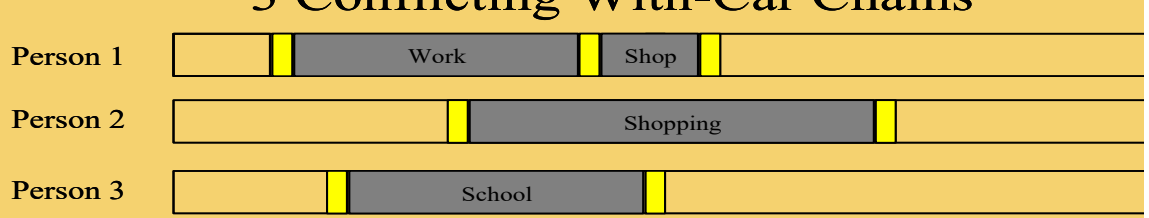
- Handles arbitrarily complex tours and sub-tours without needing to pre-specify the tours.
- Dynamically determines feasible combinations of modes available to use on tours. Modes can be added without changing the model structure.
- Cars automatically are used on all trips of a drive tour.

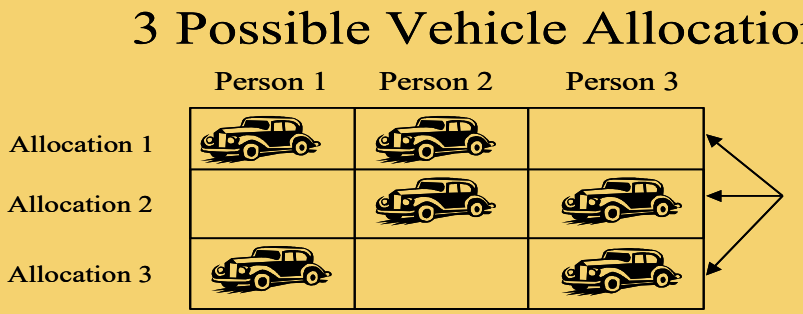
Household Level Interactions

Joint activities

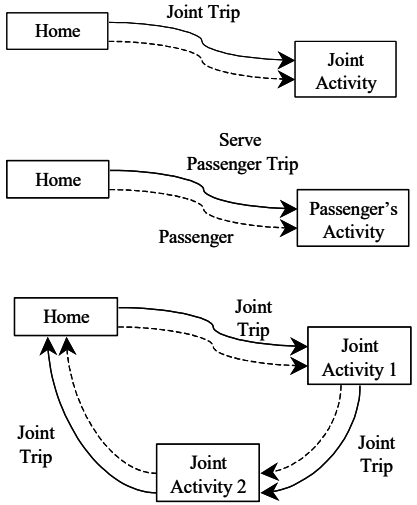


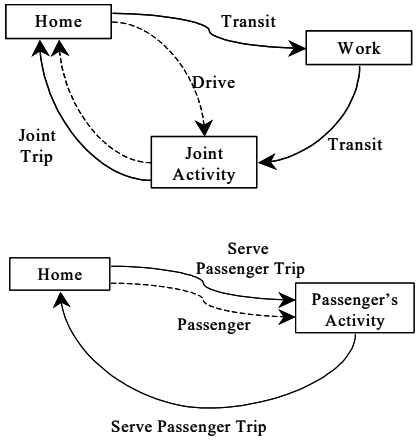
Allocating cars to drivers

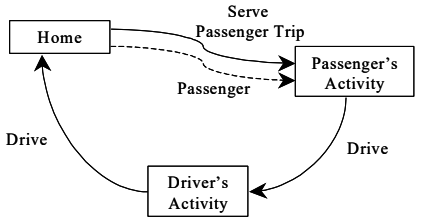




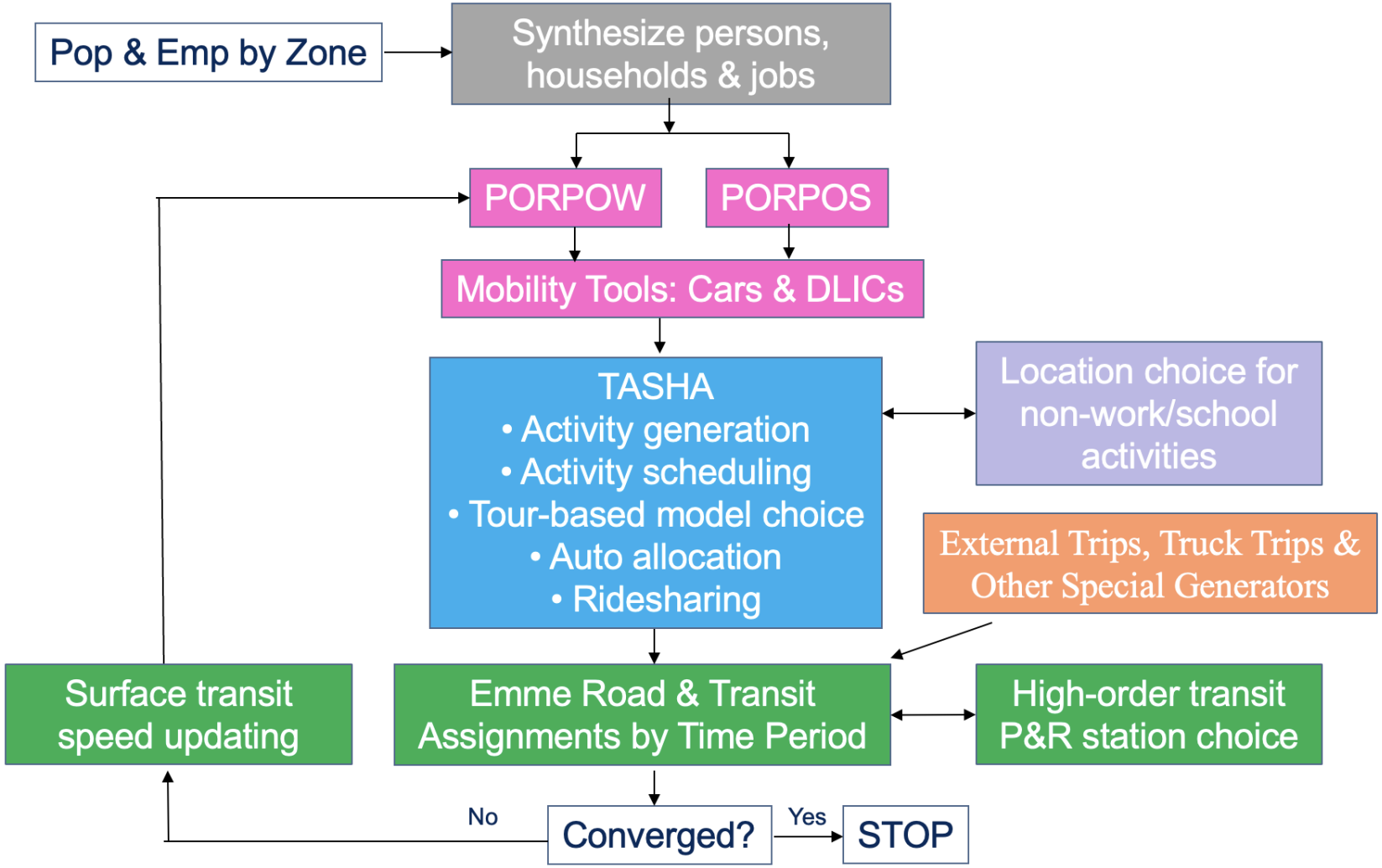
Within-household ridesharing







GTHA Model V4.2



Definitions

- Dependent Member (Child):
  - Age 14 and younger
- Independent Member (Adult):
  - Age 15 and older

Methodology

- Joint trip determination
  - Trip origin zone
  - Trip destination
  - Trip start time
- Child joint trip determination
- Trips limited to the GTHA region

Methodology

- Serve dependent trips
  - Trip purpose of a child: ‘Attend school, ‘Services’, ‘Health & personal care’
  - Trip purpose of an adult: ‘Work’ excluded
  - Mode: ‘Auto driver’, ‘Auto passenger’, ‘Walk’, ‘Transit’

RESULTS

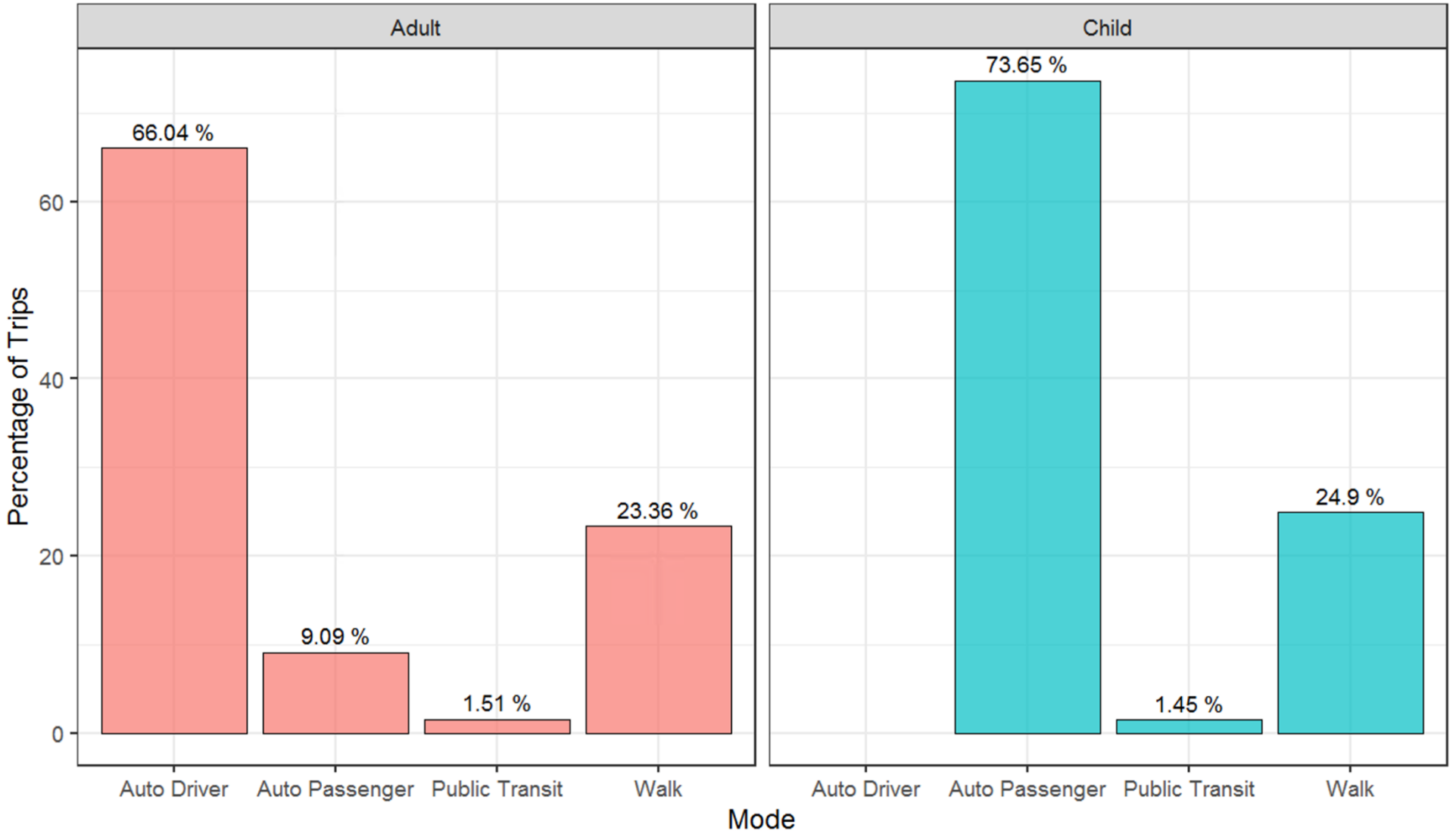
Joint Trips with Children

Trip Characteristics (Total trips = 19,089)			
	Child	Adult	Both
Min	1	1	2
Mean	1.23	1.14	2.41
Max	5	5	7

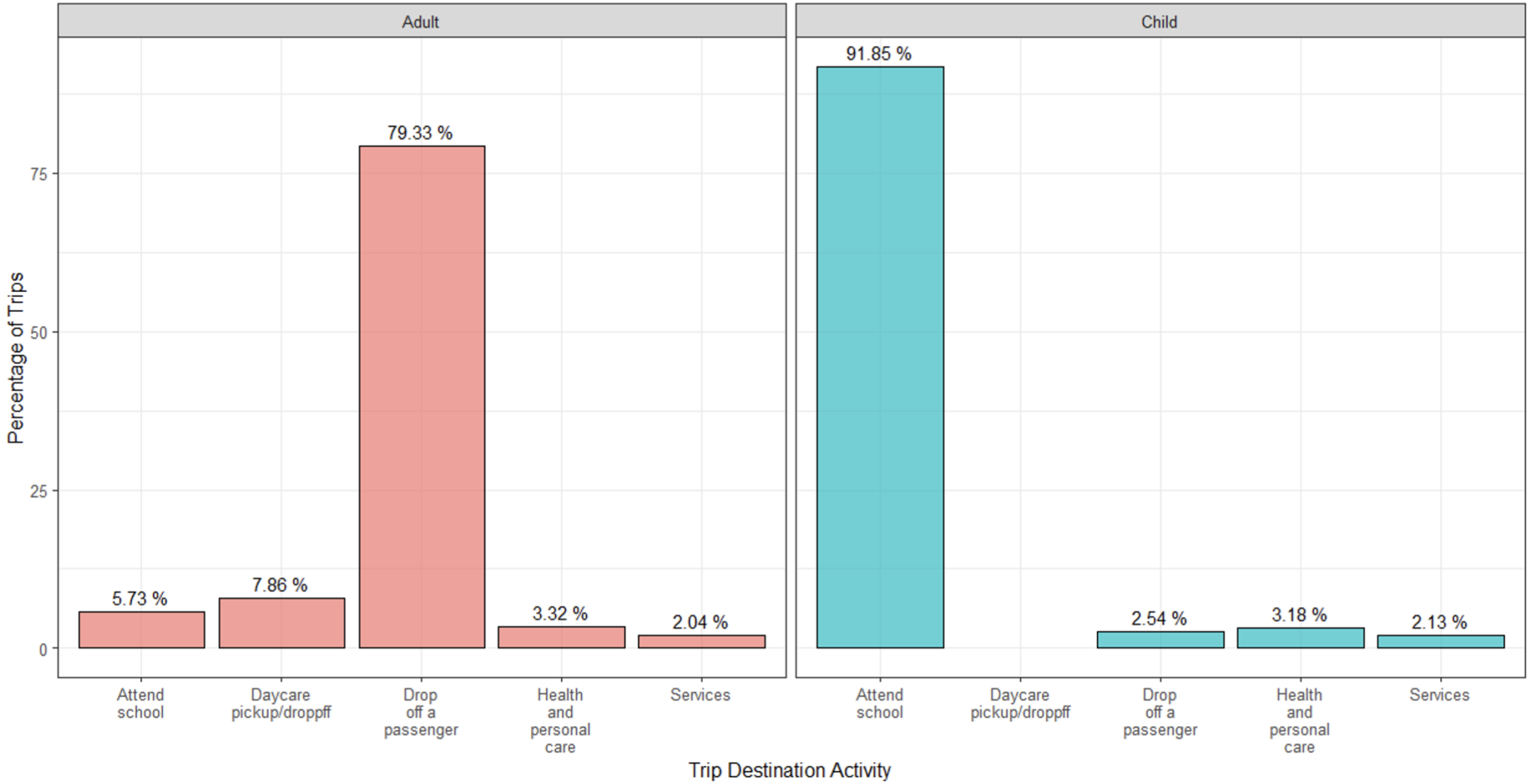
Serve Dependent Trips

Trip Characteristics (Total trips = 7113)			
	Child	Adult	Both
Min	1	1	2
Mean	1.3	0.11	2.42
Max	5	3	7

Mode Distribution



Trip Purpose



Example

- Household: 5 members

Person	Age	Category
1	41	Adult
2	37	Adult
3	9	Child
4	7	Child
5	6	Child

Example

Person/ Time	1 (Adult)	2 (Adult)	3 (Child)	4 (Child)	5 (Child)
	Home	Home	Home	Home	Home

Example

Person/ Time	1 (Adult)	2 (Adult)	3 (Child)	4 (Child)	5 (Child)
	Home	Home	Home	Home	Home
7:00					
7:30	Home - Drop off a passenger (D)	Home - Work (P)			

Example

Person/ Time	1 (Adult)	2 (Adult)	3 (Child)	4 (Child)	5 (Child)
	Home	Home	Home	Home	Home
7:00					
7:30	Home - Drop off a passenger (D)	Home - Work (P)			

Example

Person/ Time	1 (Adult)	2 (Adult)	3 (Child)	4 (Child)	5 (Child)
	Home	Home	Home	Home	Home
7:00					
7:30	Home - Drop off a passenger (D)	Home - Work (P)			
7:40	Drop off a passenger - Home (D)				

Example

Person/ Time	1 (Adult)	2 (Adult)	3 (Child)	4 (Child)	5 (Child)
	Home	Home	Home	Home	Home
7:00					
7:30	Home - Drop off a passenger (D)	Home - Work (P)			
7:40	Drop off a passenger - Home (D)				
8:00					
8:30					
9:00	Home - Drop off a passenger (D)		Home - School (P)	Home - School (P)	Home - School (P)

Example

Person/ Time	1 (Adult)	2 (Adult)	3 (Child)	4 (Child)	5 (Child)
	Home	Home	Home	Home	Home
7:00					
7:30	Home - Drop off a passenger (D)	Home - Work (P)			
7:40	Drop off a passenger - Home (D)				
8:00					
8:30					
9:00	Home - Drop off a passenger (D)		Home - School (P)	Home - School (P)	Home - School (P)

Example

Person/ Time	1 (Adult)	2 (Adult)	3 (Child)	4 (Child)	5 (Child)
	Home	Home	Home	Home	Home
7:00					
7:30	Home - Drop off a passenger (D)	Home - Work (P)			
7:40	Drop off a passenger - Home (D)				
8:00					
8:30					
9:00	Home - Drop off a passenger (D)		Home - School (P)	Home - School (P)	Home - School (P)
9:05	Drop off a passenger - Work (D)				
9:30					
10:00					
11:00					
12:00					
13:00					
14:00					
15:00		Work - Pickup a passenger (B)			

Example

Person/ Time	1 (Adult)	2 (Adult)	3 (Child)	4 (Child)	5 (Child)
	Home	Home	Home	Home	Home
7:00					
7:30	Home - Drop off a passenger (D)	Home - Work (P)			
7:40	Drop off a passenger - Home (D)				
8:00					
8:30					
9:00	Home - Drop off a passenger (D)		Home - School (P)	Home - School (P)	Home - School (P)
9:05	Drop off a passenger - Work (D)				
9:30					
10:00					
11:00					
12:00					
13:00					
14:00					
15:00		Work - Pickup a passenger (B)			
15:20		Pickup a passenger - Home (W)	School - Home (W)	School - Home (W)	School - Home (W)

Example

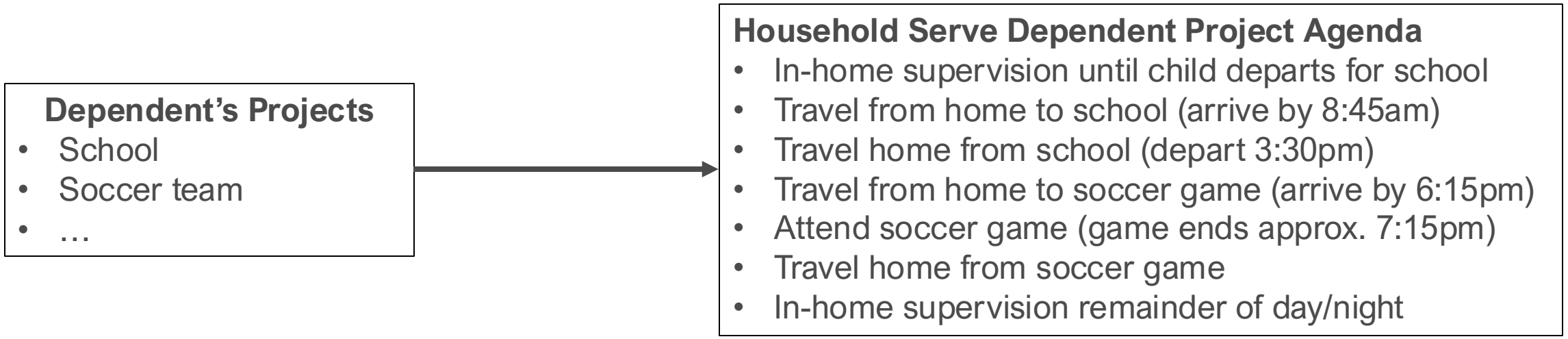
Person/ Time	1 (Adult)	2 (Adult)	3 (Child)	4 (Child)	5 (Child)
	Home	Home	Home	Home	Home
7:00					
7:30	Home - Drop off a passenger (D)	Home - Work (P)			
7:40	Drop off a passenger - Home (D)				
8:00					
8:30					
9:00	Home - Drop off a passenger (D)		Home - School (P)	Home - School (P)	Home - School (P)
9:05	Drop off a passenger - Work (D)				
9:30					
10:00					
11:00					
12:00					
13:00					
14:00					
15:00		Work - Pickup a passenger (B)			
15:20		Pickup a passenger - Home (W)	School - Home (W)	School - Home (W)	School - Home (W)

Example

Person/ Time	1 (Adult)	2 (Adult)	3 (Child)	4 (Child)	5 (Child)
	Home	Home	Home	Home	Home
7:00					
7:30	Home - Drop off a passenger (D)	Home - Work (P)			
7:40	Drop off a passenger - Home (D)				
8:00					
8:30					
9:00	Home - Drop off a passenger (D)		Home - School (P)	Home - School (P)	Home - School (P)
9:05	Drop off a passenger - Work (D)				
9:30					
10:00					
11:00					
12:00					
13:00					
14:00					
15:00		Work - Pickup a passenger (B)			
15:20		Pickup a passenger - Home (W)	School - Home (W)	School - Home (W)	School - Home (W)
15:30					
16:00					
16:30					
17:00	Work - Home (D)				
	Serve dependent trips	D: Auto Driver, P: Auto Passenger, W: Walk, B: Transit			

TASHA Framework Upgrade

- Generate dependent's project schedule first
  - Determine household serve dependent project agenda



TASHA Framework Upgrade

- Generate and schedule adult's work episodes
- Assign serve dependents agenda items to specific household members
  - May require modifying work schedules
  - Logit based models
- Schedule the remainder of the adults' schedules
- Tour-based mode choice (current process)
  - Individual choices
  - Assign autos
  - Within-household ridesharing

THANK YOU

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