Modeling Travel Behavior in Support of Sustainable Transportation

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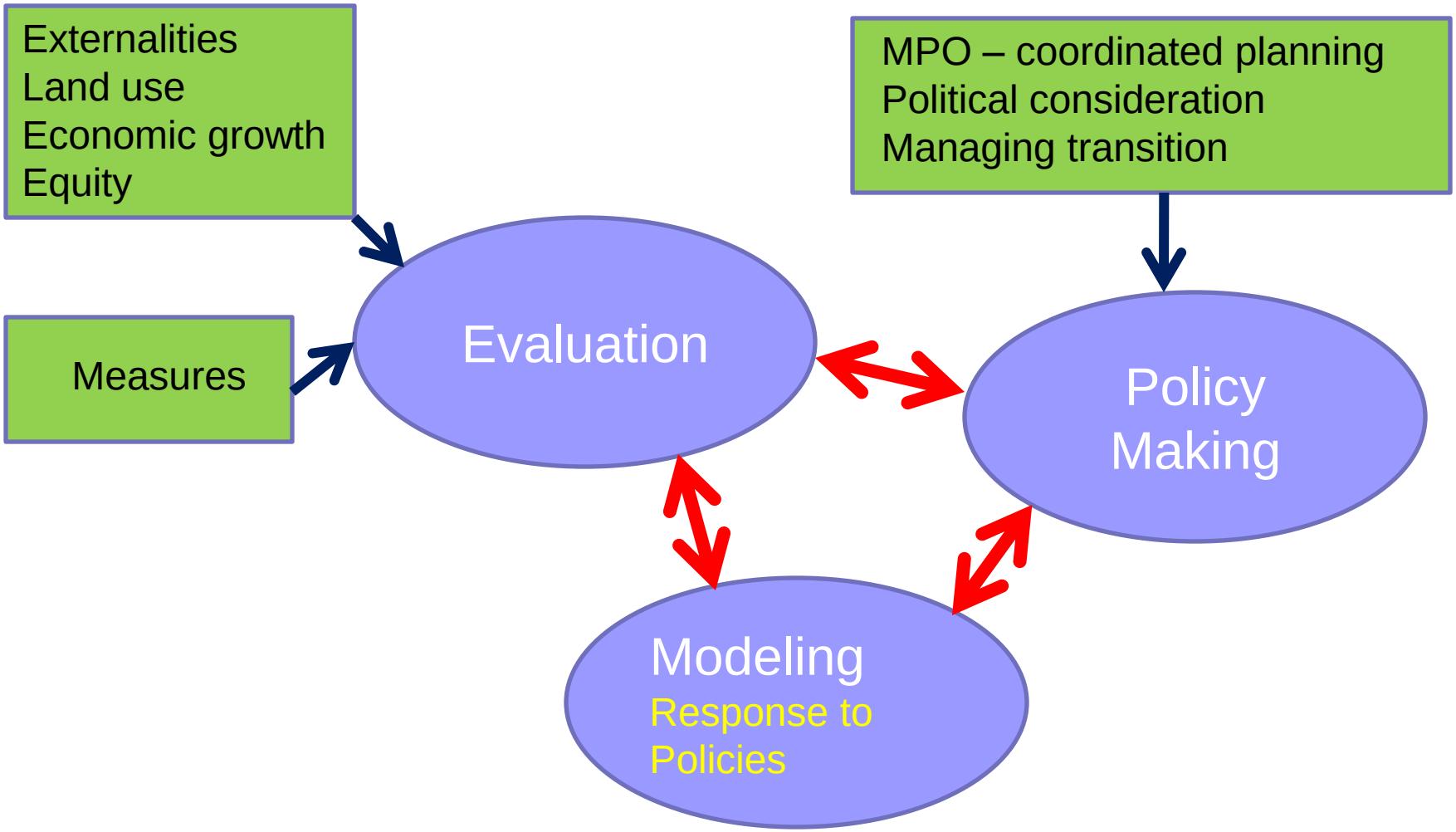
My motivation 1: More Complex Travel Patterns

- decentralization of residential, commercial and work places.
- more leisure time and more travel for non-work purposes.
- more flexibility in work hour.
- increasing participation of women in the work force.
- the introduction of information and communication technologies that enables substitute travel for all purposes.

My Motivation 2:New Needs

- New Policies/Travel demand management
  - Congestion pricing, parking restrictions, HOV.
- Response to ITS
- Land use and growth management
- Air Quality requirements:
  - Speed/acceleration profile
  - Cold/hot starts
  - Vehicle type
  - Off network activity

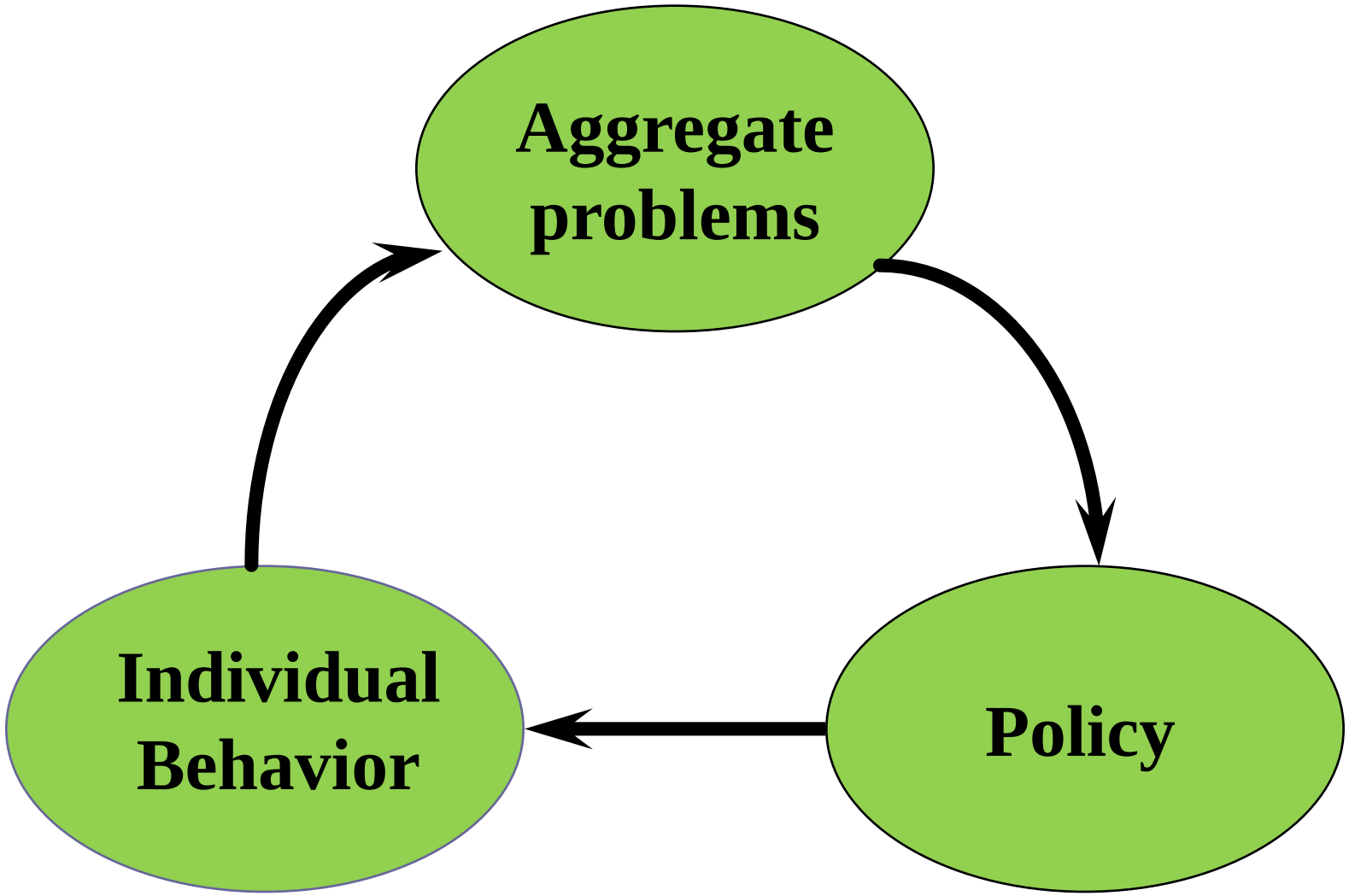
Planning for Sustainable Transportation



Problems with Current Modeling for Sustainable Transportation

- Non-motorized modes
- Policy measures
- Assumption of fix demand
- Biased towards highways
- output for air quality modeling
- Dynamic models
- Integration with land-use models
- Behavioral models

Need of Behavioral Models



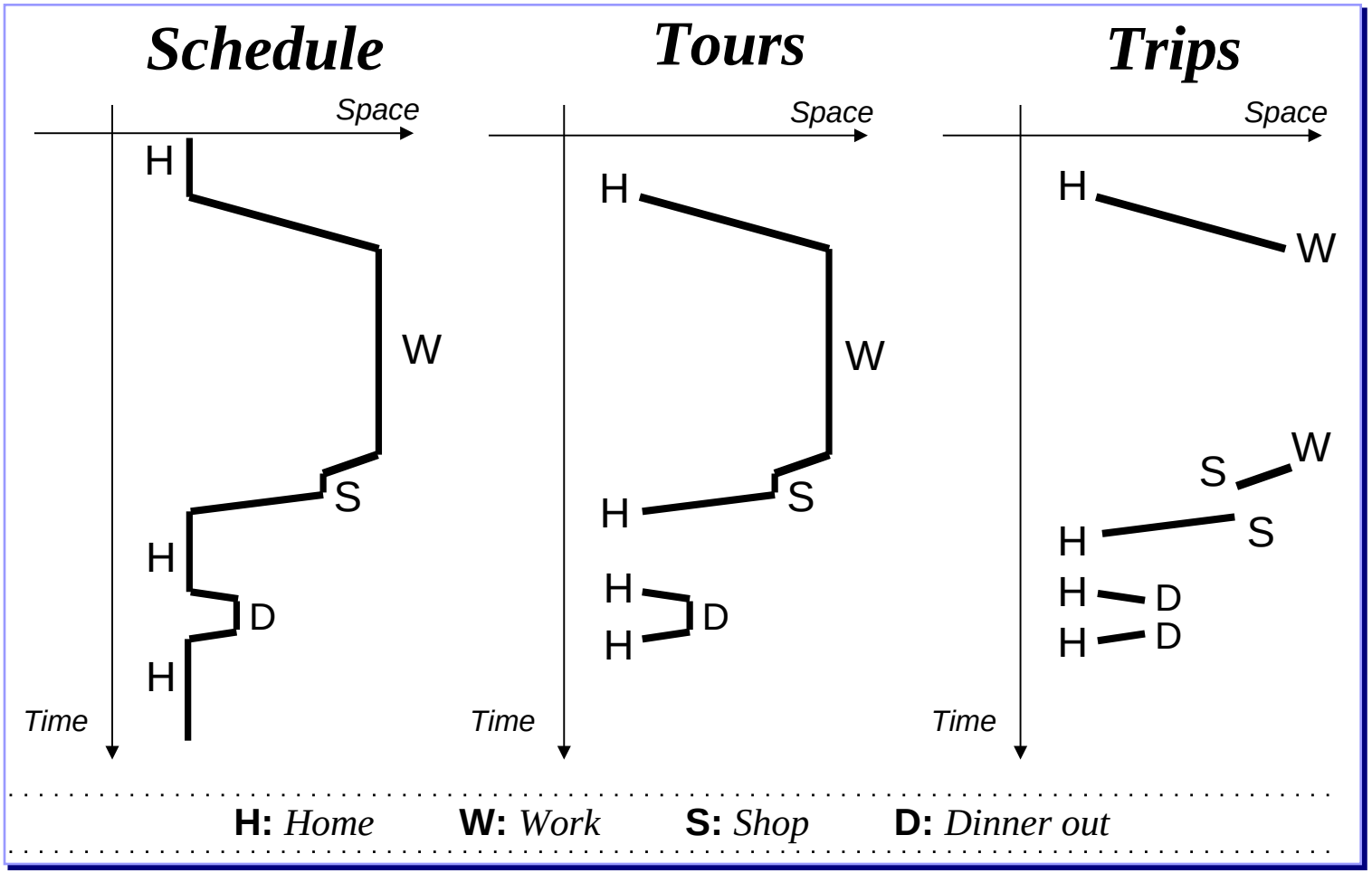
Main Approaches

- Aggregate/Four step models
- Disaggregate/Random Utility Models
- Simulation/Decision Rules
- Insight from Behavioral Science
- Activity based models
- Specific modeling responses
- Scenario analysis

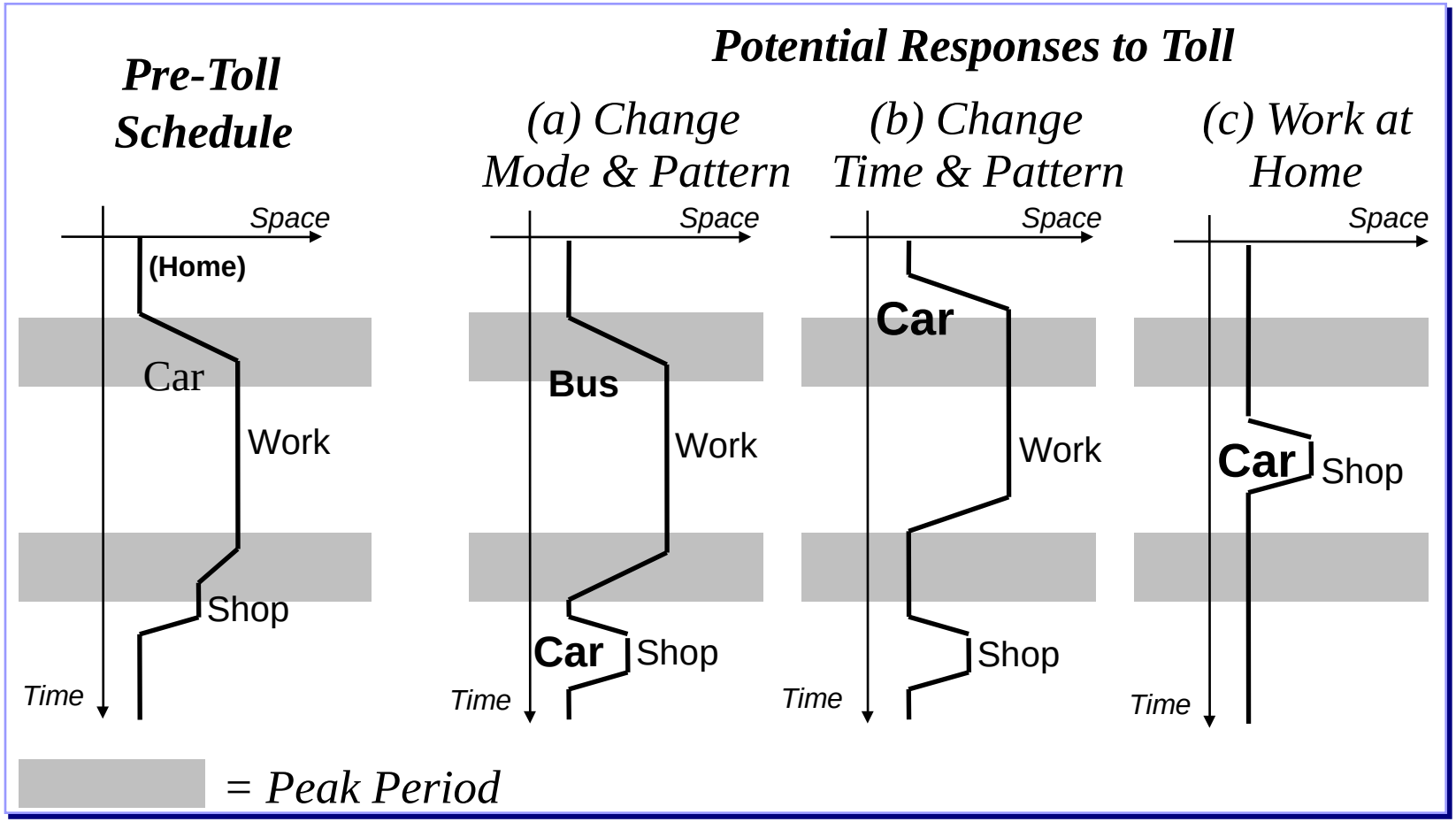
Basics of Activity-Based Travel Theory

- Travel demand is derived from demand for activities.
- People face time and space constraints that limit their activity schedule choice.
- Activity and travel scheduling decisions are made in the context of a broader framework:
  - Conditioned by outcome of longer term processes.
  - Scheduling process interacts with the transportation system.

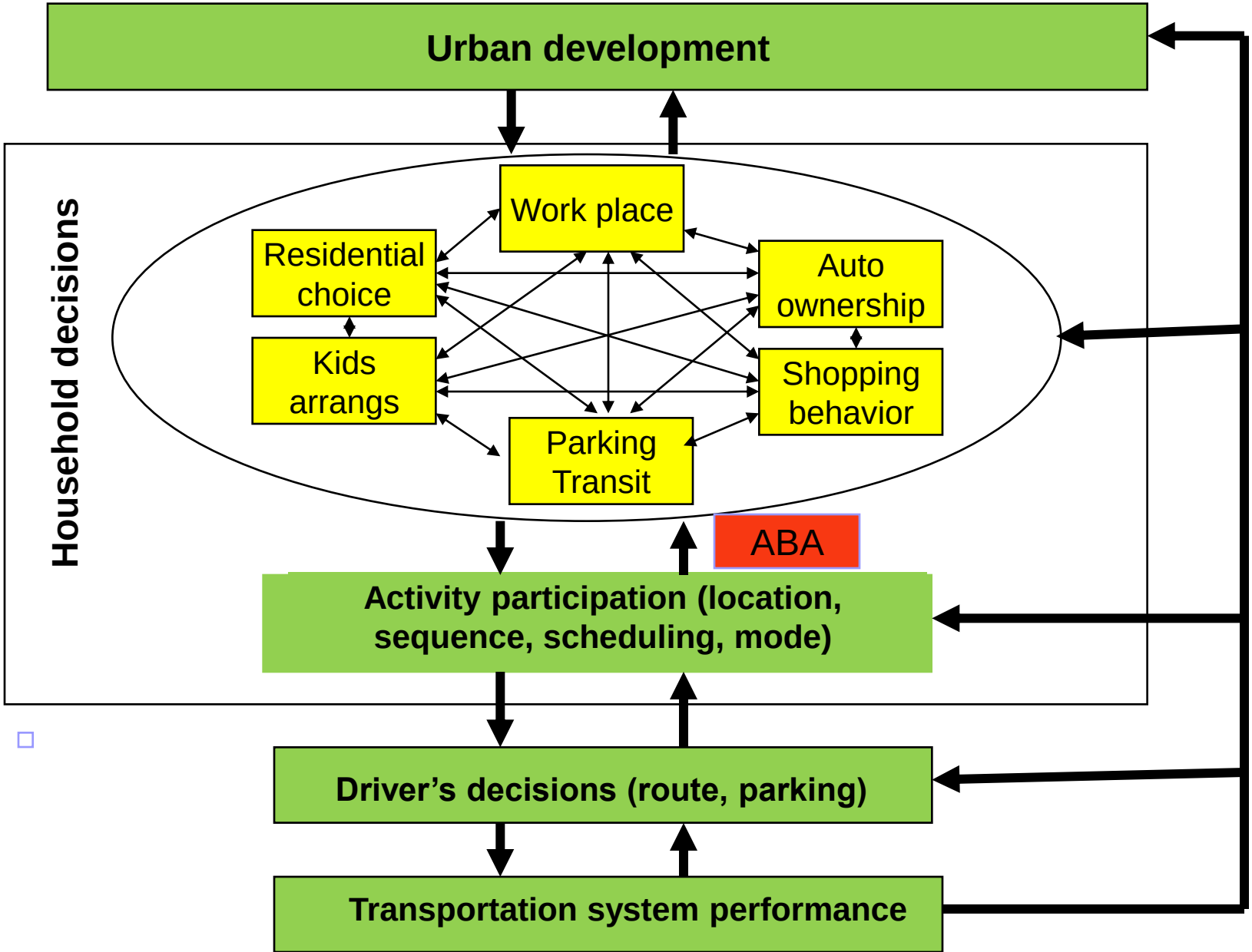
Representing Activity/Travel Behavior



Complex Responses to Policies (e.g., peak-period toll)



Extending the Framework



Portland Policy Scenarios

Policy	Actions
1. Pricing of Automobile Travel.	■Long-term parking cost is doubled in central city. ■SOV toll of one dollar is imposed for a.m. and p.m. peak period travel within the metropolitan area.
2. Telecommuting Incentives.	■Double the current share of work-at-home activity.
3. Transit Improvements.	■Bus fare is halved for travel within the metropolitan area for all time periods. ■Increase bus service resulting in reduced bus waiting time by half for travel within the metropolitan area for all time periods.
4. Combination.	■Combination of Policies 1,2, and 3.

Comparison of Emissions for Base and Combined Scenarios

A.M. Peak Period

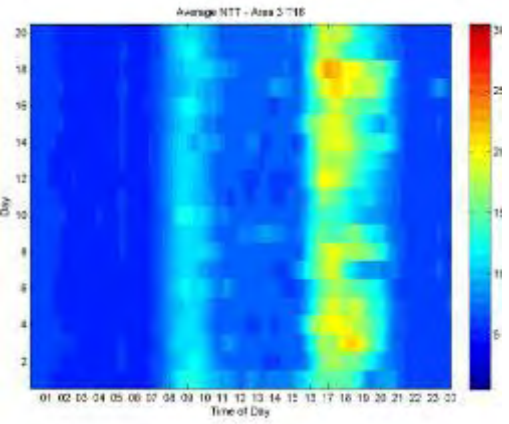
Scenario	Base	Combined	Difference	Percent Difference
VMT	6,078 K	5,905 K	-173 K	-2.84%
Total Hours	542,700	529,100	-13,600	-2.50%
Total Trips	658,950	639,850	-19,100	-2.90%
Cold Trips	472,100	455,900	-16,200	-3.43%
VOC (tons)	12.34	11.99	-0.35	-2.81%
CO (tons)	77.87	75.66	-2.21	-2.84%
Nox (tons)	12.20	11.86	-0.34	-2.77%

Tel Aviv Congestion Pricing Model

- Stated Preference questionnaire
- Revealed Tour data
- Various response options:
  - Pay congestion toll
  - Change mode
  - Change time of day
  - Chance destination
  - Cancel activity

הגודש באזור 3 (מרכז ת"א) הוא החמור ביותר

כבישים מסוג 8



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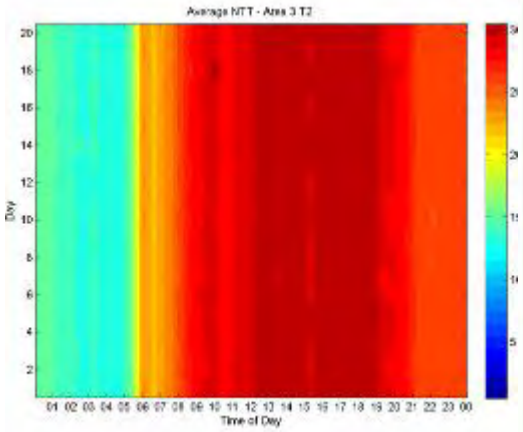

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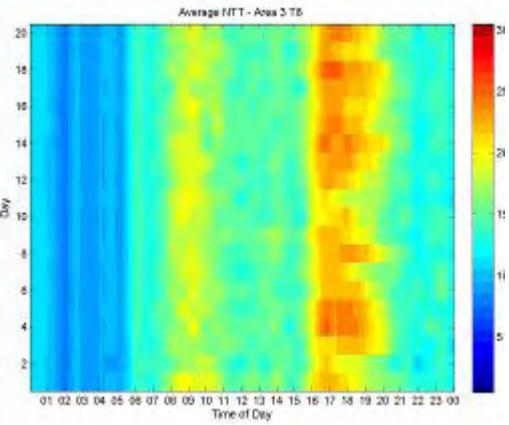

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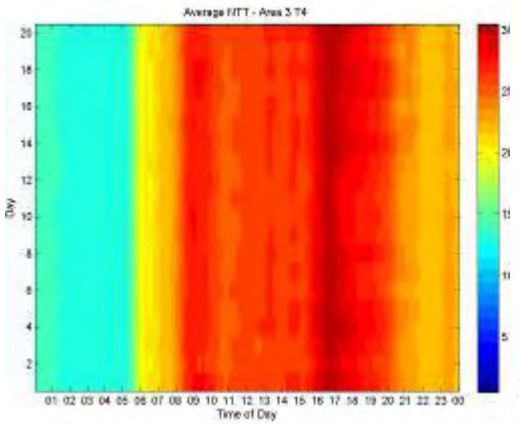
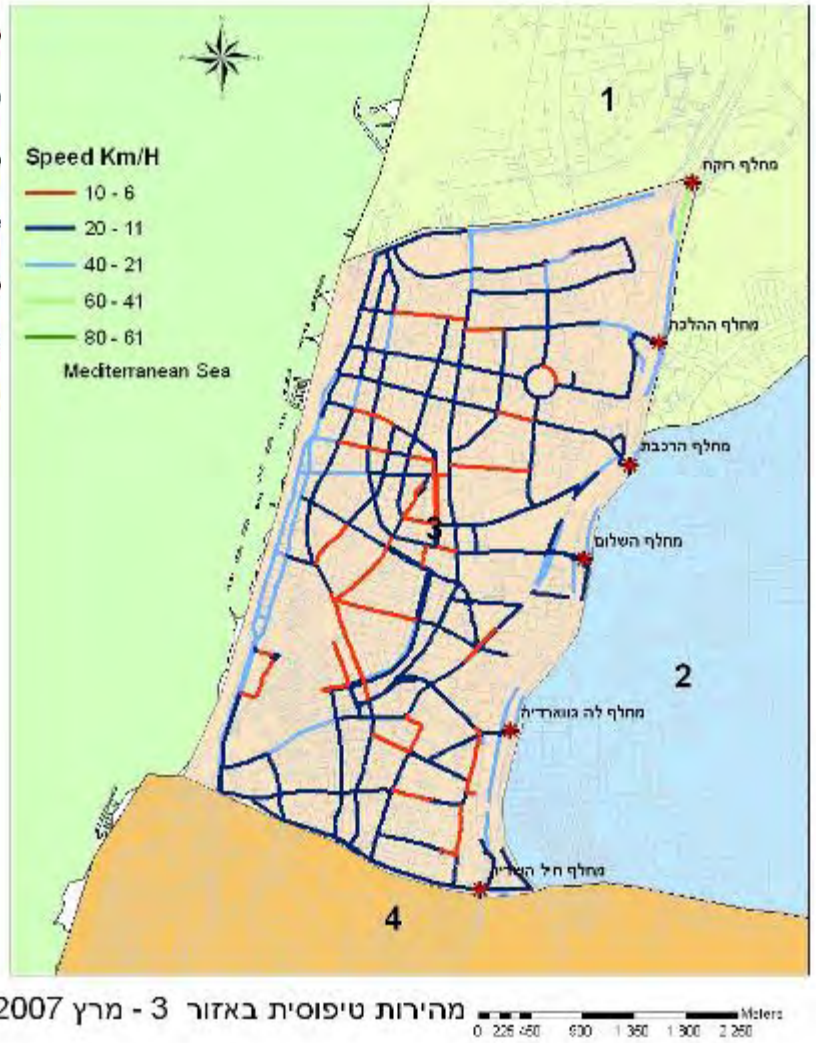
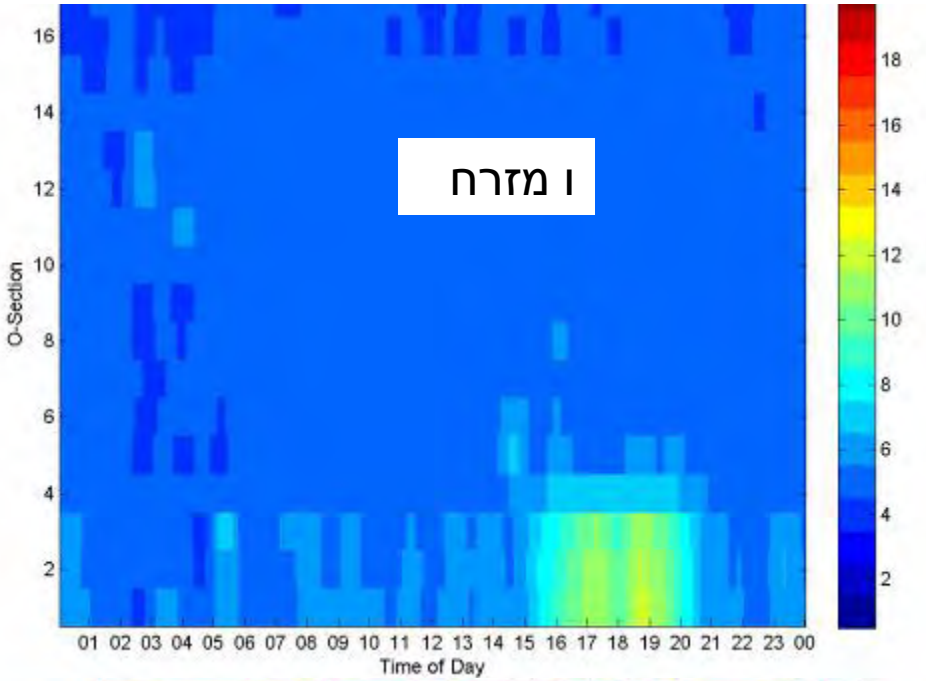




כביש 1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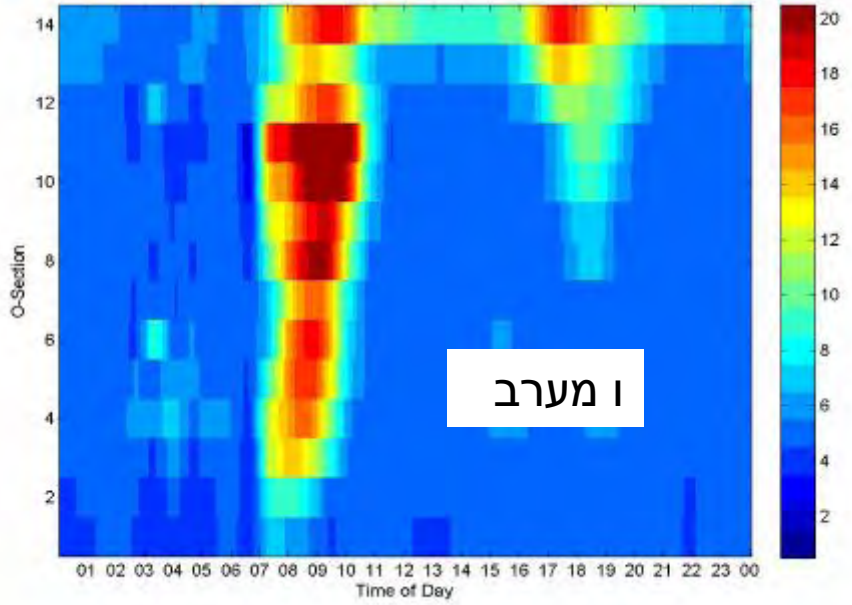
O-Section
Time of Day
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00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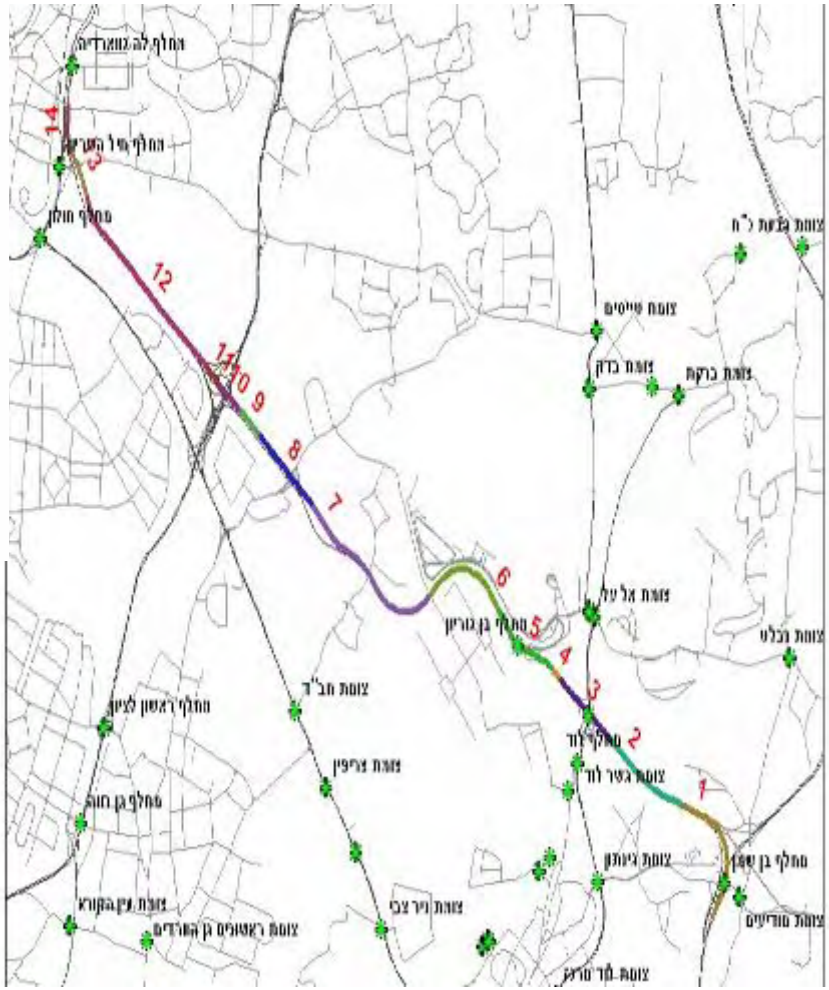
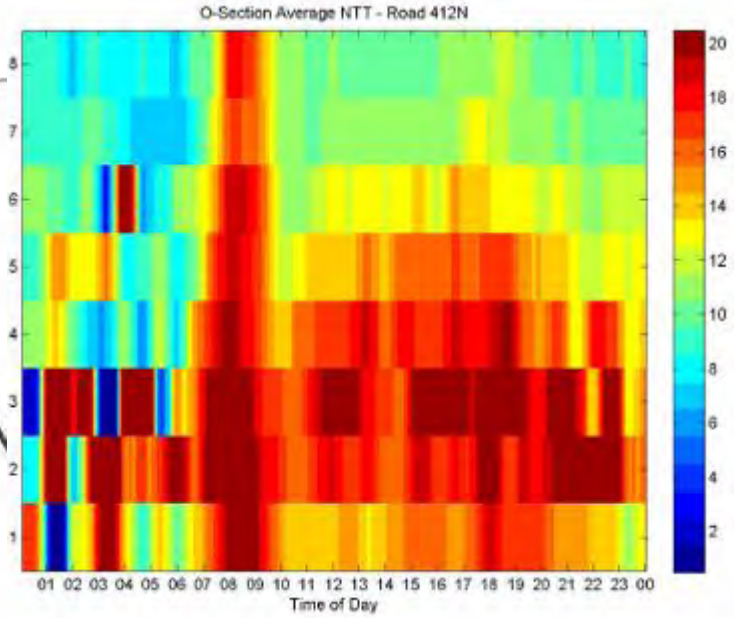
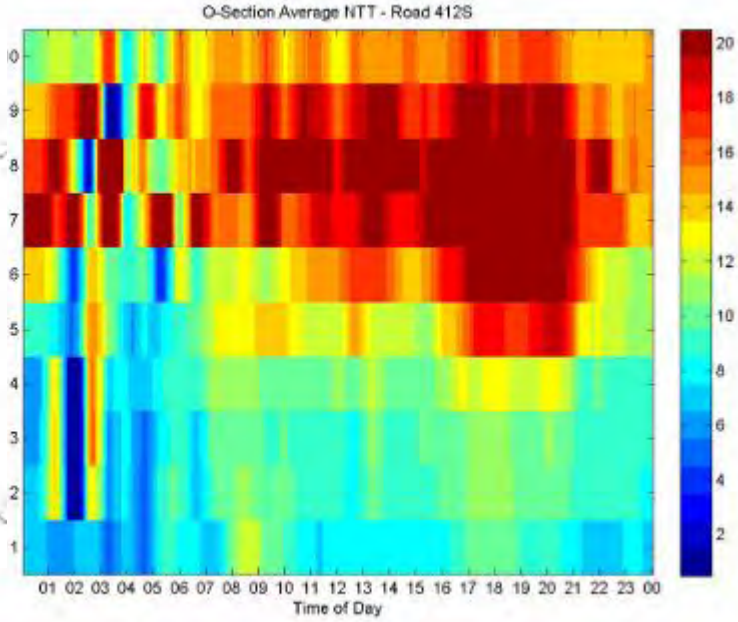


כביש 412

412 צפון

412 דרום





Three contradicting predictions from behavioral science

Theory	Authors	Predicted behavior	Empirical evidence
Hot Stove	Denrell & March, 2001	Drivers exhibit risk aversion	Abdel Aty et al., 1997
Prospect Theory	Kahenman & Tversky,1979; 1992	Drivers exhibit risk seeking (travel time framed as loss).	Katsikopoulos et al., 2002
Payoff Variability	Myers et al., 1960; Erev & Barron, 2005	Increase in variability moves behavior towards random choice.	Avineri & Prashker, 2003