Morley J Weston | **Hanson and Giuliano Ch. 5**

Chapter 5 of The Geography of Urban Transportation deals with different theories related to transportation systems, and their implications for creating and implementing different scenarios using a convergence of math, statistics, simulations, and data science. Primarily describing two theories – market theory and activity theory – and discusses how these are used by planners. The chapter finally discusses how models can be derived from these theories, using trip-based or activity-based models.

Market theory views transportation through the lens of supply and demand, where supply is generally transportation infrastructure and services and demand is trips taken. Market theory implies that these should come to an equilibrium, where the costs of transportation in time and money should be in a state of balance with the number of potential riders. However, the authors not that this fails to take externalities of travel into account – people other than the traveller are affected by increased travel, so the full cost is not accounted for in the market system. Transportation can be seen as a public good – one that is freely available and hard to control the use of, which can lead to it being underfunded in a market system. Therefore, most transportation systems are heavily subsidized by a government. Transportation is also an activity spurred on by other demands, and is rarely a demand in itself – people will not travel if there is nowhere to go. Time plays into this as well, as demand for transportation is much higher at some times of the day, and at different places. The stakeholders and ownership in a transport system are widely distributed, and it can be difficult to determine motivations for individual actors. ICT and the changing nature of work are also affecting demand, so models that once worked no longer do, and planning for the future is equally complex. *Activity theory*, on the other hand, is a system of thought that focuses on human actions, and that people must complete a certain number of activities in a limited amount of time. The authors discuss *space-time paths*, the four-dimensional structure that makes up an individual's path through an urban system. The *space-time prism* is the area that a person could reach from their current place in space and time. The authors also link in communication networks, where some forms must connect two people at the same time, while others are asynchronous.

Different modeling methods are then introduced, which can be either explanatory or predictive, with a specific end goal in mind, often towards influencing policy. Data can be aggregated in different ways, such as into households, districts, or weeks, and these data must be collected and analyzed properly, be it through mathematical, computational, or data-driven modeling, then properly evaluated for accuracy, parsimony, and functionality – is it correct, does it have the right level of complexity, and can it solve a problem? Trip-based models examine the aggregate choice of individuals in their choice of journeys, divided between trip generation (estimation of demand for transport), trip distribution (the demand for travel to different destinations), mode split (choosing between different forms of transport) and network allocation (choice of route). On the other hand, activity-based analysis focuses on people's needs and how they choose to take these different trips. This method has become prominent with the spread of GPS and cell phones, and advances in data processing. While this data is imperfect, it can help determine location, speed, schedules, patterns, groups of people and hotspots, which can be fed into various models, which can try to estimate actors' motivations for an activity. These models are often used in conjunction where appropriate.

The role of location-based data in transportation planning stood out to me. The concentration of constant location data into the hands of a few tech companies is something I find personally concerning – that Facebook, Google and Apple have granularized data about our every movement, and they can control how much of this is available to city planners. Making this data available to city governments would be a real game-changer for transport planning, but much of it is held in the hands of private companies. At the same time, I imagine many people would be distrustful of city officials asking for location data. Cities must have collected a great deal of data already. My EasyCard leaks data about my location every time I take public transport, and Taipei has security cameras that could easily count cars and pedestrians. I've had conversations with privacy activists in Taiwan who believed that data collection on citizens was quite extensive, but I'd be interested in learning how much of this is made available for positive purposes. I also wonder if there are biases in the way that data is collected; public transportation patronage can be counted down to the individual, cars can be loosely estimated, but pedestrians and cyclists are difficult to track for trip-based modeling. Has this altered urban planning decisions around the world, or are there established methods to compensate for variable data quality?

As for the models themselves, it seems that market based and trip-based models are viewed with suspicion by the authors, failing to compensate for externalities and for induced demand on transport systems. Looking at my own trips in the past few weeks, I think that my behavior could be predicted either way. I commute from Guting to NTU 5-6 days per week, done either by metro, walking, bus, YouBike, or by my own bicycle./My modal choice is influenced by a number of outside factors – a pleasant day and no hurry leads to me walking to school, an early class or heavy rain leads to me taking the metro. This choice could be modeled pretty simply by some weighted factors.

However, I only have class twice per week, and could potentially do a great deal of my schoolwork in a cafe, a public library, a friend's office, at home, or really anywhere with access to electricity and a desk. I choose to go to the university because it is close, free, and convenient, and therefore make an activity-based choice to travel to school in the first place. It seems that both models are then relevant; trip-based models can be used to simulate commutes and regular travel, where activity-based modeling can be used for things where transportation users actually have a choice in the matter. It seems there is some use for a 'grand unified theory' of transportation modeling that can combine the two theories.

It seems that we are hitting a point in history where the future of urban transportation will become very hard to predict. Some feel that self-driving cars and ICT will lead more and more people to move into the countryside, becoming more tolerant on long commutes. Others see the unprecedented global urbanization of the past few decades as an ongoing trend, where the problem of transportation will be one of dealing with increasing density and shortages. If urban planners are going to address the problems of the next 20-30 years, then adaptability and changeability will be a huge concern, one that must make today's planners especially tense. Fortunately, data collection and processing is bound to improve immensely in the coming decades, and the development of these models will outpace the changed to the world around us.