Reading reflections

USP 570

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Week 2 (Due April 11)

Mainpoint

Accessibility is the keyword this week. Levinson and Krizek (2018 ch. 1,2) explains different ways of understanding that decision-making and introduces the concept of accessibiliy. OECD (2017) also provide some latest research findings, methodologies and data sources on urban accessibility. Handy (2018) further argues that Accessibility is more worth focusing on.

Based on Planned Behavior Theory and Social Cognitive Theory, Bopp, Gayah, and Campbell (2015) explore the link between public transit use and active commuting, using a typical reseach using statistical method.

Takeaway

- The theories and models explaining how land use/built environment was measured and incorporated into the analysis

Levinson and Krizek (2018, 4–5) give a brief overview of some of the relevant theories, which largely have three sources: economics, psychology, and biology. In travel behavior research, the theory of utility maximization efforts to forecast choice of travel mode. Mode choice models rooted from *utility theory*[1] and *consumer behavior theory*[2] in economics and psychology. For transport choices tending to be discrete, scholars applied the utility theory to *discrete-choice model* and *multinomial logit model*[3]. Above models are associated with decisions to maximize utility while minimize cost.

Another category is the cognitively oriented theories. *social learning theory*[4], the *theory of*

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[1] the "Law of Comparative Judgment," by Louis Leon Thurstone in 1929, which known as (utility = predicted utility + random term) (Levinson and Krizek 2018, 3).

[2] Kelvin Lancaster's *consumer behavior theory* (1966) use a function of both the trip's benefits and its costs to repesent the demand for a transit trip.

[3] Stanley Warner first applied concepts of *utility theory* to disaggregate travel in 1962. In 1975, Daniel McFadden formalized *discrete-choice model* to predict transport mode choice in anticipation of the building of the Bay Area Rapid Transit (BART) system in the San Francisco Bay Area.
Moshe Ben-Akiva and other transportation modelers developed the *multinomial logit model* (MNL) in 1985.

[4] Albert Bandura (1977) posits that by "observing others, one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action."

planned behavior[5], the *social ecological models*[6], and the *prospect theory*[7]. THe cognitively oriented models are more explicit about the specific variables that explain behavior while models on utility theory are more explicit about the mechanism by which these variables act on behavior.

There are also some other explaination around tranport models. jones2009role summarizes that the evolving paradigm in transport research and policy agendas includs vehicle-based (P1), trip-based (P2), activity-based (P3), attitude-based (P4), and dynamics-based. OECD (2017) introduces a simple framwork with individual dimension (person-based, location based) and transport dimention (travel-time-based, generalised-costs-based). Meanwhile, Zhang and Van Acker (2017) proposes a paradigm shift from traditional approaches to the life-oriented approach for a better understanding of travel behavior and for better supporting cross-sectoral transport policymaking.

In short, these theories of travel behavior are useful but no single theory can explain all behavior. Scholars acknowledge its limitations and try to find human-centered solutions instead of vehicle-centered.

- Accessibility

"Access is the fundamental force for understanding cities,"…"is a concept that helps understand and conceptualize the complex relation between transport and land use in a city and their impacts on city organization, development, and planning to achieve more sustainable outcomes."(Levinson and Krizek 2018, 22) Lyons and Davidson (2016) argue for a focus upon the *Triple Access System* of spatial proximity in land use system, physical mobility in transport system and digital connectivity in telecommunications system as a framework for policy and investment decisions that can harness flexibility and resilience.

Levinson and Krizek (2018) introduce four measure methods for network size[8], accessibility

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[5]The theory of planned behavior focuses on the role of different types of beliefs in explaining behavior. *Behavioral beliefs* ("What will result?") contribute to people's perceptions of possible outcomes weighted by an evaluation of those outcomes. *Normative beliefs* ("What would other people think?") consider the reactions of referent individuals weighted by an individual's motivation to comply with those referent individuals. *Control beliefs* ("What else would facilitate or constrain this behavior?") suggest the user considers an array of factors that may advance or inhibit the behavior and these are weighted by the perceived power of each factor.

[6]*Social ecological models* suggest that there are a variety of contexts—individual, interpersonal, organizational, and community—that operate at multiple levels to influence individual action. "In addition to intra-individual factors, ecological models say that human behavior is shaped by higher-level factors including organizational, policy, social, and physical environments, as well as dynamic interactions across multiple domains."

[7]*Prospect theory* explains why people are seemingly irrational when analyzed through the prism of utility theory. Whereas formal utility theory assumes people only care about final outcomes, prospect theory suggests that decisions depend on how the alternatives are presented. The theory suggests that people are risk-averse when seeking potential gains; they are also risk-seeking when addressing potential losses.

[8]"Law of the Network" (and in a computer networking context, Metcalfe's Law, named for Robert Metcalfe, developer of the Ethernet network- ing standard) can be expressed as: $S = N(N - 1)$, where S is the size of the network (number of markets), N is the number of nodes.

to employment[9] , overall accessibility[10], and gravity model[11]. Network size indicates an attribute of built environment. Accessibility can descibe the "interaction by a function of the travel cost, such that distant interactions have less weight than nearby interactions." gravity models also consider distance or travel time and disclose that the interaction between places is inversely proportional to travel cost.

The authors emntioned that "in cumulative opportunities measures, $f(C_{ij}) = 1$ if cost is less than threshold T and 0 otherwise, so only employment within the threshold is considered." Here $f(C_{ij})$ seems like a indicator function denoted by $I_A(x) = \begin{cases} 1 & x \in A \\ 0 & x \notin A \end{cases}$ (Casella and Berger 2002, Definition 3.4.5) where A represents a set. I cannot understand this case well.

Levinson and Krizek (2018) also introduce some important concepts: the four-Cs Diamond of Action (constraints[12], complementors and competitors, chances) affect choices, absolute and relative accessibility[13], regional accessibility[14] etc. I put them in Notes for future use.

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[9]$A_j = \sum_j E_j f(C_i j)$ where: A_i represents accessibility to employment from zone i. E_j is employment at destination j. $f(C_{ij})$ is a function of the travel cost (time and money) between i and j. The higher the cost, the less the weight given to the employment location.

[10]an overall accessibility measure is a summation of the measures of all origins: $A = \sum_j W_i A_i$ where A is overall accessibility for region, W_i represents workers living at origin i

[11]Isaac Newton (1687) first found the relationship between the gravitational force, distance, and mass. Ernest Ravenstein (1876-1889) developed a similar idea in the context of the social sciences. William J. Reilly developed a "Law of Retail Gravitation" (1931) John Q. Stewart developed the notion of demographic force (F) between places, and this demographic force equation forms the basis of the gravity model used in many transport planning models. Alan Voorhees (1956) first applied the gravity model to address problems of urban transport planning.

$$T_{ij} = K_i K_j \frac{T_i T_j}{f(C_{ij})}$$

$T_i = \sum_j T_{ij}$, $T_j = \sum_i T_{ij}$, $K_i = \frac{1}{\sum_j K_j T_j f(C_{ij})}$, $K_j = \frac{1}{\sum_i K_i T_i f(C_{ij})}$ where: T_{ij}: trips between origin i and destination j T_i: trips originating at i (for example, workers) T_j: trips destined for j (for example, jobs) f: distance decay factor, as in the accessibility model C_{ij}: generalized travel cost between i and j K_i, K_j: balancing factors solved iteratively This gravity model suggests several things. First, as city size increases, mean commuting time increases. The structure of gravity models implies diminishing marginal returns to job opportunities at the edge, since each additional job is less and less likely to be taken and thus less likely to increase travel time. Second, these models are largely independent of density—except to the extent that density changes network speed. A uniform increase in density increases the opportunities within each time band proportionately, and thus does not change the distribution of travel times. Third, if preferences shift, mean travel time will change inward or outward. Fourth, if congestion rises, more opportunities will be farther away in terms of travel time, and fewer nearby—implying that average commuting time will rise.

[12]Constraints are matters that—voluntarily or involuntarily, explicitly or implicitly—set bounds on the daily, weekly, annual, or longer-term decisions that a household makes; they limit the range of opportunities available to any one person and demarcate the frontier that an individual cannot or will not cross. Primary constraints include time, space, finances, and responsibility.

[13]Absolute accessibility is the total measure of accessibility within a particular area. A transport improvement increases overall accessibility—analogous to increasing the size of the pie. Relative accessibility is the share of total accessibility associated with a particular place. A new transport facility increases the relative accessibility of those points that can directly use the facility—analogous to increasing the percentage of the pie that a particular slice comprises.

[14]Regional accessibility is determined by the regional structure of a metropolitan area and incorporated variables such as location, type of activities, and size of activities that affect shopping behavior. Local

Discussion

- the discussion around "M", "A", and "Ds"

Handy (2018)

The original "three Ds," coined by (Cervero and Kockelman 1997) followed later by Destination accessibility (Ewing and Cervero 2001) which measures ease of access to trip attractions.

Cervero and others (1997)

It seems that scholars are always aware of the importance of accessibility. The difference between "Ds" and "A" is, "Ds" inculde some factors of built environmnet, which are more visiable, more measurable. "Ds" are easy to applied on urban planning, policy, regulation. "A" is a abstract concept, a estimated value. "A" can be a comprehensive evaluation, a overall objective. They cannot replace each other.

- About t-test Using t-test and regression analysis, Bopp, Gayah, and Campbell (2015) explore the relatioship between public transit use and active commuting. It also shows several typical difficulties of quantitative analysis in social studis.

The data in social studies are difficult to satisfy the t-test requirments.

- the sample size are large enough but the numbers of observation are imbalanced.

- random sampling: the sampling has selection bias. the paticipants are high-income white male who advocate active commuting.

- independent assumption: public transit use and active commuting might have high correlation. Similarly, other variables such as gender, race, and income level could also show some interaction effects.

- normality assumption and constant variance: the authors examine the colinearity

A full factorial design may help to identify the interaction effects.

Compare the observed proportion to the national levels. Only one fifth people's income are higer than 50k $ per year in the U.S. (cencus, 2018).

Since the data do not satisfy the requirements for a t-test, consider using a nonparametric test such as Mann-Whitney test.

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accessibility, is primarily determined by nearby activity (where "nearby" is used to refer to the neighborhood unit, approximately one-half to one mile (800 to 1,600 m) in residential areas). Areas with higher local accessibility would be oriented to convenience goods, such as supermarkets and drug stores, and located in small centers.

Notes

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