Reading reflections

USP 570

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Week 3

Levinson and Krizek (2018 ch.1) Muller (2017) Welch, Gehrke, and Wang (2016) Liu and Shi (2017) Chen, Rufolo, and Dueker (1998)

### Main point

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

Levinson and Krizek (2018 ch. 1) explains different ways of understanding that decision-making and give a brief overview of some of the relevant theories, which largely have three sources: economics, psychology, and biology [pp. 4-5]. In travel behavior research, the theory of utility maximization efforts to forecast the choice of travel mode. Mode choice models rooted from *utility theory*[[1]](#footnote-21) and *consumer behavior theory*[[2]](#footnote-22) 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]](#footnote-23). Above models are associated with decisions to maximize utility while minimizing cost.

Another category is cognitively oriented theories. *Social learning theory*[[4]](#footnote-24), the *theory of planned behavior*[[5]](#footnote-25), the *social ecological models*[[6]](#footnote-26), and the *prospect theory*[[7]](#footnote-27). 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. Based on Planned Behavior Theory and Social Cognitive Theory, Bopp, Gayah, and Campbell (2015) explore the link between public transit use and active commuting.

There are also some other explanations around transport models. Jones (2009) summarizes that the evolving paradigm in transport research and policy agendas includes vehicle-based (P1), trip-based (P2), activity-based (P3), attitude-based (P4), and dynamics-based. OECD (2017) introduces a simple framework with individual dimension (person-based, location-based) and transport dimension (travel-time-based, generalized-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 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

Accessibility is the keyword this week. In addition to Levinson and Krizek (2018 ch. 2), OECD (2017) provide some latest research findings, methodologies and data sources on urban accessibility. Handy (2018) further argues that Accessibility is more worth focusing on.

“Access is the fundamental force for understanding cities,”…" is a concept that helps understand and conceptualize the complex relationship 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 the transport system and digital connectivity in the 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]](#footnote-28), accessibility to employment[[9]](#footnote-29), overall accessibility[[10]](#footnote-30), and gravity model[[11]](#footnote-31). Network size indicates an attribute of the built environment. Accessibility can describe 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.

In this part, authors say that “in cumulative opportunities measures, if cost is less than threshold T and 0 otherwise, so only employment within the threshold is considered.” Here seems like an indicator function denoted by (Casella and Berger 2002, Definition 3.4.5) where 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]](#footnote-32), complementors and competitors, chances) affect choices, absolute and relative accessibility[[13]](#footnote-33), regional accessibility[[14]](#footnote-34) etc. I put them in Endnotes for future use.

### Discussion

* The discussion around “A” and “Ds”

Handy (2018) argues that current academic literature pays too much attention to Ds and suggests replacing Ds with A, accessibility. It is true that there is a large number of articles discussing the effects of the built environment on travel behavior. Scholars also don’t forget accessibility in the past decades. In the year of the original “three Ds,” coined by Cervero and Kockelman (1997), Cervero (1997) also published a paper to advocate focusing on accessibility rather than mobility. “Not only do our objective change, but so do our analytical methods, styles of planning, and strategies” change from automobility to accessibility, from for movement to for people and places, from working on the supply side to emphasizing demand management. One of the followed D, destination accessibility (Ewing and Cervero 2001) involved A to measures ease of access to trip attractions.

The difference between Ds and A is, Ds focus on some elements of the built environment, which are more visible and more measurable. Thus Ds are easy to apply in urban planning, policy, regulation and easy to implement. A is an abstract concept, an estimated value. A could be a comprehensive evaluation, an overall objective. Sometimes, the verbal A is subjective while the A in some models is too complicated for many people. Some online tools for evaluating A are helpful. Ds and A will not replace each other in the future.

* How to improve the study design.

Using t-test and regression analysis, Bopp, Gayah, and Campbell (2015) explore the relationship between public transit use (PT) and active commuting (AC). What is special about this research is that they compare characteristics of the sample between two travel modes by t-test, and use many socio-economic or built environment factors including PT to predict AC by linear regression. As the author mentioned, “the two travel modes are more intrinsically connected than previously thought.” This result may be predeterminate because PT and AC are the components of the multi-modal trips. For the people without a car, PT and AC are complementary modes in single-modal trips. Before reaching any conclusions, distinguishing these types of trips and groups is necessary. The discrete-choice model might be better for this case.

Not only PT and AC, but many variables such as gender, race, and income level may not be independent. This study checks the collinearity but doesn’t report the details. A factorial design might help to identify the interaction effects among the chosen factors. The nonparametric test could work for dependent factors. Some checks of normality, residuals, and variances could help to improve the study design too.

The authors say “our sampling strategy and use of a volunteer, convenience sample limit the generalizability as well as our ability to objectively assess land use factors.” This sampling way hurts the randomization more, which is a basic requirement for t-test. The final 748 participants are recruited by 5251 emails. If there are 9766 potential participants as authors said, the conclusion may be subject to the selection bias. The participants who can access and are willing to complete the electronic survey, and live in a transit-available community, maybe AC advocators and have a strategic bias. The sample size is large enough, but the numbers of observations are imbalanced (596 non-public transit riders vs. 152 public transit riders). Using the proportions tests to compare the observed proportion with national levels may portray the respondents. For example, one-fifth people’s income are higher than 50k $ per year in the U.S. (census, 2018), does this sample have the same proportions? If not, the conclusion is fit for some specific groups.

# Notes

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1. the “Law of Comparative Judgment,” by Louis Leon Thurstone in 1929, which known as () (Levinson and Krizek 2018, 3). [↑](#footnote-ref-21)
2. Kelvin Lancaster’s *consumer behavior theory* (1966) use a function of both the trip’s benefits and its costs to represent the demand for a transit trip. [↑](#footnote-ref-22)
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. [↑](#footnote-ref-23)
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.” [↑](#footnote-ref-24)
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. [↑](#footnote-ref-25)
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.” [↑](#footnote-ref-26)
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. [↑](#footnote-ref-27)
8. “Law of the Network” (and in a computer networking context, Metcalfe’s Law, named for Robert Metcalfe, developer of the Ethernet networking standard) can be expressed as: , where is the size of the network (number of markets), is the number of nodes. [↑](#footnote-ref-28)
9. where: represents accessibility to employment from zone . is employment at destination . is a function of the travel cost (time and money) between and . The higher the cost, the less the weight given to the employment location. [↑](#footnote-ref-29)
10. an overall accessibility measure is a summation of the measures of all origins: where is overall accessibility for region, represents workers living at origin [↑](#footnote-ref-30)
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.

    where: : trips between origin and destination : trips originating at (for example, workers) : trips destined for (for example, jobs) : distance decay factor, as in the accessibility model : generalized travel cost between and : 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. [↑](#footnote-ref-31)
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. [↑](#footnote-ref-32)
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. [↑](#footnote-ref-33)
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 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. [↑](#footnote-ref-34)