Representations of everyday travel experiences: Case study of the Dallas-Fort Worth Metropolitan Area

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ABSTRACT

Disparity of access to transportation also affects access to essential urban resources, particularly for lower income populations and minorities. Studies have shown how current transportation planning practices are dominated by the notion of planners as experts that produce the knowledge of future transportation needs using a series of analytical steps and computer modeling. Consequently, existing practices such as transport modeling perpetuate barriers to mobility and lack of accessibility, and therefore, there is a need to make explicit how these existing practices exclude particular population groups. Using the Dallas-Fort Worth (DFW) Metropolitan Area as a case study, this paper makes a stronger connection between the assumptions planners make regarding transportation needs and goals with everyday travel experiences of a variety of residents. This research utilizes travel diaries to provide in-depth understandings of individual's travel experiences from various neighborhoods in the DFW Region to understand how differences in mobility and accessibility affect access to places.

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1. Introduction

Disparity of access to transportation also affects access to employment, education, and other essential urban resources. Additionally, barriers to mobility largely affect lower income populations and minorities (Jimenez and Mattingly, 2009; McKenzie, 2013). In metropolitan regions that are fragmented and auto-oriented, disparity between those who have access to cars and those who do not perpetuates social inequity and poverty (Blumenberg and Manville, 2004). Metropolitan regions in the U.S. and many other countries in the world rely on some type of transportation modeling process to determine their long term transportation demands and decisions on funding and projects. The discursive structure of the transportation modeling process plays a key role in maintaining (or challenging) disparity of socio-economic opportunities in metropolitan regions. The underlying assumptions of people's travel behavior and needs in regional modeling processes are discursively constructed, and thus can have long term implications on their everyday travel experiences.

Although the federal government requires public participation for all regional transportation planning and projects (Weiner, 2008), there are various population groups, typically of lower income and minorities that continue to be underrepresented in the planning and modeling process. Underrepresentation, in the various forms of exclusion in institutional decision-making process (Arnstein, 1969; Quick and Feldman, 2011) or reliance on institutionalized transportation practices—such as the Four-Step Transportation Model—tends to disadvantage low mobility population that is correlated with low car ownership and income (Martens and Hurvitz, 2011). Meanwhile, studies have shown that travel experiences differ for different population groups (Blumenberg, 2004; Hine and Mitchell, 2001; Jimenez and Mattingly, 2009; Rosenbloom, 2005). When some population groups continue to be underrepresented in the planning and modeling process, the effects become generational. Institutionalized processes such as planning and land use mechanisms, therefore, can perpetuate social inequalities (Wilson et al., 2008).

Current transportation planning practices continue to be dominated by the notion of planners as experts that determine the underlying assumptions and inputs for predicting future transportation needs using a series of analytical steps and computer modeling (Owens, 1995; Willson, 2001; Willson et al., 2003). Transport models, such as the traditional Four-Step travel demand model, still have the underlying assumptions of approaches based on accommodating future travel demands (Martens, 2006). The outputs of the modeling process are projections of the amount and spatial locations of future transportation demands wherein these outputs represent some, but not all, diverse population groups' transportation needs. When outputs from transportation models are "presented as 'findings' rather than a form of discourse" (Willson, 2001, p. 7), then transport decisions are unable to recognize alternative knowledges that may contradict what the model finds.
This paper aims to show the disconnect between, on the one hand, the assumptions planners make regarding transportation needs and goals, and on the other, the everyday experiences of residents from various communities in the Dallas-Fort Worth (DFW) Metropolitan Area. There have been few empirical studies of how the expert-based knowledge of transportation planners compares to the everyday experiences of the targeted population. Yet, there is a potential of transforming these everyday travel experiences into, what Friedmann (2011) calls experiential knowledge. Furthermore, mutual understanding between the expert-based and experience-based knowledges may produce alternatives to transportation planning practices and outcomes that better serve underrepresented population groups. Therefore, there is a need to study and contextualize everyday household travel data to understand transportation needs of all segments of the population.

2. Literature review

In the U.S., federal policies since the Interstate Highway Act of 1954 was established based on the understanding that the main function of transportation is to provide access to land; and the transportation planners and engineers’ role is to provide mobility by forecasting future travel demand and determine facilities to meet those forecasted demands (Dittmar, 1995). Consequently, federal transportation policies support large-scale transportation studies with emphasis on cost-benefit analysis and transport models to measure impacts of transportation investments on urban development aligned with economic development goals (Weiner, 2008). Although there have been more emphasis on sustainable transport and environmental justice since the Intermodal Surface Transportation Efficiency Act (ISTEA), Transportation Equity Act for the 21st Century (TEA–21), and Environmental Justice Executive Order, the requirement for the use of a visualization tool in long term regional planning process in the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) continues to cement the dominant role of transport models.

By comparison to Texas and the U.S., works regarding changes in transport policy in Europe, particularly in the U.K. are based on the notion that transport users should pay full transport cost and considerations of environmental concerns (Owens, 1995). The shift in transport discourse results in further focus on accessibility measures (e.g. Public Transport Accessibility Level Studies and Transport for London) as well as explicit considerations of developing measures of transport exclusion and inclusion not addressed in the transportation modeling process (see Grieco, 2003). However, specifically in the DFW, increasing road capacity continues to be a high priority in the Metropolitan Transportation Plan (MTP). Fig. 1 shows how this high priority is represented in the predictions of expenditures, in which, HOV and Freeways are allocated almost half of the total expenditures. Compared to transport policy in the U.K.—that is increasingly more centralized with consolidation of power and resources between the national to local government—transport policy in the U.S. is more decentralized with increased private investments in toll road constructions (Banister, 2002).

In general, there have been increased mobility in the modern West but the ability to move through cities continue to depend on “forms of power that either enable or delimit forms of personal freedom of mobility” (Sheller, 2008, p. 28) wherein the built environment exercise “sovereign” power that enable mobility for some at the expense of others (e.g. car users have higher mobility by occupying public space, therefore, taking the space away from other users). Applications of neoclassical economics underlying assumptions to social issues by what Adam Smith calls the “man of the system” (DeMartino, 2011) result in particular spatial layouts that constrain women, children, elderly and other minorities to move within the city according to the terms of the rational man. The notion of “the universal, disembodied subject” (Hine and Mitchell, 2001, p. 321) has been central to formulation of transport policies wherein transport users are disassociated from their social or biological traits and are not regarded as participants of different activities in different locations. The diversity in travel behavior—according to socioeconomic characteristics, race, ethnicity, gender, and age—are channeled by the transport model by aggregating into limited attributes, e.g. households income and size.

Martens (2006) contends that most policy initiatives only remediate the problems after it arises instead of addressing the underlying cause. Lack of explicit considerations of equity—in the two most utilized tools in transportation planning: travel demand models and cost-benefit analysis. Furthermore, the use of modeling tools remove issues from daily experiences and scrutiny of mobility constraints (Rajé, 2007) because the transport modeling process reinforces its underlying assumptions based on the existing travel patterns that prefer one category of users (e.g. car owners) over others (Martens, 2006; Martens and Hurvitz, 2011). Therefore, there is a need to integrate travel experiences to address mobility constraints (Hine and Mitchell, 2001) as well as explicit considerations of the discourse that informs practices, in particular, the underlying philosophy of transport modeling process (Timms, 2008). Thus, this paper focuses on how the transport model as a dominant tool in planning practices in the DFW Metropolitan Area produces and reproduces particular representations of travel experiences while subjugating other experiences.

2.1. The role of representations

This section discusses the significance of transport models as a mechanism to represent future transport needs in the transport decision-making process. A system of representation—as an essential part of the process by which meanings is produced and exchanged among members of a culture” (Hall, 2003, p. 15)—acts as the vessel in which what is considered as knowledge can be shaped and reshaped by members of a discourse. The construction of knowledge, then, involves a process of black-boxing—where contested knowledges are settled into a set of mathematical equations and computer programming—while simultaneously suppresses other kinds of knowledges (Latour and Woolgar, 1986). Similarly, the transport model is akin to a black-box where only input (e.g. households’ income and size) and output (e.g. forecasted number of trips) are known.
Foucault (1980) argues that domination of everyday lives through subtle and continuous coersions is an exercise of institutionalized knowledge—a kind of disciplinary power that can be distinguished from overt forms of power such as the police power. Similarly, an institutionalized policy discourse contains underlying assumptions that are deep-rooted in the discipline and institutional practices (Vigar, 2002). The transport modeling process, as an institutionalized practice, exercises disciplinary power over everyday practices, for example, when individual travel experiences are aggregated into narrow forms of modal ‘choice.’ Much of the underlying assumptions in the modeling process—particularly the Four-Step Model—is based on representations of individuals as rational and utility-maximizers in a concerted effort to form a state of equilibrium (Banister, 2002; Timms, 2008). Furthermore, measures of mobility and proximity commonly used in transport policies tend to leave out physical and financial barriers mostly experienced by lower income and minorities (Grieco, 2003). Consequently, the modeling process contributes to decisions that produce particular built-environments that, once built, dominate travel behaviors that do not conform to the rational-choice model.

As a system of representation, the validity of the transportation modeling process requires acceptance by transportation planners and engineers on particular sets of variables perceived as significant to produce the modeling output. Once these potentially contested knowledge are black-boxed—e.g. into the transportation modeling process—the constructions of language, signs and images situated within the transport discourse convey meanings and are understood as normal practices by members in the discourse. For example, transportation planners often use the language of numbers that signal “unambiguous representations of reality” (Willson, 2001, p. 1). This positivist approach signifies how “facts” are understood to be of independent existence and to be the results of objective empirical observation (Sprague, 2005). Hence, the model’s output can be seen as “facts” that is separate from political values, and therefore, established authority over potentially contested issues.

As a tool to visualize human behavior and its relationships with the existing built environment, a model is a product of specialized knowledge and practices that apply partial knowledge about human behavior as its underlying assumptions (Pavlovskaya, 2009). As such, these specific parameters, often referred to as “assumptions,” limit the ability to portray a variety of real-world phenomenon represented in the model. The construction of transportation models is also constrained by the capability of existing technology to capture the range of human behavior and reasonings. The practice of forecasting means that the transportation model operates under the assumptions of ceteris parabus—with other conditions remaining the same—an assumption viewed as essential to the modeling process due to the various complexities associated with the transportation modeling process (Timms, 2008). The implication of this deliberate attempt to remain constant is a predetermined future in terms of the types and particular transportation projects that ultimately get built for the next 20–30 years’ time span. Limitations of existing computer programming and technical analysis reinforce how these underlying assumptions determine which data are to be used or discarded, and how variables are categorized; and consequently determine who-gets-what-when-where-why-and-how.

Transportation decisions, including those in the Dallas-Fort Worth Metropolitan Area, are not the result of the model per se but the result of a variety of historical, political, and disciplinary traditions. Nevertheless, transportation planning as a discipline—with deliberate emphasis on technical and analytical skills—becomes the mechanism of coercive disciplinary power, and what Young (1990) refers to as bureaucratic authority. Thus, the continued emphasis on the use of transportation models in transport policies (Banister, 2002; Martens, 2006) has long term implications and the tendency to reinforce existing structures of inequality in the metropolitan region.

Assumptions of the Four-Step transportation model are built from past trends and have a high probability to continue the trajectory of the projection. The Four-Step transportation modeling process inherently promote higher mobility (Banister, 2002), and therefore, continued dependency on automobiles for travel in metropolitan regions such as the DFW Metropolitan Area. Consequently, communities that have been losing population are projected to have less amount of trips and are also projected not to need transportation investments for another 20–25 years. Already high dependency on private car and output from transportation modeling’s long term projections, ultimately perpetuate the social issues associated with uneven urban development in the metropolitan region.

Fig. 2 shows how representations of future transportation needs in the DFW Metropolitan Area can take the form of a map, for example, one that displays an output from the transportation modeling process regarding areas where congestion levels are predicted to increase in the year 2035 (North Central Texas Council of Governments, n.d.-b). This map is a form of representation that conveys future transportation demands by one variable of “congestion index” with language such as ‘no-build scenario.’ The congestion index serves as a benchmark to measure congestion levels that is understood as delay time for drivers in peak-period (e.g. rush hours) against off-peak travel (NCTCOG, 2006). For example, a congestion index of 1.15 represents a peak-period trip that takes about 15 percent longer than an off-peak trip. Meanwhile, a ‘no build-scenario’ refers to a scenario that is projected to happen if a set of proposed transportation projects is not implemented—viewed as “an unacceptable level of congestion and delay time” (NCTCOG, 2006, p. 20).

Although the map represents only some kinds of knowledge about future transportation needs, the decision of how congestion is portrayed in the map can have implications on the kinds of subsequent decisions to be made in the planning process. The production of this kind of map is an outcome of a deliberate process to communicate and exchange meanings regarding future transportation needs in the region based on particular underlying assumptions. Therefore, maps and diagrams are representations of a particular transport discourse, and once established, become a part of the discourse themselves.

3. Methodology

This paper evaluates the various ways transportation needs of various population groups are represented in the transportation modeling process through discourse analysis of planning documents, in particular, the Metropolitan Transportation Plan (MTP) Mobility 2035 Update (North Central Texas Council of Governments, n.d.-b), and other supplemental documentation of the Four-Step Transportation Modeling process produced by the North Central Texas Council of Governments (NCTCOG) as the Metropolitan Planning Organization for the DFW Area.

This paper focuses on the underlying assumptions of the Trip Generation and Mode Choice stages in the Four-Step Transportation Model. Assumptions on personal or individual household’s trips in the Trip Generation stage are typically based on factors like Households’ income, car ownership, family size, and Household’s structure, (Ortizar and Willumsen, 2011). The Trip Generation stage performed by the NCTCOG uses assumptions on the number of trips produced by a variety of households’ income and size (North Central Texas Council of Governments, 2007). Meanwhile,
the Mode Choice stage produces person trip tables by *purpose* and *mode* that estimates the probability of individuals to choose between travel modes based on attributes associated with the travel mode (e.g., travel time), the individuals (e.g., car ownership), and the environment (e.g., land use) (Ortúzar and Willumsen, 2011). The Mode Choice stage performed by the NCTCOG uses assumptions based on daily person trip tables by purpose for trips that occurred within the NCTCOG region (North Central Texas Council of Governments, n.d.-c). The paper then compares this expert knowledge—assumptions of the Trip Generation and Mode Choice stages in the Four-Step Transport Models as represented in the modeling documentation—with everyday travel experiences of residents from various diverse neighborhoods located in three different cities, Arlington, Dallas, and Plano, in the DFW Metropolitan Area (see Fig. 3).

### 3.1. Case study

Case studies can be used to expand and generalize theories through a rigorous process of case selection, data collection, coding process and analysis (Yin, 2008). The in-depth approach of a case study is useful to test theoretical propositions that can be compared with the observation from the case. The proposition, “all swans are white” can be falsified by the existence of a single “black swan” in an observation, which can, “either clearly confirm or irrefutably falsify propositions and hypotheses” (Flyvbjerg, 2006, p. 231). Thus, case study can provide in-depth information to dispute accepted assumptions as findings generate further inquiry into the existing theory and contribute to the accumulation of knowledge.

### 3.2. Data

This case study collected and evaluated everyday travel experiences of 15 participants who completed both the one-week travel diary and semi-structured interviews. Table 1 shows that most participants’ household income (40%) correspond to the median household income of $57,658 for the DFW Metropolitan Area reported by the U.S. Census 2010.

This research utilized Global Positioning System (GPS) recorder to collect travel data of participants along with a self-written form containing: date; time; destination route; mode, whether or not they drive alone; and costs for every trip they make in one week. Participants were also asked to take pictures of their experience when they encountered difficulties or easiness in their travel. At the end of the week, participants were interviewed to outline their travel, as well as in-depth discussions on the challenges faced in their everyday travel experience through questions about physical limitations to travel and how to improve their travel experiences. For purposes of this research, the mixed-methods data collection by GPS recorder, travel form, and images are referred to as *travel diary*.

Data from the travel diaries were qualitatively analyzed to provide contexts for the travel patterns of the residents. Interviews were transcribed verbatim and selectively coded based on themes related to the factors considered for input into the Trip Generation and Mode Choice stage of the Four Step Model, such as household characteristics, availability of and attitude towards alternative transport modes. The results from travel diaries across communities were compared to understand how the differences in mobility and accessibility affect the travel experiences of participants. A Geographic Information Systems (GIS) software were used to map travel data from the GPS to understand how these travel experiences differ spatially. Data on the number of trips, distance, and duration were obtained from the GPS recording device. Data are triangulated by matching GPS data with the self-written form, as well as clarification of any missing data in the exit interviews.

### 3.3. Dallas–Fort Worth Metropolitan Area

As a state, Texas is not only undergoing a significant increase in the Hispanic population as well as the foreign-born share, but now is considered a majority minority state (Jimenez and Mattingly, 2000).
According to the U.S. Census 2010, the DFW Metropolitan Area is the fourth largest and the fastest growing metropolitan area in the nation. In addition, the DFW-Arlington TX Metropolitan Statistical Areas population increased (23.4%) from year 2000–2010. According to the Texas State Data Center (TxSDC), the Hispanic population for North Central Texas is projected to experience the largest increase by 60%, followed by Other (24%), and Blacks (14%), and Anglo (5%). Therefore, the DFW Metropolitan Area along with the state of Texas is likely to continue experiencing population growth with significant changes in socio-demographic characteristics.

### 3.4. Central Plano

According to Census 2010, the City of Plano has a population of 259,841 people with a median household income higher than ($81,475) compared to DFW ($57,658). According to NCTCOG (2007), household income categories for the Trip Generation stage are distributed based on the ratio of each Traffic Survey Zone’s (TSZ) median income to the regional median income. Based on this assumption, roughly twenty percent of household in Plano are categorized low income; twenty percent are categorized high income; thirty percent are categorized low-median income; and thirty percent are categorized high-median income. Therefore, Plano was selected because households in the city are most likely to closely resemble characteristics of the typical households considered in the modeling process.

### 3.5. South Dallas

The City of Dallas was selected because compared to other cities in the region, Dallas has a more comprehensive transportation network and thus should have more transportation option. Yet, a preliminary study on food deserts where residents identified...
accessibility to transportation as one of the barriers to access to healthy and affordable foods for residents in Oak Cliff Gardens (Dallas Area Habitat for Humanity, n.d.). According to Census 2010, the household median income of this neighborhood ($24,485) is far below the DFW Region ($57,658) and out of the whole population (2462 people), residents with African Americans (63%) and Hispanic (34%) as the ethnic majority (Dallas Area Habitat for Humanity, 2013).

Travel models that use existing travel patterns, such as the Four-Step Model employed in the DFW Region, have the tendency to reproduce differences in accessibility and mobility and therefore ultimately reinforce those that are predicted to travel more (e.g. HHs with higher income and car) compared to those that already have lower accessibility and mobility (Martens and Hurvitz, 2011). As there are differences in travel behavior of African Americans and Hispanics that typically have lower trips per households and lower car ownership compared to their Caucasian counterpart in Texas (Jimenez and Mattingly, 2009), it is most likely that households in this neighborhood do not resemble the aggregated assumptions of the Four-Step modeling process employed in the region.

3.6. Central Arlington

The City of Arlington was selected because it had just shed its image as the largest city in the U.S. without public transportation when it began its pilot public bus project, the Metro Arlington Express (MAXX), in 2013. However, given the MAXX’s limited service, residents in the City of Arlington continue not to have many viable options other than to travel by private cars, bike, or walking. Neighborhoods in Arlington were identified through the city’s neighborhood plans. This neighborhood includes areas in central Arlington, the University of Texas at Arlington (UTA), and the surrounding residential areas (City of Arlington, 2009). The neighborhood is where one of the first bus stops for the MAXX is located as a result of initiatives between the City of Arlington and UTA. About twenty three percent are below the poverty level, making less than $30,000 per year in income as compared to Arlington’s mean households income of $64,627 (City of Arlington, 2009).

Fig. 4 shows that on average, the travel to work patterns of the cities of Arlington, Plano and Dallas are not significantly different from the state of Texas and the nation (U.S. Census Bureau). While Plano has a higher percentage of people who drive alone and lower percentage of people who carpool to work, both Arlington and Plano have a higher percentage of people who drive alone to work compared to Texas and the nation. The percentage of people in Arlington who use public transportation (0.3%) is significantly lower than other locations because Arlington, until recently, does not provide public transportation options for its residents.

4. Assumptions and representations of the everyday experiences

This section reviews some underlying key assumptions in the Four-Step Transportation Model, particularly those that applied in the Four-Step Transportation model in DFW, compares these assumptions with everyday travel experiences, and explores their implications of this comparison on various communities in the DFW Metropolitan Area. The assumptions under review are: (1) the assumption on households’ characteristics and income as input for future number of trips produced in the Trip Generation stage, (2) the assumption on access to auto mode in the Mode-Choice stage, and (3) the assumption on availability of alternative travel modes in the region. These three assumptions are basis to both the Trip Generation and Mode-Choice Stage of the Four-Step Transportation Model, wherein, the outputs of these two stages have the most significant impact on transportation policies decision-making process (Ortúzar S. & Willumsen, 2011). The paper then presents how these underlying assumptions have implications imposed by the disciplinary power of transportation modeling process on the everyday travel experiences. The generational effects of these implications reinforce income disparity, lack of accessibility, illusions of choice both in access to auto modes as well as availability of alternative travel modes for travelers.

4.1. Representations of household’s income and future trips

The first key underlying assumption in the Four-Step Transportation Model—that of households’ income as one of the main variables to predict the future number of trips produced in TSZs—is typically represented in a statistical formula that uses households’ demographic characteristics such as income and size as independent variables to determine the number of trips produced by households in a TSZ (Ortúzar S. & Willumsen, 2011). The Trip Generation stage is one of the first inputs into the modeling process in which the outputs are number of trips per household in each TSZ. Therefore, the outcomes of this stage can have a snow-ball effect on the consequent stages. Household income categories are derived based on the ratio of the zonal median income to the regional median income, with range from income quartile 1 (low income) to income quartile 4 (high income) (North Central Texas Council of Governments, 2007). As shown in the NCTCOG’s Model Description, Table 2 shows the trip rates for a variety of income quartile for input into the Trip Generation stage.

Table 2 shows that for Home-Based Work (HBW) trips, for example, a four-person household in the income quartile 4 (high income) is predicted to make about four times more trips per day than a four-person household in the income quartile 1 (low income). This is an example how transport demand models have a “built-in tendencies” to strengthens the mobility of high-mobile group—often correlated with higher income and car ownership—and alternative policy considerations to include other factors still have difficulties to measure the extent these other factors address the mobility and accessibility gaps for different population groups (Martens, 2006). Although decisions about allocation of transport

Table 2

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<th>Income quartile</th>
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<td>1</td>
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Fig. 4. Travel to work mode (source: U.S. Census Bureau – ACS report 2003–2007).
benefits considers various factors in addition to results from the transportation model, regional transportation planning practices utilize forecasts of future travel demands to make regional transport policy recommendations, particularly those related to development of transportation services and infrastructures (e.g. highway constructions).

The first implication of this assumption on transportation policies—of future trips based on income—is that areas with higher household income continue to benefit as a top priority for transportation projects because of their perceived needs, while areas with lower income continue to be under represented and underfunded. Transportation decision-making processes that do not involve adequate representations of transportation needs in lower income areas will have long term and generational effects, including lack of mobility and accessibility to access socio-economic opportunities in the region.

Fig. 5 shows the location of participants relative to the projected 2035 No-build congestion levels, and Fig. 6 shows the location of participants relative to households’ median income by Census Block Group according to the 2008–2012 data from the American Community Survey (ACS). Participants living in one household or with addresses in close proximity are clustered together, thus, the number of symbols do not correspond to the number of participants in this study. As shown in Fig. 6, there is a wide disparity of households’ median income in the DFW Metropolitan Area, wherein Plano participants live in higher income areas while Dallas participants live in some of the poorest neighborhoods in the region. One of the many implications of this

Fig. 5. Projected 2035 no-build congestion levels (Source: NCTCOG, n.d.-a).

Fig. 6. Participants by Households median income (Source: ACS 2008–2012).
income disparity is reflected spatially through their visual narratives of what they see when traveling. The disparity as a consequence of this assumption on the everyday experiences is revealed through the photographs taken by participants.

When asked to take pictures of their surroundings and experiences during travel, participants in Oak Cliff, Dallas, tended to take pictures of problem areas in their neighborhoods as portrayed in Fig. 7. The photos taken by Unique, a middle-aged female participant from Oak Cliff Gardens in Dallas with an annual income of less than $12,000, represent the continuous issues faced by the neighborhood, such as illegal dumping, vacant houses, and barriers to walkability in the neighborhoods. Meanwhile, Fig. 8 shows a sample of Mike's travel experience, a middle-aged male participant from the City of Plano with an annual income of $40,000–$75,000. Whereas the photos taken represent the transportation investments poured into the northern areas of the DFW Region through images of open roads and highway constructions encountered on his travel to work.

Photographs in Figs. 7 and 8 show the disparity of investments in transportation networks in the areas surrounding the two different areas in the DFW Region, which is congruent with the projections of the region's congestion levels as part of the inputs to determine future transportation needs previously depicted in Fig. 2. There are also significant differences in the quality of road surfaces and maintenance between Oak Cliff Dallas and Plano as depicted by the participants in these communities, for example, as shown in Figs. 9 and 10.

The second implication of the underlying assumption regarding households' income and future trips is that communities predicted to have low travel demand continue to be subjected to the kinds of built environments that reinforce this assumption. Assumptions on the number of future trips generated from particular TSZs reinforce the current conditions of built environment. This is problematic because lower income minorities such as African American and Hispanic immigrant in Texas, have significantly less daily trips and less vehicles per households compared to their Caucasian counterpart (Jimenez and Mattingly, 2009). Thus, lower income minorities typically have lower mobility and lack of accessibility to socio-economic opportunities.

The travel diaries show that on average, participants from lower income households travel further and longer to reach their destinations, compared to participants from higher income households. The built environment then exercises “sovereign” power that enable mobility for some at the expense of others (e.g. car users have higher mobility by occupying public space therefore taking the space away from other users) (Sheller, 2008). Consequently, the existing spatial layouts of the built-environment exert disciplinary power by limiting the choices people make when they travel from one place to another. If transportation investments are particularly directed to congested areas—e.g. building roads where there are higher travel demands—then many lower income and minorities households’ daily travel struggle to access places are reinforced by their surrounding built environment.

Fig. 10 and Fig. 11 show the spatial arrangements of retail and commercial uses in Plano and Dallas neighborhoods that influence participants’ access to these places. Retail and commercial land uses for Plano participants in these neighborhoods are not only clustered along highways but are also located on almost every major road intersections in the city (Fig. 10). Therefore, most participants in Plano typically drive about 5–15 min to grocery stores. Meanwhile, many of the retail and commercial establishments within Dallas Oak Cliff are small convenience stores as shown in Fig. 11. Access to healthy food options is one of the many challenges for inner city neighborhoods where food sold in these smaller stores is limited and is sold with higher prices (Cook, 2006; Walker et al., 2010). Dahlia, an elderly retired female participant from Oak Cliff Gardens in Dallas, drives approximately 20 min one way from home to a national-chain grocery store. The
same trip would take at least 3 transfers and approximately 1 h
and 30 min by public transit Fig. 12.

4.2. Representations of ‘Choice’ in access to auto mode

The second key underlying assumption in the Four-Step
Transportation Model—that of the ability for households to choose
between auto trips and other travel modes in the Mode-Choice—is
typically represented by the probability of households to choose
between all available travel modes (Ortúzar et al., 2011). The
output of the Mode-Choice stage is the distribution of trips that
are conducted by the various travel modes available in the planning
area. As stated in the NCTCOG’s Mode Choice document
(North Central Texas Council of Governments, n.d.-c):

...auto modes are available to all travelers; households without
autos are assumed to be auto passengers; this assumption was
borne out by the fact that HHs without cars made auto trips in
the HH survey data set. (p. 9).

This assumption represents how in the modeling process, trav-
ellers are perceived to always have access to a car. An implication
of this assumption is that future transportation needs will con-
tinue to be focused on car travel, particularly private cars. In
contrast, participants in this study often expressed the lack of
choices in travel mode and the impacts on their quality of life
when no car was available. The disciplinary power of the trans-
portation modeling discourse can be seen here in the illusion of
mobility, particularly for the community in Oak Cliff Gardens
(Dallas) because people either have to allocate a significant

Fig. 8. Mike’s travel map, Plano.

Fig. 9. Oak Cliff Dallas participant’s travel experience.

Fig. 10. Plano participant’s travel experience.
amount of their income for private auto or a significant amount of time for travel with public transit. When asked whether her car is reliable, Unique answers, “[a] car is where you invest your money.” Beatrice, a participant in Oak Cliff Gardens in Dallas, also illustrates this lack of choice:

I would probably say I don’t shop in my neighborhood because there is, like, a limit. You have Minyard, that’s a grocery store...
There’s a new CVS that’s open, and there is a Walgreens. But the things that I want to buy, maybe [in] Walgreens, the prices are going to be more than if I went to the Walmart because Walmart keep matching the prices. So I have a choice, but I know a lot of people don’t have that choice. I guess if I don’t have that choice then I would probably be forced to shop in my neighborhood. (Beatrice, personal communication, October 14, 2013).

The underlying in the modeling process that auto modes are available to all travelers seems to superficially capture these experiences but does not reveal the diverse contexts and motivation of travelers. Participants express to some extent as having experiences but does not reveal the diverse contexts and motivation of travelers. Unique uses the term “handicapped” to describe the effect of not having a car available to her:

I had a car, a truck from my brother, and somebody stole it. They handicapped me (emphasis added). I had to wait on people and (ugh) get a ride, and I don’t like to take the bus, so I broke down and get a car. (Unique, personal communication, October 7, 2013).

4.3. Representations of ‘Choice’ in availability of alternative travel modes

The third key underlying assumption of the Four-Step Transportation Model—that of the perceived availability of various travel modes—by categorizes trips as those conducted by (North Central Texas Council of Governments, n.d.-c):

Auto - drive alone; Auto - two occupants; Auto - three or more occupants; Transit - Auto access; and Transit – Walk access. (p. 5).

This assumption represents alternative travel modes that are considered in the Four-Step Transportation Model when calculating the distribution of trips being carried out by each travel mode. The first implication of this assumption is the lack of feasibility rather than the availability of using public transit. For example, participants in Oak Cliff have access to public transit but have real concerns about safety and crime issues as well as physical limitations from old age and disabilities.

People who live in areas where walking to transit is very difficult, due to safety and crime issues, would have little to no alternatives than travel by private auto. Unique uses the term “too much drama” to describe the situations that she might encounter when using public transit. Public transit is not seen as an option for elderly because of the many transfers it requires to get to a destination. So, in effect, modal choice is limited in the everyday travel behavior of Oak Cliff Gardens’ residents despite the assumptions of the model.

The effect of the disciplinary power of the transportation modeling discourse is evident in the way individuals perceive driving as the only option for travel mode. The assumption that alternative travel modes are available is not present when participants are asked about their reasons for choosing to drive compared to other modes. Ashley, who commutes to work from Oak Cliff Gardens to north Dallas, expresses her reluctance and the various barriers to use public transit:

I prefer using a car... If I caught a bus, I'd have to get up much early to get out and catch the bus [sic]. And then if I have to transfer, I have to make sure that I have to be at that place, then, I have to get to my job. When I was younger it probably was OK but I'm old now. (Ashley, personal communication, October 16, 2013).

Participants from Arlington and Plano mainly see the potential of using public transit if their main destination is Downtown Dallas or cross-region, but not as part of their everyday travel experiences. This is congruent with the function of the Dallas Area Rapid Transit (DART) as a commuter system to transport workers to central areas but not necessarily a viable public transit means to move in the region.

Raymond, who uses the MAXX in Arlington to commute, says that using the bus to commute to work reduces his stress level and hidden costs of driving such as car maintenance. Nevertheless, he does not walk to the bus stop because he carpools with his wife to the bus stop on her way to work even though he has the advantage of living within walking distance. However, when asked whether the availability of public transit affect their decisions to locate in their neighborhoods, all participants except Beatrice from Oak Cliff Gardens (Dallas), respond that availability of public transit was not a consideration.

In conclusion, travel behavior is complex and interrelated with other aspects of an individual’s life—as shown from the everyday travel experiences and interviews with participants—contrary to the underlying assumptions of the Four-Step modeling process discussed in this section. Local discourses, through travel experiences, can alter the way planners think about future travel demands when making observations about the lack of diversity in transport model’s outputs. For example, travel decisions affected by housing choices—e.g. increased households in Downtown Dallas—may seem insignificant in the short-term, but collectively and over a long-period of time, these choices can affect the modeling process.

5. Conclusion

Long-term regional planning processes, such as and planning for transportation infrastructures, can have generational effects that perpetuate inequality in a metropolitan region. Although these practices are not meant to be discriminative, they contribute to lack of accessibility and become barriers to social mobility and opportunities. The outputs of transportation models are condemning particular areas of metropolitan regions to 20–30 years of continued lack of mobility and accessibility when the modeling process use assumptions that reinforce past trends. Consequently, various representations of transportation demands can convey to decision makers that some areas in the region will require little to no transportation improvements because these areas are projected to have low transportation demands. Thus, without further inquiry into diverse everyday experiences of residents from various neighborhoods in the region, an aggregated modeling process such as the Four-Step Model renders these communities invisible.

The findings of this research demonstrate that underlying assumptions used in the Four-Step Transportation Model—that of household’s income, access to auto mode, and availability of alternative travel modes—leave out various population groups and their daily travel needs. Household Travel Surveys provide extensive households’ travel behavior data for transportation planners and engineers but are expensive to conduct due to the exhaustive data collection methods (Ortúzar S. and Willumsen, 2011). Thus, transportation planning projects often weigh between cost versus accuracy because of the high-cost and large scale nature of infrastructure planning and development. This trade-off is used for much of the modeling practices and methodologies in transportation planning. Yet, given the ability for discursive practices to produce the effects they assume, there is a pressing need for alternative representations of transportation needs of underserved population groups, such as lower income, minorities, elderly, people with disabilities, and children.

If the central orientation of transportation planning is the “public” then more studies are required to uncover ways in which
transportation planners can facilitate mutual learning between the expert-based knowledge and experience-based knowledge. In particular, further research is much needed to find ways where experience-based knowledge of the targeted population can be integrated into the transportation modeling process. This paper provides a preliminary inquiry into everyday travel experiences of the targeted population as a basis for the experience-based knowledge. Literature has pointed out the existence of conflicting interests, and the need to evaluate transportation planning practices from reliance on expert knowledge into more communicative and collaborative approaches (Khisty, 2000; Khisty and Arslan, 2005; Willson, 2001; Willson et al., 2003). Further research is needed to investigate how these experience-based knowledges can contribute to more inclusive transportation planning processes; and in what ways alternative knowledges can inform both the process and outcomes of transportation planning and modeling practices.

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