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Project Title
Does the Livability of a Residential Street Depend
on the Characteristics of the Neighboring Street Network?

University
University of Colorado Denver

Principal Investigators
Wesley Marshall, PhD, PE
Asst. Professor
University of Colorado Denver
Department of Civil Engineering
phone: 303-352-3741
email: wesley.marshall@ucdenver.edu

Carolyn McAndrews, PhD, MCP, MS
Asst. Professor
University of Colorado Denver
Department of Planning and Design
phone: 303-315-0028
email: carolyn.mcandrews@ucdenver.edu

Research Need
What makes a high-quality residential street? Existing research shows that a combination of streetscape features and social factors contribute to the quality of a residential street. Yet, most residential neighborhoods in the US depend heavily on arterials—roads that carry high volumes of fast traffic—for everyday travel and access to public transit, nearby shopping, and other activities. In this research we investigate the hypothesis that residents' perceptions of the quality of their residential street, and their travel patterns, reflect not only the quality of their own residential street, but also the quality of the arterial roads in their neighborhood.

Since the 1920s, traffic engineers and planners in the US have removed traffic from residential streets and channeled it onto major roads (arterials) because people want to live on quiet residential streets, and arterial roads can be designed to accommodate the high traffic flows. This strategy, exemplified by the functional classification system (Federal Highway Administration, 1997), aimed to preserve traditional neighborhood life in the face of increasing motorization and traffic, while optimizing traffic capacity in the road transportation system (UK Ministry of Transport, 1963).

Yet, creating networks of single-purpose streets has produced a new set of conflicts. Arterials concentrate heavy traffic into one place, which can burden adjacent neighborhoods and create barriers for pedestrians, bicyclists, and transit riders. Traffic congestion is also a problem on arterials, and drivers may choose to cut through residential neighborhoods where streets are not designed with sidewalks or other kinds of protection for this kind of through-traffic. In cities across

the country, and in particular here in Denver, policy makers, engineers, and designers search for strategies to help make traffic more livable (City of Denver, 2002).

Solving the problem of traffic in neighborhoods is not as simple as installing sidewalks, though they may a good starting point. Streetscape features such as street trees, good lighting, visual complexity, and secure places for pedestrians also increase the livability of streets (Jacobs, 1995; Owens, 1993). Similarly, social factors such as fostering social surveillance and reducing crime also seem to make a difference (Jacobs, 1961 [1992]; Doeksen, 1997; Hur and Morrow-Jones, 2008).

Decades of qualitative and quantitative research have looked at the livability of residential streets, but these studies have not analyzed residential streets in the context of their networks. In this proposed research, we introduce a new question: Does the perceived quality of one's residential street, as well as residents' use of their residential and arterial streets, also depend on characteristics of the neighborhood street network?

We will select four case neighborhoods in Denver, CO for in-depth study to identify how the combination of traffic, network design, streetscape design, and street life affects residents' perceptions of neighborhood livability and their travel patterns within their neighborhoods. Research methods include environmental measurement, residential surveys, and focus groups.

We hypothesize that people who live on good residential streets surrounded by good arterials travel farther and more frequently in their neighborhood, use their residential streets more frequently, and rate their residential streets as being very livable (see Table 1). In contrast, we expect that residents who live on poor residential streets surrounded by poor arterials minimize the travel in their neighborhood and use of their street, and rate their residential streets as being very unlivable.

Table 1: Hypothesized relationships between residential street livability and network quality

	Good residential street quality	**Poor residential street quality**
Good arterial / network quality	H_o: Residents in this neighborhood have the following characteristics: Travel to arterials: high Residential street use: high Livability ratings: high	H_o: Residents in this neighborhood have the following characteristics: Travel to arterials: medium Residential street use: low Livability ratings: low
Poor arterial / network quality	H_o: Residents in this neighborhood have the following characteristics: Travel to arterials: low Residential street use: medium Livability ratings: medium	H_o: Residents in this neighborhood have the following characteristics: Travel to arterials: low Residential street use: low Livability ratings: low

For those who live in neighborhoods with good residential streets but poor arterials, or in neighborhoods with good arterial streets but poor residential streets, we expect that the relationships between arterials and residential streets will be more complicated. In these cases, we expect that the negative effects of poor arterial streets spill over onto residential streets, which will decrease their livability and use. Similarly, we expect that having good arterials will still attract trips, but fewer than would have been the case if the residential streets had higher quality.

Preliminary Literature Review

This study builds on an established literature at the intersection of urban design and transportation engineering. Appleyard and Lintell (1972) developed a methodology for doing comparative studies of streets to learn how their traffic and physical characteristics influenced residents' use of them, and residents' perceptions of their quality. Among the key issues for residential street quality are: acceptable speeds, acceptable volumes, pedestrian access, pedestrian safety, acceptable noise, acceptable parking, streets functioning as open space, and sound maintenance and pleasant appearance (Appleyard, 1980).

Although Appleyard (1980) raised the idea that, *"…an effective national policy to create livable streets should concentrate on the concept of protecting neighborhoods,"* existing research has not considered the role of street networks on residential street quality.

In a similar study, Bosselmann, Macdonald, and Kronemeyer (1999) investigated how the design of *residential arterial* streets affected their perceived livability, arguing that most arterial streets in cities are also residential streets and therefore we also need to consider arterials. Their study found that the design features of one type of residential arterial, the multiple-roadway boulevard, best buffered the negative effects of high traffic volumes.

Our proposed study builds on the Bosselmann et al. study by investigating how the characteristics of arterials affect nearby residential streets, thus putting all residential streets into the context of their larger transportation network. For instance, if a high-quality multiple-roadway arterial buffers the effect of traffic for its residents, does it also do that for residents of nearby streets? In addition, we will measure both residents' perceptions of the quality of their street and their travel patterns in their neighborhood to learn how the network characteristics affect travel outcomes.

Research Objectives

This study will:

1. Explore and test the following hypotheses outlined in Table 1.
2. Identify the most important explanatory variables and dependent variables that we should carry over into a larger study.
3. Propose a plan to scale the research using the Denver Region Council of Governments (DRCOG) Front Range Travel Survey, which provides information from travel diary surveys about where people travel and how often.

To the extent possible in this pilot study, we will consider how gender, income, and race/ethnicity influence the answers to our research question, but a full investigation of social and demographic characteristics will require a more synoptic study design based on secondary data. We have the appropriate secondary data to carry out such a study in the future (Front Range Travel Survey), but first need to investigate validity of our constructs and hypotheses before applying them to the entire region.

Research Methods and Analytical Approach

This study design provides the high level of detail needed to understand the complexity of the relationship between the built environment, traffic, and residents' perceptions.

Planning phase, spring 2013:

Apply for Faculty Development and Mountain Plains Consortium grants. Prepare and submit materials to the Institutional Review Board. Collect secondary data.

Phase 1, July 2013:

Conduct a thorough literature review to identify potential variables of interest, and refine our hypotheses about how neighborhood network characteristics influence residents' perceptions of their streets and their intra-neighborhood travel.

Phase 2, July-August 2013:

Using available secondary data sources for land use, traffic volumes, posted speeds, street design, residential housing type, and household characteristics for the Denver metropolitan area, we will identify a set of potential study neighborhoods that represent each of the four conditions (good residential/good arterials, good residential/poor arterials, poor residential/good arterials, and poor residential/poor arterials). We will conduct preliminary field studies and select four neighborhoods that have similar residential populations, but the desired differences in streets and networks.

There are a variety of types of neighborhood arterials. For example, some are designed like parkways and others are commercial arterial streets (those that offer some form neighborhood- or region-serving retail). In this study, we will focus only on arterials with commercial development and will not consider arterials with a parkway-style design at this point. In addition, we aim to study neighborhoods where the commercial arterials are served by transit, and where the surrounding neighborhoods have relatively low rates of household access to a private automobile.

Upon identifying potential neighborhoods, we will communicate with local organizations and residents' groups to learn whether their neighborhoods have an interest in this project. The ability to form relationships with local organizations will be included as selection criteria because it can increase participation in the survey and focus groups.

During this period we will also develop an environmental measurement protocol that will be used in Phase 3.

Phase 3, August 2013-January 2014:

Meet with local groups to understand residents' concerns about transportation and street environments in their neighborhoods. Use these sessions to develop and pre-test the residential survey instrument. The survey instruments by Appleyard (1972) and Bosselmann et al. (1999) will serve as a starting point and will be modified to include questions specific to the street network and household travel patterns.

During this period, we will implement residential surveys, finishing the surveying before mid-October because of weather and light. We will arrange one follow-up focus group meeting in each the four neighborhoods.

To carry out the survey, we will create a random sample of blocks in each neighborhood and survey each residence on each of the block's four faces, including multifamily buildings. The survey will be conducted in-person by trained students (and possibly residents) in English and Spanish. If no one answers the door, we will leave a survey at the door with a pre-paid mailing envelope. Each survey

will include the question of whether we can follow up to invite the respondent to a focus group. During this period we will also clean and prepare the survey data that we collect.

We will carry out field measurements and observations for variables that are not available in secondary data sets. For instance, we will use direct observation to measure the levels of activity on streets (e.g., walking, bicycling, neighbors talking, shopping, playing, etc.). Collecting environmental data can be integrated with fall-semester courses such as Transportation Planning and Policy, and Sustainable Transportation Systems.

Phase 4, February-May 2014:
We will analyze the survey data using methods that allow us to link individual-level perceptions to local street and neighborhood characteristics. These multilevel techniques have been used widely in research about how neighborhood characteristics affect individual- and family-level phenomenon, and in our case, we are emphasizing the role of streets and networks. During this period we will also begin writing up the findings from the focus groups and the survey as manuscripts for peer-reviewed academic journals. Student researchers who make unique contributions to the research will be included as co-authors on these publications.

During this period we will also be developing a methodology for scaling this project to the region using available secondary data such as the Front Range Travel Survey and applying for funding to carry out this follow-on study. Thus, this in-depth pilot study will provide the preliminary data for a highly competitive proposal for national funding.

We also want to link our questions about travel and livability with other outcomes such as transit ridership and population health (e.g., childhood obesity prevention) to broaden the impact of this research.

Phase 5, May-June 2014:
Prepare materials for presenting the preliminary findings to policy and academic audiences, including a paper for the Transportation Research Board Annual Meeting in January 2015 (due August 1, 2014).

Expected Outcomes
The expected outcomes of this work include:

1. Findings with respect to the testable hypotheses and remaining questions;
2. A set of key explanatory and dependent variables and constructs;
3. A plan for scaling up this study and refined research questions and methods;
4. A manuscript for presentation at TRB and manuscripts for other peer-reviewed journals;
5. A presentation for academic and policy audiences; and
6. A module about streets, network design, and livability for transportation courses at the University of Colorado Denver.

Relevance to Strategic Goals
The work primarily falls under the heading of livable communities, but it also highly relates to economic competitiveness in terms of neighborhood revitalization, physical activity, and environmental sustainability. A framework for evaluating the quality of urban street networks, and understanding network effects on residents' perceptions of livability and their intra-neighborhood travel allows for better integration of sustainability goals into transportation system design.

Educational Benefits

This study will be integrated into Dr. Marshall's "Sustainable Transportation Systems" graduate course and Dr. McAndrews's "Transportation Policy and Planning" graduate course through a case study approach that will not only present research materials to the students, but because the study is local, students can be involved in data collection and analysis as part of their term projects. These transportation courses are based in the Civil Engineering Department and the Department of Planning and Design, and they are cross-listed with each other, as well as Public Administration and Geography. The secondary data collected for this project will also be made available to students for use in term projects or master's reports. As a result, this project will influence students from a variety of disciplines that comprise our future transportation professionals. Students who work on the project will have the opportunity to be co-authors on publications and presentations.

Work Plan

The proposed scope of work is scheduled for a one-year timeframe, beginning with notice to proceed from the Mountain Plains Consortium. Major project steps include the following:

Task	Timeline
Apply for IRB approval	Spring 2013
Initiate secondary data collection efforts	Ongoing
Literature review	Months 1-2
Select four case neighborhoods	Months 1-2
Develop environmental measurement protocol	Months 1-2
Information sessions with neighborhoods	Months 2-3
Design residential survey	Months 2-3
Conduct residential survey	Months 3-4
Conduct environmental measurement/observation	Months 3-7
Clean and code survey data, follow up questions	Months 4-6
Conduct residential focus groups	Month 7
Data analysis (survey, focus groups, environmental)	Months 8-12
Develop plan to scale the analysis	Months 8-12
Draft manuscript, presentation materials	Months 8-12

Findings will be published in peer-reviewed journals, and/or peer-reviewed conference proceeding, as well as presented at various conferences including the Transportation Research Board Annual Meeting. This work will also be disseminated to the public works and city planning departments in Denver, the Denver Region Council of Governments, and the Regional Transportation District.

Project Cost

Total Project Costs: $161,918.51
MPC Funds Requested: $80,916.00
Matching Funds: $81,002.51

Source of Matching Funds: University of Colorado Denver Faculty Development Center; University of Colorado Denver

TRB Keywords

Arterial roads, residential streets, functional classification, vitality, livability, street networks, active transportation

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