Title

Can Smart Growth Reduce Vehicle Travel in Rural Communities?

Authors

Schukei, Harrison

Rowangould, Dana

Publication Date

2024-12-01

DOI

10.7922/G2BG2M9G

Data Availability

The data associated with this publication are managed by: https://nhts.ornl.gov/; https://www.epa.gov/smartgrowth/smart-location-mapping

Can Smart Growth Reduce Vehicle Travel in Rural Communities?

December 2024

A Research Report from the National Center for Sustainable Transportation

Harrison Schukei, University of Vermont

Dana Rowangould, University of Vermont

TECHNICAL REPORT DOCUMENTATION PAGE

<table>
<tr><td>1. Report No.
NCST-UVM-RR-24-37</td><td>2. Government Accession No.
N/A</td><td colspan="2">3. Recipient’s Catalog No.
N/A</td></tr>
<tr><td colspan="2" rowspan="2">4. Title and Subtitle
Can Smart Growth Reduce Vehicle Travel in Rural Communities?</td><td colspan="2">5. Report Date
December 2024</td></tr>
<tr><td colspan="2">6. Performing Organization Code
N/A</td></tr>
<tr><td colspan="2">7. Author(s)
Harrison Schukei, https://orcid.org/0009-0009-4390-6586
Dana Rowangould, Ph.D., https://orcid.org/0000-0001-9839-368X</td><td colspan="2">8. Performing Organization Report No.
N/A</td></tr>
<tr><td colspan="2" rowspan="2">9. Performing Organization Name and Address
University of Vermont
Transportation Research Center
Mansfield House
25 Colchester Avenue
Burlington, VT 05405</td><td colspan="2">10. Work Unit No.
N/A</td></tr>
<tr><td colspan="2">11. Contract or Grant No.
USDOT Grant 69A3551747114</td></tr>
<tr><td colspan="2" rowspan="2">12. Sponsoring Agency Name and Address
U.S. Department of Transportation
Office of the Assistant Secretary for Research and Technology
1200 New Jersey Avenue, SE, Washington, DC 20590</td><td colspan="2">13. Type of Report and Period Covered
Final Research Report (September 2022 – August 2023)</td></tr>
<tr><td colspan="2">14. Sponsoring Agency Code
USDOT OST-R</td></tr>
<tr><td colspan="4">15. Supplementary Notes
DOI: https://doi.org/10.7922/G2BG2M9G</td></tr>
<tr><td colspan="4">16. Abstract
Reducing greenhouse gas emissions from transportation poses a significant challenge in the exurban fringe and rural communities. Populations living in these areas rely more heavily on personal vehicle travel than nonrural populations and are more likely to experience mobility challenges. One approach to curtailing these emissions is building more compact development or smart growth. However, nearly all research to date on travel and the built environment has focused on urban and suburban areas, leaving decision-makers in exurban and rural communities with little guidance for how to effectively reduce GHGs in their communities. To address this gap, travel behavior data from the Federal Highway Administration’s National Household Travel Survey is combined with detailed built environment data from the Environmental Protection Agency’s Smart Location Database to evaluate the relationships between personal and built environment factors and sustainable travel behaviors including vehicle miles traveled (VMT) and mode choice. The relationship between travel and the built environment is distinct in rural and urban areas. Notably, while in both urban and rural areas increased regional accessibility is associated with lower VMT, it is associated with increased motorized travel reliance and decreased utilitarian active travel in rural areas. Transportation planners and researchers should take note of the differing relationship of the built environment and travel between urban and rural areas. This research suggests that relationships between travel and the built environment observed in prior research conducted in urban areas may not hold in rural contexts.</td></tr>
<tr><td colspan="2">17. Key Words
Built environment, travel behavior, VMT, mode choice, rural</td><td colspan="2">18. Distribution Statement
No restrictions.</td></tr>
<tr><td>19. Security Classif. (of this report)
Unclassified</td><td>20. Security Classif. (of this page)
Unclassified</td><td>21. No. of Pages
25</td><td>22. Price
N/A</td></tr>
</table>

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

NCST

About the National Center for Sustainable Transportation

The National Center for Sustainable Transportation is a consortium of leading universities committed to advancing an environmentally sustainable transportation system through cutting-edge research, direct policy engagement, and education of our future leaders. Consortium members include: the University of California, Davis; California State University, Long Beach; Georgia Institute of Technology; Texas Southern University; the University of California, Riverside; the University of Southern California; and the University of Vermont. More information can be found at: ncst.ucdavis.edu.

Disclaimer

Acknowledgments

This study was funded, partially or entirely, by a grant from the National Center for Sustainable Transportation (NCST), supported by the U.S. Department of Transportation (USDOT) through the University Transportation Centers program. The authors would like to thank the NCST and the USDOT for their support of university-based research in transportation, and especially for the funding provided in support of this project. The Federal Highway Administration provided spatially detailed NHTS data. Sierra Espeland and Mitch Robinson assisted with setting up the code and provided valuable feedback.

Can Smart Growth Reduce Vehicle Travel in Rural Communities?

A National Center for Sustainable Transportation Research Report

December 2024

Harrison Schukei and Dana Rowangould

Department of Civil and Environmental Engineering, University of Vermont

[page intentionally left blank]

TABLE OF CONTENTS

List of Tables

List of Figures

Can Smart Growth Reduce Vehicle Travel in Rural Communities?

EXECUTIVE SUMMARY

Reducing greenhouse gas emissions (GHGs) from transportation poses a significant challenge in rural communities. Rural populations rely more heavily on personal vehicle travel than nonrural populations; 21% of the US population lives in rural areas (*1*) while over 30% of US vehicle miles traveled (VMT) occur in rural areas (*2*). There is limited evidence that the relationship between the built environment and travel is different in rural versus urban contexts. This poses a risk that GHG reduction policies that encourage the use of non-auto modes or discourage driving will be ineffective or exacerbate existing mobility challenges faced in rural communities.

To further explore the relationship between rural travel and the built environment we use travel behavior data from the Federal Highway Administration's National Household Travel Survey combined with detailed built environment data from the Environmental Protection Agency's Smart Location Database. We evaluate the personal and built environment factors that relate to vehicle miles traveled (VMT) and mode choice. We quantify the mode choice as the probability that a traveler participates in utilitarian active travel (walking and biking) or is reliant on motorized travel for utilitarian travel. We model the relationship between VMT and mode choice outcomes and built environment characteristics including regional access, local access, local job diversity, and transit access, while controlling for personal characteristics.

Our results indicate that the relationship between travel and the built environment differs in rural and urban communities. We see this primarily when comparing regional and local access, which both have a similar importance in rural areas. This is not the case in urban areas, where greater local access is much more strongly associated with sustainable travel outcomes. Job diversity has a marginal relationship with all modeled travel outcomes. Transit access is associated with more sustainable travel though no urban rural differences were observed due in part to the small sample of rural respondents with transit access.

It should be noted that our study is cross-sectional so we are unable to determine causality. Nonetheless, our results show that there are clear differences in the relationship between travel and the built environment in urban and rural areas. Additionally, we see that in rural areas personal characteristics have a smaller impact on travel behavior, which may reflect a narrower range of travel options. Our results indicate that rural planners should proceed with caution when applying findings from existing literature on travel and the built environment. Future research should evaluate urban and rural differences while accounting for causality.

Introduction

Reducing greenhouse gas emissions (GHGs) from transportation poses a significant challenge in rural communities. Rural populations rely more heavily on personal vehicle travel than nonrural populations; 21% of the US population lives in rural areas (*1*) while over 30% of US vehicle miles traveled (VMT) occur in rural areas (*2*). Rural populations are also more likely than their nonrural counterparts to experience mobility challenges including burdensome transportation costs and unmet travel needs, particularly for those with limited vehicle access and fewer resources (*3*). There is a risk that GHG reduction policies that encourage the use of non-auto modes or discourage driving will exacerbate existing challenges and inequities in rural communities.

As many urban communities have turned to land use and planning to influence travel behavior, rural communities have also done so (*4*–*6*). There is a large catalog of research the built environment's impact on travel behavior in urban and suburban contexts (*7*, *8*); however, the same cannot be said for rural areas (*5*, *6*). There is a risk that strategies developed in urban contexts will not influence rural travel behavior in the ways that would be expected when they are applied in rural contexts, which differ substantially in terms of the built environment and travel behavior.

Prior transportation research that focuses on travel in rural contexts points to the unique character of rural travel behavior. Rural areas are typically more dispersed and have a lower density, so it is not surprising that rural travelers make fewer trips and that those trips are longer, resulting in higher overall VMT when compared with urban areas (*6*, *9*, *10*). Rural residents are also less likely to engage in walking for utilitarian purposes and are concerned with different aspects of the built environment than their urban counterparts (*6*). Furthermore, the ability to use land use policies to influence travel is much more difficult in rural communities (*11*). Importantly, there is evidence that the built environment and its relationship to vehicle travel does not follow the same trends in rural contexts as in urban and suburban areas (*11*–*15*). There is a need to develop a deeper understanding of the relationship between the built environment and travel behavior in rural contexts in ways that can more clearly inform rural planners' decision making.

We evaluate the relationship between the built environment and travel choices, including VMT and mode choice, using the US-wide 2017 National Household Travel Survey (NHTS) (*16*) combined with built environment data from the US EPA's 2020 Smart Location Database (SLD) (*17*). We then compare how the relationship between travel behavior and local and regional access differ between urban and rural contexts.

The Built Environment and Travel Behavior

There is broad consensus that the built environment has some impact on travel behavior (*7*, *8*). Many studies that evaluate the relationship between travel and the built environment focus on the "D-variables". These variables were first formalized by Cervero and Kockelman (*18*) as the "3 D's of the Built Environment": density, diversity and design. The 3 D's have since expanded to six (and by some accounts more) D's, including destination accessibility, distance to transit, and demand management (*7*, *8*). Evaluations of these measures demonstrate significant association between the built environment and travel behavior, with compact development, a range of transportation options, and a mix of land uses tied to less personal vehicle travel and a greater likelihood of walking or using transit (*7*, *8*, *18*–*20*).

Travel Behavior in Rural Communities

While the literature on travel and the built environment is extensive, it has largely focused on metropolitan areas or smaller urban and suburban areas (*6*–*8*). Even where travel behavior is observed across large areas (the nation or large metropolitan areas) that include some rural populations, results are likely to be biased towards nonrural areas due to the substantial share of the population living in those areas. However, there are clear differences in rural travel behavior across rural and nonrural contexts. Rural travelers make fewer, longer trips and are more likely to drive (*9*, *14*, *15*).

Our existing knowledge of rural travel behavior differences stem primarily from studies that are national in scope and include a binary or categorical rural variable in a multivariate statistical model (*15*, *29*, *30*). This model formulation effectively allows for differences in travel behavior across urban and rural areas while assuming the nature of the relationship between travel and built environment factors (e.g., the Ds) is consistent in urban and rural contexts. This may not be accurate because these contexts are so distinct. Not only does the range of values of the D factors differ in rural and urban contexts, there is also the possibility that the effects of rurality and the built environment on travel behavior are interrelated or synergistic.

Examining the literature that focuses on rural travel behavior suggests that it is likely that the relationships between travel behavior and personal and built environment factors differ across urban and rural contexts. For example, Rasca and Saeed (*28*) evaluated transit use in small cities and towns, finding that the relationship between transit use and many of the built environment factors was in line with those found in urban areas. However, they also found that greater trip distances had a strong positive association with transit use, in contrast to findings from the nonrural-focused literature. Similarly, evidence from walking behaviors in rural communities points to fundamental differences in the relationship between travel and the built environment in rural contexts. Stewart et al. (*6*) found that as expected, residents in Seattle, Washington often engaged in utilitarian walking while residents of nine small towns across the United States did not. Furthermore, the reasons for walking differed across contexts: Seattle residents were more likely to value the ease of walking while those in small towns valued safety. Additionally, in contrast to research on urban utilitarian walking, Doescher et al. (*31*) found that manufacturing land uses were associated with more utilitarian walking in small towns, while the opposite is true in nonrural communities. Their findings suggest that was because the manufacturing in the towns was small-scale and concentrated in relatively small parcels located near retail, recreational, and residential locations.

The difference in how land uses affect travel in rural and nonrural areas is also borne out in a comparison of vehicle travel. Ihlanfeldt (*11*) used 13-year panel data of counties in Florida and then looked at how changes of eight different land uses over time impacted daily VMT. While changes in a variety of land uses had an impact on daily VMT in urban counties the only significant land uses in rural counties were “industrial” and “institutional” (with institutional land uses being majority churches but also including clubs, lodges, union halls etc.). Similarly, increasing residential density, which is often found to have a small negative effect on VMT (*7*, *8*) may actually be less relevant in rural communities. Using the 2001 National Household Travel Survey (NHTS), Brownstone and Golob (*12*) found that residential density has a much smaller impact on VMT in rural and small town communities. Both of these studies point to interrelated effects of rurality and the built environment on vehicle travel, however they do not evaluate the built environment measures typically used in planning literature.

Salon (*32*) assessed the impact of built environment measures across the rural-urban spectrum in California using metrics from contemporary literature and practice. Salon’s study found differing relationships across the urban-rural spectrum and used these results as a means to control for residential self-selection as they predicted the impact of built environment changes on work and non-work commutes. Examining this study to glean differences in urban versus rural travel behavior suggests that the impact of regional job access and local job access on commute miles traveled may be greater in rural contexts relative to other contexts. However, this type of comparison was not the study’s purpose and the study defined rural using a clustering algorithm as opposed to a commonly applied definition. These factors, combined with the study’s California focus, prevent us from generalizing to rural contexts across the US based on this study alone.

We build on the findings of Brownstone and Golob (*12*) Ihlanfeldt (*11*), and Salon (*32*) which suggest that there are differences in the relationship between VMT and the built environment in rural versus nonrural contexts. Our study advances this body of knowledge by evaluating the relationship between travel and the built environment in rural versus urban contexts nationwide using built environment measures that are typically used in contemporary planning literature. These measures are designed to capture travelers’ experiences (accessibility) or attributes of land use that can be targeted during the design of communities and the planning process (the Ds). Additionally, our focus includes mode choice as a travel behavior in addition to VMT and applies a frequently used definition of rural. Our results are valuable to decision-makers in rural communities, many of whom are already implementing policies that target smart growth (*4*, *5*) without clear information on the impacts they may have on travel behavior.

Data and Methods

This analysis evaluates two research questions. First, is the relationship between travel and the built environment different in urban and rural communities? Second, if there are differences, what are they? We represent travel behavior in terms of both travel mode and VMT. We evaluate the relationship between these behaviors and the characteristics of both the people and the built environment in which they live. We evaluate separate models for each travel outcome and for urban and rural communities. We address the first research question by evaluating differences between the urban and rural models for each modeled outcome; we answer the second by seeing if any observed differences are consistent across all modeled outcomes. We also evaluate models of the full sample to see if the observed differences between the community types are significantly different from a combined model of the general population.

We obtain travel behavior and traveler demographic information at the individual level from the 2017 National Household Travel Survey (NHTS) (*33*). We obtained block-group location information for the NHTS data from FHWA by request. We obtain built environment data from the 2021 release of the United States Environmental Protection Agency's (EPA) Smart Location Database (SLD). The spatially detailed NHTS and the SLD are both available at the block group level allowing them to be spatially joined. The definition of urban/rural used in this study is the one employed by the US Census Bureau (*34*) and is included with the NHTS. We make use of this relatively granular definition as it is defined at the Census Block level.

The NHTS, conducted by the United States Federal Highway Administration, is a survey of households across the US about their travel behavior and vehicles. This study uses the sociodemographic information at the household and person level, respondent weights that translate surveyed respondents into a population that is closer to representative of the US, and information from the travel diary, wherein respondents were asked to record their travel on a single day (the "travel day"). The travel day information used in this study includes the distances traveled, modes used, and trip purpose. For "vehicle access", we classify people as "fully equipped" or "non-fully equipped" based on the ratio of vehicles to adults in the household, where households with a ratio of household adults to vehicles of one or greater are "fully equipped" those with a ratio less than one are not, consistent with Blumenberg et al. (*35*).

The outcome variables in our models are travel day mode and travel day VMT. For each trip we defined three separate modes: "motorized", "bike/ped", and "other." Motorized was defined as all trips taken in a car, pickup truck, SUV, van, motorcycle, and taxi or ride share. Bike/ped was defined as walking and biking, and "other" comprised all other modes. Travel day mode for each person included in the sample was then categorized in three ways. "Auto reliant" refers to people who exclusively use motorized modes for utilitarian trips on the travel day. "Auto user" refers to people who use motorized modes at least once for utilitarian trips on the travel day. "Active traveler" refers to people who use bike/ped for at least one utilitarian trip on the travel day. We modeled auto reliance and active travel. We also evaluated travel day VMT as the total of the motorized utilitarian trip distances that each person traveled on the travel day. We defined utilitarian travel as trips to or from home, work, school/daycare/religious activity, medical/dental services, shopping/errands, to transport someone, and meals.

The EPA SLD contains a variety of measures of the built environment estimated from US Census Bureau population data from 2014 to 2018, US Census Bureau jobs data from 2017, HERE Maps Infrastructure data from 2018, and publicly available transit data (see EPA, 2021 for more information). We selected built environment measures from the EPA SLD that represent important aspects of the built environment, are not highly correlated, and are commonly used in the extant literature (*7*, *8*). We refer to these variables as local access (defined as the natural log of the number of jobs and households per acre in the Census Block Group), regional access (defined as the natural log of jobs accessible within a 45 minute drive), transit access (defined as transit available within ¾ mile from the respondent's census block centroid), and local job diversity (defined as a static 8-tier job mix entropy statistic and used as a proxy for land use mix.) We standardize the continuous variables for local access, regional access, and job diversity. Summary statistics for these variables are shown in Table 1.

We use multivariate modeling to evaluate our research questions using a person-level unit of analysis. We include people who are 22 years of age or older to clearly represent travel behaviors for adults, who took at least one trip on the travel day. We included people who worked at home for pay, treating this as a trip that uses a non-vehicle travel mode. For those who took a trip we further restricted the sample to include only those that made at least one trip to their home, as this is the area for which we have built environment data. We also excluded people who were missing NHTS and EPA SLD variables used in this analysis. Additionally, because we are primarily concerned with routine travel behaviors, we also eliminated those who traveled over 300 miles on the travel day. We sample one person per household surveyed to ensure that observations are independent. Of the 264,235 people in the NHTS, our analysis included 109,612 people.

Table 1 shows summary statistics for the people included in the study, including both unweighted and weighted characteristics. These statistics echo those observed in prior literature, with rural and small town residents driving further, relying on vehicles more, and taking fewer walking/active travel trips than their non-rural counterparts (*6*, *9*). We also see that rural people are more likely to be white, older, and lower income.

To model travel day VMT we use gamma models with a log-link as they capture the shape of the VMT distribution well. The gamma distribution also effectively handles data with a single bound at zero and heteroskedasticity (*36*). For this model, we subset our sample to only be those who produced VMT on the travel day (auto users), as the gamma model cannot include zero values.

We model travel day mode using logit models with results presented as odds ratios. We model the odds that a respondent was auto reliant. We also modelled the odds that a respondent was an active travelers. We additionally standardized all our continuous regressors so that the size of the effect is measured in relative and not absolute terms.

Table 1. Summary of survey respondents by urban/rural classification.

Variable	Urban N = 85,470 Sample %	Urban N = 85,470 Weighted %	Rural N = 24,121 Sample %	Rural N = 24,121 Weighted %
Categorical Variables				
Race and Ethnicity				
Non-Hispanic White	75	60	89	85
Non-Hispanic Black	8	15	5	6
Hispanic (all races)	9	17	3	5
Other race, multiple, or unknown	8	9	4	3
Age				
22-35	18	26	11	19
36-50	22	28	18	26
51-69	41	34	49	41
70+	19	11	22	14
Employed[1]	61	68	54	64
Education				
High school or less	19	23	29	32
Some college	29	29	33	34
Bachelor's or more	52	48	38	34
Household Income				
<$35,000	26	32	29	30
$35,000 - $74,999	30	29	33	32
$75,000 - $125,000	24	22	24	24
>$125,000	19	17	14	14
Two or more adults[1]	65	68	75	81
Children in home[1]	24	36	22	38
Vehicle access: fully equipped[1]	83	72	91	86
Female[1]	54	54	52	50
Transit access[1]	42	53	2	1
Auto user (at least one motorized utilitarian trip)[1]	92	88	96	96
Auto reliant (all utilitarian trips are motorized)[1]	75	71	84	87
Active traveler (at least one bike/ped utilitarian trip)[1]	21	24	13	10
Continuous Variables	**Sample Mean (SD)**	**Weighted Mean (SD)**	**Sample Mean (SD)**	**Weighted Mean (SD)**
Regional access[2]	0.50 (0.81)	0.31 (0.83)	-1.00 (0.81)	-1.00 (0.82)
Local access[2]	0.61 (0.73)	0.45 (0.68)	-1.40 (0.71)	-1.30 (0.67)
Local job diversity[2]	-0.01 (1.00)	0.05 (1.00)	-0.23 (1.00)	-0.16 (1.00)
VMT on travel day	31 (38)	32 (39)	47 (45)	45 (45)

[1] Variable is binary, [2] Variable is standardized

For all three outcomes we evaluated separate models for urban populations, rural populations, and the full sample. We then compare the estimated effects of the built environment on travel outcomes across the three models. We evaluate differences in these relationships across models by comparing the estimated effects of each variable using 95% confidence intervals around each estimated coefficient or odds ratio. Confidence intervals that do not overlap indicate significantly different associations between the corresponding variable and travel outcomes in different types of urban or rural communities. For all models we report their Akaike Information Criterion (AIC) scores, where models with a lower AIC score have a better fit (*36*). One important note on AIC scores is that they are based on sample size, with larger samples producing larger AIC scores.

Results and Discussion

We first evaluate the question of whether the relationships between the built environment and travel are different in urban and rural communities, we compare the 95% confidence intervals of the built environment coefficients and odds ratios for the urban and rural models for each travel outcome. The results of the VMT model are presented in Table 2 and the results of the auto reliance models and utilitarian active travel models are presented in Table 3 and Table 4 respectively. Estimates that are significant at the 95% level are shown in bold. We also visualize the 95% confidence intervals for the built environment factors and the vehicle access variables of all models in Figure 1. All statistical differences discussed in the paper are visualized in Figure 1.

Looking first at personal characteristics in each model, across all modeled travel outcomes we observe consistent results. We also observe that personal characteristics are generally related to travel in ways that are expected. We observe few statistically significant differences between the urban and rural models in terms of the effects of most personal characteristics on travel behavior. For those that differ significantly, we see that the effects are moderated (i.e., smaller in magnitude or non-significant) in the rural models when compared with urban models. This effect is most pronounced with the vehicle access variable (visualized in Figure 1). The more moderate effects observed in rural contexts indicates that variation in travel outcomes is less related to who someone is in rural contexts when compared with urban contexts, which may result from fewer travel options in these communities. A notable exception is the effect of age on mode choice. In rural models some older age groups are less likely to be auto reliant and more likely to be active travelers when compared with younger travelers. This contrasts with the urban and full models, where we see the opposite relationship.

When we evaluate the effect of the built environment on travel behavior, we see that there are differences between the urban and rural model estimates, particularly for regional and local access. The effect of regional accessibility on all travel outcomes is greater in the rural models than in the urban models, with greater levels of regional access associated with less active travel and more auto reliance in both rural and urban contexts, although the effects are muted in urban contexts relative to urban. Interestingly, greater regional access is associated with lower VMT in rural contexts, seemingly in contrast to its positive relationship with auto reliance. In other words, people with more regional access in rural contexts rely on their vehicle more but do not drive as far. We do not observe a significant effect on VMT in urban contexts, which is not the case in the extant literature (*7*, *8*, *32*).

Looking next at local access, we see across modeled outcomes that there are significant differences between the urban and rural models. In all models increasing local access is associated with lower VMT, less auto reliance, and higher chances of utilitarian active travel. This result is largely in line with the existing literature in terms of direction and magnitude (*7*, *8*). Interestingly, the magnitude of this effect is smaller in the rural models than in the urban models, indicating that local access matters less in terms of travel behavior in rural contexts. This finding is consistent with the findings that local density had a smaller association with VMT than in more urbanized areas in Brownstone and Golob (*12*) though it is at odds with the findings of Salon (*32*).

In terms of local job diversity, we see marginal associations with all modeled travel outcomes, with statistically significant differences between urban and rural for the mode choice outcomes but not for VMT. Greater job diversity is associated with more sustainable travel outcomes when significant, in line with the extant literature (*7*, *8*). Results for transit access are as expected for both the VMT and mode outcomes, though no statistically significant differences between urban and rural were found, likely because of the low level of variation in this variable in the rural model, which leads to a very wide confidence interval.

We interpret these results with caution for several reasons. First, our study is cross-sectional, which means that it cannot establish causality and is subject to more variability (*37*); we do not control residential self-selection which may impact our results (*8*, *19*). Nevertheless, our results indicate that the associations between the built environment and travel in urban and rural areas are likely different, which suggests that prior studies that establish causal relationships may not apply in rural contexts. Secondly, we use only one definition of urban and rural, and it possible that our result is sensitive to the definition of rural applied (*10*, *38*). There may also be differences across different types of rural contexts such as small towns versus dispersed rural areas, as rurality is not homogenous.

Conclusion

Our results indicate that the relationship between the built environment and travel behavior in rural contexts is distinct from urban contexts. This is most apparent when comparing the effects of regional and local access on mode choice and vehicle travel. Regional and local access are similarly important in rural contexts, while in urban areas local access is much more strongly associated with travel choices. Additionally, we also see that while greater regional access is associated with lower VMT in rural contexts, it is also associated with greater rates of auto reliance and lower rates of active travel. This difference is not present in our urban studies. At the same time, the effects of personal characteristics on VMT and mode choice are more muted in rural contexts than in urban contexts, which may result from fewer travel options in these communities.

An important limitation to this work is that our results indicate differences in associations rather differences in causal relationships. While we attempt to control for residential self-selection by including a wide range of socio-demographic factors, we could not explicitly control for it (*8*, *19*). If our findings were to also hold causally, it would indicate that the largely urban literature that establishes the effects of the built environment on travel behavior may not apply in rural contexts. At present we can only suggest that this is a possibility. Future research is needed to establish whether causal relationships differ across urban and rural contexts. Future study is also needed to determine whether there are any differences in relationships across different types of rural contexts, for example small towns versus dispersed rural areas.

Acknowledging these limitations, our results present important considerations for future research and practice. Planners who undertake projects to reduce VMT and auto reliance in rural contexts should proceed with caution when following the prescriptions of urban-focused research.

Research Support

The National Center for Sustainable Transportation at the University of Vermont funded this research and the Federal Highway Administration provided spatially detailed NHTS data. Sierra Espeland and Mitch Robinson assisted with setting up the code and provided valuable feedback.

Table 2. Gamma model of VMT on the travel day.

Effect	Full Model				Urban Model				Rural Model			
	Coeff	95% CI		*p-value*	Coeff	95% CI		*p-value*	Coeff	95% CI		*p-value*
		LL	UL			LL	UL			LL	UL	
Intercept	**3.051**	**3.013**	**3.089**	**<0.001**	**2.997**	**2.952**	**3.042**	**<0.001**	**3.284**	**3.208**	**3.361**	**<0.001**
Person Characteristic Variables												
Race and Ethnicity (*Base: Non-Hispanic White*)												
Non-Hispanic Black	**0.083**	**0.055**	**0.111**	**<0.001**	**0.080**	**0.048**	**0.112**	**<0.001**	**0.093**	**0.033**	**0.155**	**0.003**
Hispanic (all races)	**0.075**	**0.047**	**0.103**	**<0.001**	**0.073**	**0.042**	**0.105**	**<0.001**	**0.102**	**0.028**	**0.178**	**0.007**
Other race, multiple, or unknown	0.013	-0.015	0.041	0.367	0.005	-0.027	0.036	0.779	0.044	-0.022	0.111	0.196
Age (*Base: 22-35)*												
36-50	0.001	-0.024	0.024	0.968	0.003	-0.025	0.031	0.831	0.000	-0.049	0.048	0.994
51-69	-0.011	-0.033	0.012	0.348	-0.007	-0.033	0.019	0.592	-0.002	-0.048	0.043	0.922
70+	**-0.133**	**-0.160**	**-0.105**	**<0.001**	**-0.139**	**-0.171**	**-0.106**	**<0.001**	**-0.100**	**-0.154**	**-0.047**	**<0.001**
Female	**-0.085**	**-0.100**	**-0.071**	**<0.001**	**-0.088**	**-0.105**	**-0.071**	**<0.001**	**-0.077**	**-0.102**	**-0.052**	**<0.001**
Employed	**0.143**	**0.125**	**0.160**	**<0.001**	**0.167**	**0.146**	**0.187**	**<0.001**	**0.063**	**0.033**	**0.093**	**<0.001**
Education *(Base: High school or less)*												
Some college	**0.091**	**0.071**	**0.112**	**<0.001**	**0.097**	**0.072**	**0.123**	**<0.001**	**0.086**	**0.053**	**0.118**	**<0.001**
Bachelor's or more	**0.112**	**0.092**	**0.133**	**<0.001**	**0.119**	**0.094**	**0.144**	**<0.001**	**0.088**	**0.054**	**0.122**	**<0.001**
Annual Income (*Base: >$35,000*)												
$35,000-$74,999	**0.174**	**0.154**	**0.194**	**<0.001**	**0.189**	**0.165**	**0.213**	**<0.001**	**0.136**	**0.102**	**0.170**	**<0.001**
$75,000-$125,000	**0.242**	**0.219**	**0.265**	**<0.001**	**0.251**	**0.223**	**0.278**	**<0.001**	**0.218**	**0.178**	**0.258**	**<0.001**
$125,000+	**0.286**	**0.259**	**0.312**	**<0.001**	**0.285**	**0.254**	**0.316**	**<0.001**	**0.281**	**0.232**	**0.329**	**<0.001**
Two or more adults	**0.036**	**0.019**	**0.054**	**<0.001**	**0.040**	**0.019**	**0.061**	**<0.001**	0.023	-0.009	0.055	0.162
Children in home	**0.026**	**0.006**	**0.046**	**0.010**	**0.025**	**0.002**	**0.048**	**0.034**	**0.045**	**0.009**	**0.082**	**0.016**
Vehicle access: fully equipped	**0.222**	**0.201**	**0.243**	**<0.001**	**0.238**	**0.214**	**0.263**	**<0.001**	**0.122**	**0.076**	**0.166**	**<0.001**
Built Environment Variables												
Regional access	**-0.016**	**-0.026**	**-0.005**	**0.003**	0.002	-0.011	0.015	0.744	**-0.059**	**-0.076**	**-0.041**	**<0.001**
Local access	**-0.179**	**-0.190**	**-0.168**	**<0.001**	**-0.176**	**-0.193**	**-0.160**	**<0.001**	**-0.099**	**-0.122**	**-0.077**	**<0.001**
Local job diversity	**-0.008**	**-0.015**	**-0.001**	**0.031**	-0.006	-0.014	0.003	0.193	**-0.019**	**-0.032**	**-0.006**	**0.005**
Transit access	**-0.033**	**-0.051**	**-0.015**	**<0.001**	**-0.033**	**-0.054**	**-0.013**	**0.001**	**-0.135**	**-0.226**	**-0.042**	**0.004**
Model Fit Information												
N	108773				84887				23886			
AIC	983283				753959				228863			

Table 3. Binary logit model of auto reliance (motorized mode for all utilitarian travel on the travel day).

	Full Model				Urban Model				Rural Model			
Effect	**Odds**	**95% CI**		***p-value***	**Odds**	**95% CI**		***p-value***	**Odds**	**95% CI**		***p-value***
			UL			**LL**	**UL**			**LL**	**UL**	
Intercept	**1.116**	**1.030**	**1.210**	**0.007**	**1.114**	**1.018**	**1.219**	**0.019**	**3.599**	**2.845**	**4.565**	**<0.001**
Person Characteristic Variables												
Race and Ethnicity (*Base: Non-Hispanic White*)												
Non-Hispanic Black	**1.146**	**1.077**	**1.221**	**<0.001**	**1.142**	**1.068**	**1.221**	**<0.001**	**1.279**	**1.045**	**1.581**	**0.020**
Hispanic (all races)	**1.216**	**1.140**	**1.298**	**<0.001**	**1.269**	**1.186**	**1.359**	**<0.001**	0.873	0.694	1.110	0.256
Other race, multiple, or unknown	1.056	0.994	1.123	0.081	**1.096**	**1.027**	**1.169**	**0.006**	0.932	0.766	1.142	0.487
Age (*Base: 22-35)*												
36-50	1.047	0.991	1.105	0.102	1.059	0.999	1.123	0.056	0.854	0.721	1.009	0.066
51-69	**1.080**	**1.027**	**1.135**	**0.003**	**1.114**	**1.055**	**1.175**	**<0.001**	**0.770**	**0.658**	**0.899**	**0.001**
70+	**1.466**	**1.376**	**1.562**	**<0.001**	**1.524**	**1.422**	**1.634**	**<0.001**	0.960	0.802	1.147	0.658
Female	**1.075**	**1.040**	**1.111**	**<0.001**	**1.072**	**1.033**	**1.111**	**<0.001**	1.070	0.988	1.158	0.095
Employed	**1.410**	**1.355**	**1.467**	**<0.001**	**1.431**	**1.369**	**1.496**	**<0.001**	**1.345**	**1.227**	**1.474**	**<0.001**
Education *(Base: High school or less)*												
Some college	0.980	0.933	1.030	0.432	1.012	0.956	1.070	0.689	**0.858**	**0.769**	**0.956**	**0.006**
Bachelor's or more	**0.628**	**0.598**	**0.660**	**<0.001**	**0.654**	**0.619**	**0.691**	**<0.001**	**0.542**	**0.486**	**0.604**	**<0.001**
Annual Income (*Base: >$35,000*)												
$35,000-$74,999	**1.201**	**1.147**	**1.258**	**<0.001**	**1.229**	**1.168**	**1.294**	**<0.001**	1.085	0.973	1.211	0.142
$75,000-$125,000	1.023	0.970	1.079	0.410	1.042	0.982	1.105	0.176	0.950	0.837	1.078	0.429
$125,000+	**0.778**	**0.733**	**0.826**	**<0.001**	**0.764**	**0.715**	**0.816**	**<0.001**	0.865	0.744	1.005	0.058
Two or more adults	**1.610**	**1.547**	**1.675**	**<0.001**	**1.642**	**1.572**	**1.716**	**<0.001**	**1.344**	**1.217**	**1.483**	**<0.001**
Children in home	**1.344**	**1.283**	**1.408**	**<0.001**	**1.290**	**1.226**	**1.357**	**<0.001**	**1.398**	**1.234**	**1.586**	**<0.001**
Vehicle access: fully equipped	**2.980**	**2.852**	**3.113**	**<0.001**	**3.113**	**2.968**	**3.264**	**<0.001**	**1.853**	**1.629**	**2.104**	**<0.001**
Built Environment Variables												
Regional access	**1.165**	**1.138**	**1.194**	**<0.001**	**1.118**	**1.088**	**1.149**	**<0.001**	**1.281**	**1.213**	**1.352**	**<0.001**
Local access	**0.691**	**0.673**	**0.709**	**<0.001**	**0.574**	**0.554**	**0.596**	**<0.001**	**0.831**	**0.776**	**0.890**	**<0.001**
Local job diversity	**0.973**	**0.957**	**0.989**	**0.001**	**0.974**	**0.957**	**0.992**	**0.005**	**0.904**	**0.867**	**0.943**	**<0.001**
Transit access	**0.701**	**0.673**	**0.730**	**<0.001**	**0.765**	**0.733**	**0.799**	**<0.001**	0.876	0.678	1.145	0.321
Model Fit Information												
N	96490				75231				21259			
AIC	90772				73656				16657			

Table 4. Binary logit model of active travel (taking at least one utilitarian trip by walking or bicycling).

Effect	Full Model				Urban Model				Rural Model			
	Odds	95% CI		*p-value*	Odds	95% CI		*p-value*	Odds	95% CI		*p-value*
			UL			LL	UL			LL	UL	
Intercept	**0.562**	**0.516**	**0.612**	**<0.001**	**0.555**	**0.504**	**0.610**	**<0.001**	**0.199**	**0.153**	**0.257**	**<0.001**
Person Characteristic Variables												
Race and Ethnicity (*Base: Non-Hispanic White*)												
Non-Hispanic Black	**0.696**	**0.648**	**0.746**	**<0.001**	**0.690**	**0.640**	**0.743**	**<0.001**	**0.700**	**0.550**	**0.879**	**0.003**
Hispanic (all races)	**0.783**	**0.729**	**0.839**	**<0.001**	**0.743**	**0.690**	**0.799**	**<0.001**	1.246	0.967	1.586	0.081
Other race, multiple, or unknown	**0.901**	**0.844**	**0.961**	**0.002**	**0.866**	**0.808**	**0.927**	**<0.001**	1.061	0.851	1.310	0.591
Age (*Base: 22-35)*												
36-50	0.946	0.893	1.003	0.061	**0.936**	**0.880**	**0.995**	**0.035**	1.167	0.971	1.408	0.103
51-69	**0.928**	**0.880**	**0.978**	**0.006**	**0.900**	**0.851**	**0.953**	**<0.001**	**1.326**	**1.119**	**1.579**	**0.001**
70+	**0.711**	**0.665**	**0.761**	**<0.001**	**0.694**	**0.646**	**0.747**	**<0.001**	1.049	0.864	1.279	0.630
Female	**0.964**	**0.931**	**0.999**	**0.041**	**0.955**	**0.918**	**0.992**	**0.018**	1.035	0.950	1.128	0.433
Employed	**0.677**	**0.649**	**0.677**	**<0.001**	**0.675**	**0.644**	**1.154**	**<0.001**	**0.677**	**0.613**	**0.675**	**<0.001**
Education *(Base: High school or less)*												
Some college	**1.082**	**1.026**	**1.142**	**0.004**	1.042	0.981	1.107	0.181	**1.274**	**1.130**	**1.436**	**<0.001**
Bachelor's or more	**1.717**	**1.630**	**1.809**	**<0.001**	**1.640**	**1.547**	**1.739**	**<0.001**	**2.033**	**1.805**	**2.292**	**<0.001**
Annual Income (*Base: >$35,000*)												
$35,000-$74,999	**0.845**	**0.805**	**0.888**	**<0.001**	**0.838**	**0.794**	**0.885**	**<0.001**	**0.881**	**0.783**	**0.991**	**0.035**
$75,000-$125,000	0.978	0.924	1.035	0.442	0.972	0.913	1.034	0.370	0.999	0.871	1.145	0.986
$125,000+	**1.252**	**1.175**	**1.334**	**<0.001**	**1.276**	**1.191**	**1.368**	**<0.001**	1.097	0.933	1.289	0.263
Two or more adults	**0.652**	**0.625**	**0.679**	**<0.001**	**0.647**	**0.618**	**0.678**	**<0.001**	**0.734**	**0.660**	**0.816**	**<0.001**
Children in home	**0.774**	**0.737**	**0.814**	**<0.001**	**0.808**	**0.765**	**0.852**	**<0.001**	**0.734**	**0.639**	**0.842**	**<0.001**
Vehicle access: fully equipped	**0.416**	**0.397**	**0.436**	**<0.001**	**0.408**	**0.388**	**0.429**	**<0.001**	**0.595**	**0.518**	**0.686**	**<0.001**
Built Environment Variables												
Regional access	**0.830**	**0.809**	**0.851**	**<0.001**	**0.857**	**0.833**	**0.882**	**<0.001**	**0.773**	**0.729**	**0.819**	**<0.001**
Local access	**1.484**	**1.443**	**1.527**	**<0.001**	**1.739**	**1.674**	**1.807**	**<0.001**	**1.230**	**1.143**	**1.323**	**<0.001**
Local job diversity	**1.034**	**1.016**	**1.052**	**<0.001**	**1.032**	**1.013**	**1.052**	**0.001**	**1.108**	**1.059**	**1.160**	**<0.001**
Transit access	**1.384**	**1.326**	**1.444**	**<0.001**	**1.287**	**1.230**	**1.346**	**<0.001**	1.087	0.815	1.430	0.559
Model Fit Information												
N		96490				75231				21259		
AIC		83050				68027				14732		

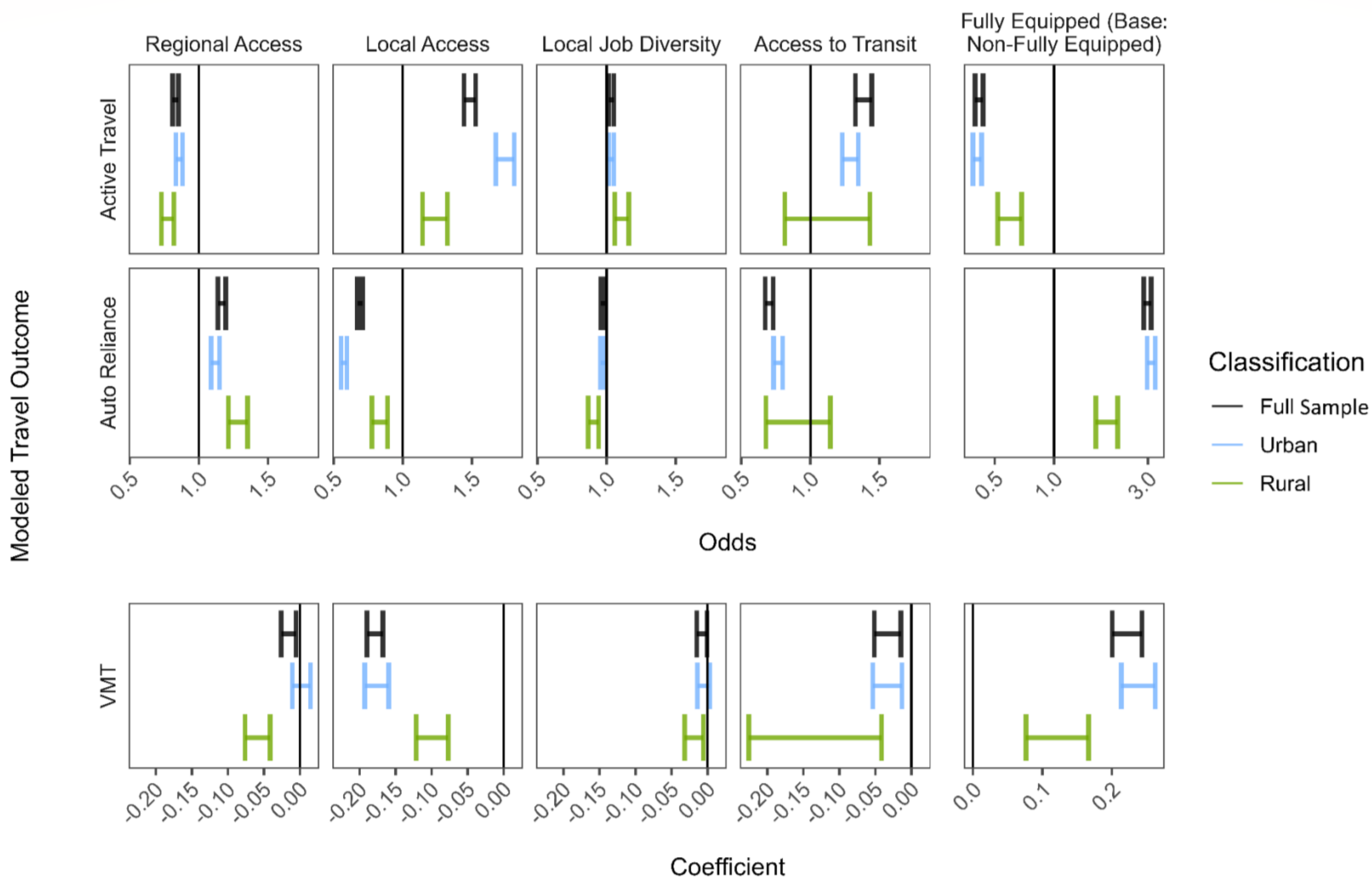

Figure 1. Estimated effects of built environment variables and vehicle access on travel behavior (95% confidence intervals).

References

1. United States Census Bureau. 2020 Decennial Census. , 2020.
2. Federal Highway Administration. Highway Statistics 2020. *Highway Statistics 2020*. https://www.fhwa.dot.gov/policyinformation/statistics/2020/. Accessed Jun. 26, 2023.
3. Espeland, S., and D. Rowangould. Rural Travel Burdens in the United States: Unmet Need and Travel Costs. *Journal of Transport Geography*, Vol. 121, 2024, p. 12. https://doi.org/10.1016/j.jtrangeo.2024.104016.
4. Dalbey, M. Implementing Smart Growth Strategies in Rural America: Development Patterns That Support Public Health Goals. *Journal of Public Health Management and Practice*, Vol. 14, No. 3, 2008, pp. 238–243. https://doi.org/10.1097/01.PHH.0000316482.65135.e8.
5. Frank, K. I., and S. A. Reiss. The Rural Planning Perspective at an Opportune Time. *Journal of Planning Literature*, Vol. 29, No. 4, 2014, pp. 386–402. https://doi.org/10.1177/0885412214542050.
6. Stewart, O. T., A. Vernez Moudon, B. E. Saelens, C. Lee, B. Kang, and M. P. Doescher. Comparing Associations Between the Built Environment and Walking in Rural Small Towns and a Large Metropolitan Area. *Environment and Behavior*, Vol. 48, No. 1, 2016, pp. 13–36. https://doi.org/10.1177/0013916515612253.
7. Ewing, R., and R. Cervero. Travel and the Built Environment. *Journal of the American Planning Association*, Vol. 76, No. 3, 2010, pp. 265–294. https://doi.org/10.1080/01944361003766766.
8. Stevens, M. R. Does Compact Development Make People Drive Less? *Journal of the American Planning Association*, Vol. 83, No. 1, 2017, pp. 7–18. https://doi.org/10.1080/01944363.2016.1240044.
9. Pucher, J., and J. L. Renne. Rural Mobility and Mode Choice: Evidence from the 2001 National Household Travel Survey. *Transportation*, Vol. 32, No. 2, 2005, pp. 165–186. https://doi.org/10.1007/s11116-004-5508-3.
10. Quallen, E. L., and G. Rowangould. Consistently Inconsistent: An Assessment of Definitions of Rural and Travel Behavior Outcomes in Vermont. Jul 31, 2021.
11. Ihlanfeldt, K. Vehicle Miles Traveled and the Built Environment: New Evidence from Panel Data. *Journal of Transport and Land Use*, Vol. 13, No. 1, 2020, pp. 23–48. https://doi.org/10.5198/jtlu.2020.1647.
12. Brownstone, D., and T. F. Golob. The Impact of Residential Density on Vehicle Usage and Energy Consumption. *Journal of Urban Economics*, Vol. 65, No. 1, 2009, pp. 91–98. https://doi.org/10.1016/j.jue.2008.09.002.
13. Millward, H., and J. Spinney. Time Use, Travel Behavior, and the Rural–Urban Continuum: Results from the Halifax STAR Project. *Journal of Transport Geography*, Vol. 19, No. 1, 2011, pp. 51–58. https://doi.org/10.1016/j.jtrangeo.2009.12.005.

14. Ralph, K., C. T. Voulgaris, B. D. Taylor, E. Blumenberg, and A. E. Brown. Millennials, Built Form, and Travel Insights from a Nationwide Typology of U.S. Neighborhoods. *Journal of Transport Geography*, Vol. 57, 2016, pp. 218–226. https://doi.org/10.1016/j.jtrangeo.2016.10.007.

15. Voulgaris, C. T., B. D. Taylor, E. Blumenberg, A. Brown, and K. Ralph. Synergistic Neighborhood Relationships with Travel Behavior: An Analysis of Travel in 30,000 US Neighborhoods. *Journal of Transport and Land Use*, Vol. 10, No. 1, 2017, pp. 437–461. https://doi.org/10.5198/jtlu.2016.840.

16. Federal Highway Administration. *2017 National Household Travel Survey*. U.S. Department of Transporation, Washington DC, 2017.

17. United States Environmental Protection Agency. Smart Location Database Technical Documentation and User Guide Version 3.0. Jun, 2021.

18. Cervero, R., and K. Kockelman. Travel Demand and the 3Ds: Density, Diversity, and Design. *Transportation Research Part D: Transport and Environment*, Vol. 2, No. 3, 1997, pp. 199–219. https://doi.org/10.1016/S1361-9209(97)00009-6.

19. Cao, X. (Jason), P. L. Mokhtarian, and S. L. Handy. Examining the Impacts of Residential Self-Selection on Travel Behaviour: A Focus on Empirical Findings. *Transport Reviews*, Vol. 29, No. 3, 2009, pp. 359–395. https://doi.org/10.1080/01441640802539195.

20. Ralph, K., C. T. Voulgaris, and A. Brown. Travel and the Built Environment: Insights Using Activity Densities, the Sprawl Index, and Neighborhood Types. *Transportation Research Record*, Vol. 2653, No. 1, 2017, pp. 1–9. https://doi.org/10.3141/2653-01.

21. Handy, S. Enough with the "D's" Already — Let's Get Back to "A." Transfers Magazine, 1, May, 2018.

22. Handy, S. Understanding the Link Between Urban Form and Nonwork Travel Behavior. *Journal of Planning Education and Research*, Vol. 15, No. 3, 1996, pp. 183–198. https://doi.org/10.1177/0739456X9601500303.

23. Karner, A., K. Levine, L. Alcorn, M. Situ, D. Rowangould, K. Kim, A. Kocatepe, National Cooperative Highway Research Program, Transportation Research Board, and National Academies of Sciences, Engineering, and Medicine. *Accessibility Measures in Practice: A Guide for Transportation Agencies*. Transportation Research Board, Washington, D.C., 2022.

24. Levinson, D., and D. King. Transport Access Manual: A Guide for Measuring Connection between People and Places. 2020.

25. Levinson, D. M. Accessibility and the Journey to Work. *Journal of Transport Geography*, Vol. 6, No. 1, 1998, pp. 11–21. https://doi.org/10.1016/S0966-6923(97)00036-7.

26. Handy, S., and D. A. Niemeier. Measuring Accessibility: An Exploration of Issues and Alternatives. *Environment and Planning A: Economy and Space*, Vol. 29, No. 7, 1997, pp. 1175–1194. https://doi.org/10.1068/a291175.

27. Hanson, S., and M. Schwab. Accessibility and Intraurban Travel. *Environment and Planning A: Economy and Space*, Vol. 19, No. 6, 1987, pp. 735–748. https://doi.org/10.1068/a190735.

28. Rasca, S., and N. Saeed. Exploring the Factors Influencing the Use of Public Transport by Commuters Living in Networks of Small Cities and Towns. *Travel Behaviour and Society*, Vol. 28, 2022, pp. 249–263. https://doi.org/10.1016/j.tbs.2022.03.007.

29. Pickrell, D., and P. Schimek. Trends in Personal Motor Vehicle Ownership and Use: Evidence from the Nationwide Personal Transportation Survey. *Journal of Transportation and Statistics*, Vol. 2, 1999.

30. Schimek, P. Household Motor Vehicle Ownership and Use: How Much Does Residential Density Matter? *Transportation Research Record*, Vol. 1552, No. 1, 1996, pp. 120–125. https://doi.org/10.1177/0361198196155200117.

31. Doescher, M. P., C. Lee, E. M. Berke, A. M. Adachi-Mejia, C. Lee, O. Stewart, D. G. Patterson, P. M. Hurvitz, H. A. Carlos, G. E. Duncan, and A. V. Moudon. The Built Environment and Utilitarian Walking in Small US Towns. *Preventive Medicine*, Vol. 69, 2014, pp. 80–86. https://doi.org/10.1016/j.ypmed.2014.08.027.

32. Salon, D. Heterogeneity in the Relationship between the Built Environment and Driving: Focus on Neighborhood Type and Travel Purpose. *Research in Transportation Economics*, Vol. 52, 2015, pp. 34–45. https://doi.org/10.1016/j.retrec.2015.10.008.

33. Federal Highway Administration. Derived Variables. U.S. Department of Transporation, Washington DC, Aug, 2020.

34. United States Census Bureau. *Urban Area Criteria for the 2010 Census*. 2011.

35. Blumenberg, E., A. Brown, and A. Schouten. Car-Deficit Households: Determinants and Implications for Household Travel in the U.S. *Transportation*, Vol. 47, No. 3, 2020, pp. 1103–1125. https://doi.org/10.1007/s11116-018-9956-6.

36. Smithson, M., and Y. Shou. *Generalized Linear Models for Bounded and Limited Quantitative Variables*. SAGE, Los Angeles, 2020.

37. Handy, S. Thoughts on the Meaning of Mark Stevens's Meta-Analysis. *Journal of the American Planning Association*, Vol. 83, No. 1, 2017, pp. 26–28. https://doi.org/10.1080/01944363.2016.1246379.

38. Wineman, A., D. Y. Alia, and C. L. Anderson. Definitions of "Rural" and "Urban" and Understandings of Economic Transformation: Evidence from Tanzania. *Journal of Rural Studies*, Vol. 79, 2020, pp. 254–268. https://doi.org/10.1016/j.jrurstud.2020.08.014.

Data Summary

Products of Research

This project uses data from the 2017 National Household Travel Survey (NHTS) and from the US EPA Smart Location Database (EPA SLD). The project uses detailed locations for the NHTS data (provided by FHWA) to match NHTS data to EPA SLD data. The NHTS detailed location data requires FHWA permission to access.

The publicly available NHTS data used in this study can be accessed by the public at https://nhts.ornl.gov/). The publicly available US EPA Smart Location Database is available at https://www.epa.gov/smartgrowth/smart-location-mapping. The project uses detailed locations for the NHTS data which are not publicly available but can be requested from FHWA.

Data Format and Content

The data can be downloaded in a variety of formats from the sources noted above.

Data Access and Sharing

See above.

Reuse and Redistribution

See above.