HIGH SCHOOL EDITION
Journal of Student Research
Volume 13 Issue 3 (2024)

The Use of Bike Infrastructures in Suburban Public High Schools

Mahima Srivarshini[1] and Daria Kuscenko[#]

[1]Ridge High School, USA
[#]Advisor

ABSTRACT

The growing use of motorized vehicles such as cars has greatly contributed to the modern declining environment. This situation is partly caused by the decreased use of active transportation methods, including biking. Previous research has revealed that in highly populated areas, biking is quite common when compared to biking in areas with lower population density. Furthermore, studies reveal that there is a severe lack of research done regarding active transportation methods in areas with lower population density. This study used a quantitative analysis method where participants were asked to rate physical factors regarding the bike infrastructure surrounding the school. This study aims to identify the specific factors that most affects students' decision to bike in the mornings to a from a high school. The results of this study reveal that the most influential factors for students when making the decision to bike are traffic, terrain, and the availability of bike-housing facilities. These results may not be applicable to the entire suburban population as the participants in this study were a fraction of the population and can only be applied to the group in the study. The results of this study may also not apply to areas with differing weather conditions, infrastructures, and other factors.

Introduction

In recent years, the prevalence of biking in urban communities has gone up significantly. Increasing about 40% between the years 2000 and 2014, biking has become a mode of transportation used by many. In fact, it has experienced the largest share increase of any transportation mode (Gilderbloom et al., 2016). In contrast, this same finding cannot be applied to other communities with differing levels of population density. In suburban areas, biking has not been a mode of transportation as much as it has in urban areas as many residents rely on vehicle transportation as their main methods of transportation. This method of transportation is not the most effective as it can have harmful effects on the environment, making this problem important to address. Increasing the use of active transportation, which are methods of transportation powered by human mobility, can significantly reduce the impact that gas-emitting vehicles have on the environment (Glazener & Khreis, 2019). This brings up a gap in the research as there is little knowledge about how biking behavior may be influenced in suburban areas. It is necessary to establish this knowledge so that bike infrastructures in suburban communities can be improved to better suit bikers, increasing usage. This research paper aims to address the question "What are the perceived physical factors including features of a bike infrastructure (traffic, natural scenery, terrain, etc.) which most influence biking behavior in suburban communities?".

Literature Review

The presence of a supportive environment will increase the likelihood of bike infrastructure usage by individuals in cities (Dill, 2009). Bike infrastructure can be defined as pathways that accommodate bicycling including

sidewalks, bike lanes, railways, and where permitted, freeways. This shows that in order to increase bike usage by individuals, an environment which provides the necessary features will support active transportation. The environment of the infrastructure can be defined as the surrounding features of an infrastructure including nature, human population, and other characteristics which may influence a person's perception. Furthermore, the design of the cycling infrastructure also has an impact on the biker's perception and usage (Hull & O'holleran, 2014). This reveals that design and environment of an infrastructure can influence the usage; however, the setting of these studies may place a factor on perception. A majority of studies relating to this topic have been conducted in urban areas or cities. Urban cities are defined as areas with generally high population density as well as residential and business building density. Those living in urban areas tend to cycle and walk more than those living in rural and suburban areas (Pucher et al., 2011). These factors point to a gap such that the factors that may influence perceptions of bike infrastructure in cities or urban areas may not be similar in suburban areas as these areas tend to be less dense with respect to the amount of infrastructures or residential buildings. Suburban areas can be defined as residential areas with low population densities compared to urban but higher population densities than rural areas. These areas do not have easy access to buildings without the use of a car or a similar vehicle. Therefore, this study aims to specifically delve into the relationship between bike infrastructures and their usage in the setting of suburban public high schools in order to better implement features that motivate bike infrastructure usage.

Importance of Studying Influencing Factors

In suburban communities, the introduction or usage of conservative modes of transportation is especially important. In the modern era, the use of heavy motorized vehicles has been increasingly prevalent, especially in suburban areas as buildings and services are located at significantly large distances (Delucchi & Kurani, 2014). It is important to motivate and take action to reduce the use of these motorized vehicles for the benefit of the environment. The increased use of motorized vehicles works to the detriment of our environment, releasing harmful gases into the atmosphere. In just 20 years, the amount of carbon emissions worldwide increased by 48% solely from road transportation (Delucchi & Kurani, 2014). Furthermore, suburban areas noticeably exhibit higher household carbon footprints than other population densities, with 50% of the highest household carbon footprints coming from suburban areas when compared to urban and rural areas (Jones & Kammen, 2014). The extent to which this problem occurs implies that use of motorized vehicles needs to be reduced and other modes of transportation should be adopted in order to mitigate these effects. This problem is amplified in low density areas such as suburban communities. Due to low population density in suburbs, the presence of public transportation is lessened and is correlated with a higher use of personal vehicles to travel leading to increased consumption (Kahn, 2000). These factors put together establish an incentive to improve methods of active transportation in suburban areas in order to reduce the effect that motorized vehicles have on the environment

Study Participants

The subjects of the study are high school students generally between the ages of 13 and 18. High school students have been chosen as subjects due to the freedom they have to choose their own mode of transportation. The younger aged population has a higher tendency to use alternative forms of transportation, such as bicycling, due to the inability to drive cars or other motorized vehicles because of age limitations. Younger people are positively associated with the likelihood to use biking as a form of transportation (Barberan, 2017). Furthermore, high school students were chosen specifically as this population has increased freedom to choose modes of transportation when compared to elementary or middle schools. With increased freedom, the raw relationship

between the compatibility of a bike infrastructure and the amount of bikers can be better established with relevant data. The choice of transportation that the younger population makes to bike or not to bike shows the ability of the infrastructure to accommodate bikers as the usage depends entirely on the surveyed population.

Physical Factors

Previous research on bicycle commuting provides information about which external factors have the most influence on biking habits. External factors in this study can be defined as the physical characteristics of an environment which influence bike infrastructure usage. Some external factors include road traffic, characteristics of terrain, and weather. One of the most defining factors of bike infrastructures is the road traffic or congestion. This places a degree of danger surrounding bike infrastructures and can significantly impact perception of safety among users, leading to a reduction in biking. This study also concludes that the presence of bike facilities, the accommodations a building or service has to house bikes, may or may not affect biking (Handy & Xing, 2011). While these factors may be prevalent in cities, it is important to distinguish that these same features may not affect suburban bike infrastructure usage as infrastructures can differ in suburban communities when compared to cities. Natural scenery of the features of the natural environment also affect biking behavior in urban areas as many people preferred a bike route with pleasing visual stimuli (Wild & Woodward, 2019). This same behavior may or may not be present in suburban areas due to different settings. In a study done about the influence of safety, Marshall and Garrick looked into whether the safety impact bicycling rates. They found that in cities with lower risk of fatal crashes, there were higher rates of biking in those cities (Marshall & Garrick, 2011). While these factors may be prevalent in cities, it is important to distinguish that these same features may not affect suburban bike infrastructure usage as infrastructures can differ in suburban communities when compared to cities. Weather conditions also play a role in infrastructure usage. As shown in one study done regarding what makes people bike, the need to dress appropriately or carry certain items to address the weather played a role in the decision to bike (Wunsch et al., 2015). While weather will impact decisions in a suburban community as well, the focus of this study is to look into independent factors which do not change as it is clear that extreme weather can disincentivize outside interaction. Another factor that would affect usage is usability, referring to the terrain and difficulty of the ride. This can be important especially for those who have low fitness levels and therefore are discouraged from biking. The issue regarding safety may also be defining infrastructure use as a study conducted in Amsterdam found that high levels of bicycle theft disincentivized bikers to bike (Beck & Immers, 1994). Distance between households and destinations may influence willingness to cycle. People that report cycling tend to live closer to their respective destinations, revealing that distance can play a role in bike use (Wuerzer & Mason, 2015). While distance is something that cannot be ignored, the focus of this study will be to look at the immediate features of the bike infrastructure. These factors are directly associated with the bike infrastructure instead of other external factors. Many of these factors have only been studied in urban areas; hence, it is imperative to understand whether these factors are prevalent in suburban communities in order to establish features in bike infrastructure in suburban areas that may support biking.

The Level of Bicycle Compatibility Index

The Level of Bicycle Compatibility Index carefully measures the compatibility of a bike infrastructure regarding the surrounding environment. It takes into account the regulations such as speed limit and path width, identifying the infrastructures based on the traffic stress level. This valid and recent tool is specific to the state where the study will take place and therefore can be applied to suburban public schools in the state to determine the compatibility of bike infrastructures. This will further allow for further analysis of the question, “What are the perceived physical factors including features of a bike infrastructure (traffic, natural scenery, terrain, etc.) which most influence biking behavior in suburban communities?”. The gap that will be addressed in this research is

what factors most influence biking in suburban areas as this topic has only been previously studied in urban areas or cities where landscape and population density is different. Furthermore, according to McAndrews et al., there has been extensive research done regarding infrastructure planning in urban areas, but there is a severe lack of planning in suburban areas (McAndrews et al., 2018), which is what this study aims to address.1

Method

Demographics and Participants

This study will be conducted in a suburban public high school located in suburban areas. The survey in this study will be applicable to all students who attend the high school. These participants are between the ages of thirteen and eighteen of all genders and demographics. There are no limitations to participants based on race or ethnicity.

The participants of this study are high school students attending the high school being studied. The high school in this study was chosen as the setting of this study because it is classified as a building in a suburban county. High school students were chosen as the participants of this study because if they attend the chosen public school in this study, it can be extrapolated that they live in a suburban community and commute to the school within the community. This means that they are more exposed to bike infrastructures within the suburban community. Compared to adults who may have to travel out of suburban communities to commute to work-places, this participant group allows the research to be confined to suburban communities only which will yield relevant data.

Factor Ratings

The gap addressed by this method includes what factors most affect biking behavior at the public high school. The setting of this research method takes place around a suburban public school in the state. To begin, the compatibility of the infrastructure surrounding the target school will be calculated using the Level of Bicycle Compatibility. The Level of Bicycle Compatibility Index is a tool, specific to bicycle infrastructures in the state only, that classifies the safety of bike infrastructures surrounding a road. This index also includes off-path bike infrastructures, meaning that they are not connected to main roads. The purpose of this tool is to identify bicycle compatibility and create a road network aimed towards building a better biking environment. This index classifies the bike infrastructure based on safety from a range of having little to no stress (LBC 1) to having high stress (LBC 4 or LBC 5). It also classifies whether it would suit specific populations. For example, LBC 1 is suitable for children; however, LBC 4 is mostly suitable for only skilled bicyclists. This index is a valid resource for classifying bicycle infrastructures because it is specific to the state and has been used before. After this data has been calculated and compiled in a table, data will be obtained through questionnaires about how many students ride their bicycles to school. A questionnaire has been used in this research method to ask whether students bike to school or not due to weather implications. The time the study will be conducted takes place in a cold external setting which means that students will be less likely to bike to school due to extreme weather conditions. Observation-based data (physically counting how many people bike to school) will not provide accurate outcomes as people will bike more when weather conditions are suitable and therefore would not yield sufficient or accurate data. The questionnaire takes weather into account, giving students the option to clarify that without extreme weather conditions, they would bike to school. After this data is obtained, the number of students who bike to and from the high school will be compared to the compatibility of the bike infrastructure at the school using the LBC. This comparison will show whether bicycle compatibility affects the amount of

student bikers. Furthermore, the questionnaire also asks students to rate the physical characteristics of the infrastructures surrounding their school using the Likert Scale on a scale of one to five. This scale was adapted from another study in which participants were asked to rate their level of comfort when biking on different types of infrastructures on a scale of 1 to 5 (Sanders and Judelman, 2018). It was adapted to the conditions of each factor that was assessed instead of the participant's comfort level with each factor. To determine the underlying factors of bike infrastructure usage, data regarding students' perceptions of the physical environment must be collected. In the questionnaire, students will be asked to rate the physical characteristics of the bike infrastructure including terrain, traffic, natural scenery, bike-housing facilities, safety, and the level of activity (amount of people, cars) around their school on a scale of one to five. For example, if students are asked to rate the natural scenery of their surroundings, they would rate it on a scale of one to five (one = terrible scenery, five = great scenery). By collecting this data, further clarification can be made into the relationship between the number of student bikers and the compatibility of the infrastructure. The questionnaire also asks about demographics and gender. This data will allow for potential relationships to be made between demographics, gender, and biking. The questionnaire asks students about alternate modes of transportation, including cars and buses, and how far they live from their school. These two factors play a big role in bike infrastructure usage and may also serve as a limitation to this research method.

Ethical Considerations

The distribution of this survey will be through the Genesis Portal at the high school in this study. This research method does not involve people disclosing any personal or sensitive information they may not want to share. The option to take the survey is entirely voluntary and all questions within the survey are optional as well. The student may choose to answer questions at their discretion. Questions regarding demographics and gender are entirely optional. The questions that will be asked and answered in this survey have no potential for physical, mental, or psychological harm as they only request basic information regarding the students' mode of transportation. The participants will be fully informed about the study being conducted and the manner of the questions being asked before taking the survey. At this time, they may also deny their participation. Additionally, this survey has been approved by the Institutional Review Board of the high school to ensure that any potential risks have been eliminated from the survey. To keep participants from having to share their names or identifying information, each participant will be assigned a number which they will enter at the beginning of the survey to indicate that they are taking the survey. The number will not have any ties to the person and their identifying information and will be distributed at random. This will allow participants to remain confidential throughout this paper. The data that will be obtained through the survey will be stored in a password-protected folder to ensure the security of all information. Three years after this research has concluded, all data regarding this study will be destroyed. All participants will be referred to any medical professional, as needed, should any emergency occur while taking the survey. Finally, guardians of the students will sign parental consent forms to acknowledge their consent for their child to participate in this study. Students taking the survey will also sign a student assent form to acknowledge their consent to participate in this study. The consent forms that were utilized in this study were adapted from Smith College's consent templates (Smith College). This will further ensure that the participant and their guardian have reviewed any risks that may be involved and are willing to participate.

Results

With the results from the survey, the study was able to answer the question "A combined total of 20 responses were available for analysis among high school students. All rating questions were answered; thus, all responses were qualified for deep analysis. An analysis of the infrastructure surrounding the high school was conducted

using the Level of Bicycle Compatibility Index. Based on the speed limit, bike lane length, and shoulder lane length, the infrastructure was identified to have an LBC of 1. This is the lowest classification of bike infrastructure, meaning that it is the safest. LBC 1 is defined as having little to no stress and is suitable for almost all cyclists including children. As this infrastructure is identified as the lowest and safest classification possible on the scale, there should be no limitations on people riding bikes to the high school. However, this is not the case as the results of this study reveal that only one person out of twenty participants claimed that they ride their bike to and from school when the weather permits. This statistic is not entirely applicable to the entire school population as twenty participants are not sufficient to make conclusions.

With this classification, it is important to consider the factors that influence behavior around these infrastructures. There are several factors that may influence this behavior, but with resource limitations, the factors that can be best analyzed are bike accessibility, transportation accessibility, skill, scenery, traffic concentration, safety, facilities, activeness, weather, and terrain. The figure below (Figure 1) provides a definition for each of these factors and their relevance to biking.

Factor	Description
Accessibility	The participant's ability to obtain a bike for use
Skill	The participant's ability to ride a bike safely
Natural Scenery	The natural features surrounding a bike infrastructure such as trees, grass, and others
Traffic	A high concentration of vehicles moving along a road connected to or separated from the bike infrastructure
Safety	The features of the infrastructure that protect users from injury or harm
Facilities	The equipment provided to safely store bicycles in an area
Activity	This refers to how lively or bustling the area surrounding the infrastructure is, including the amount of the people and cars.
Weather	The general condition of the atmosphere in a particular area
Terrain	The physical features or topography of a stretch of land

Figure 1. Factors influencing infrastructure usage

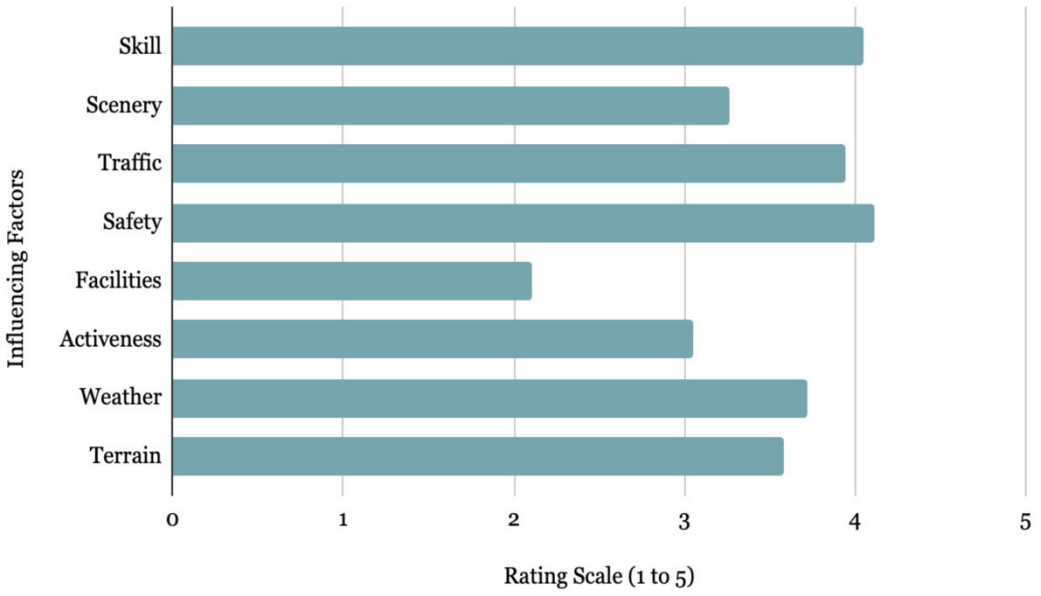

Figure 2. Mean (average) rating of influencing factors among all participants

The figure above (Figure 2) shows the mean ratings of all factors that participants were asked to rate based on the Likert scale (modified in the questionnaire for clarification). The questionnaire (See Appendix A) shows the conditions which qualify for a rating of 1 and a rating of 5. These conditions vary for each factor. When looking at the overall mean, traffic, facilities, and terrain stand out to be the most influential factors as they are substantially closer to the extreme ratings (1 or 5). The average rating for skill was closer to 5, meaning that people were highly skilled at biking which did not affect their decision to bike. The average rating for safety was also close to 5, meaning that people generally thought the neighborhood surrounding the school is safe and does not impact their decision to bike. The average ratings for scenery and activeness were closer to a rating of 3, meaning that people felt generally neutral about these factors so they were concluded to not have an impact on biking behavior.

Since much cannot be deduced from the mean ratings of all participants, Figure 3 has been organized into the most influential factors (including traffic, facilities, terrain, and activeness of the neighborhood) and the approximate distance that participants live from school. The data was organized in this way because there were clear and visible differences between ratings from participants who lived more than a mile away from school and participants who lived less than a mile away from school.

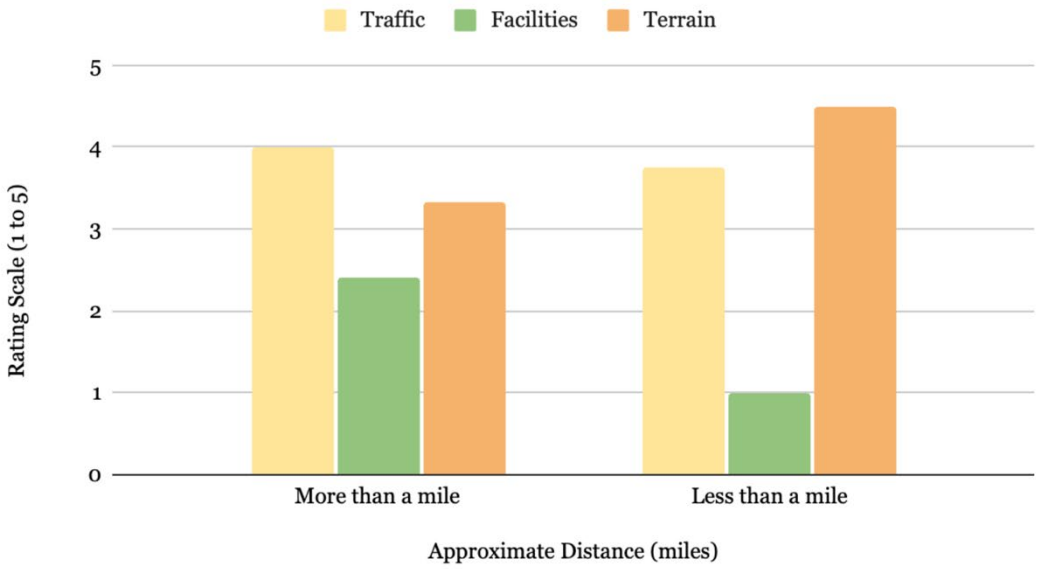

Figure 3. The mean (average) ratings of most influential factors for participants who live more than a mile away and participants who live less than a mile away.

Based on the results from Figure 2, it is clear that there are differences in how participants who live closer to school perceive the infrastructure when compared to participants who live more than a mile away. The perception of traffic did not differ significantly between the two groups and is very similar to that of the mean rating for traffic in Figure 2. There is a noticeable difference between the ratings of the bike-housing facilities and terrain for the two groups.

Discussion

Facilities Analysis

When looking at the analysis of how participants perceived facilities, it is important to consider whether participants had ever considered using biking as a form of transportation. This means that if they considered biking as an option, the participant would have likely looked at whether there were facilities to park their bikes. As people who live more than a mile away would likely not consider biking as an option, their knowledge of the bike-housing facilities the school provides would likely be limited or inaccurate. For this reason, it is important to acknowledge that participants who lived closer would rate the facilities more accurately. To bolster this assumption, based on observation of the school's bike facilities, this high school provides only one bike rack for a school of around 1,500 students, proving this rating by participants who lived closer to school to be more accurate than those who lived farther away.

When looking at Figure 3, it can be seen that participants who lived less than a mile away rated the facilities with a very extreme attitude. These participants rated the facilities with a one on a scale of one to five. This clearly indicates that there is very little accessibility to bike housing facilities in the area of the high school. Additionally, all participants who claimed that they lived less than a mile away from school gave the facilities a very low rating. When looking at the mean rating for all participants (Figure 2), it is evident that the facilities were rated the lowest. This suggests that the bike-housing facilities a suburban area may provide have a significant influence on the choices made to bike. If students do not have the ability to safely store their bikes in an area, they are more likely to not ride their bikes. This further reveals that bike-housing facilities are an important factor that influences bike behavior in suburban areas.

Terrain Analysis

Looking at the mean rating of the terrain for all participants reveals that the participants were generally neutral about the terrain. In contrast, when separating participants based on distance from the school, it can be seen that participants who lived closer to the school rated the terrain to be more difficult and inconsistent than those who lived farther away. As established before, participants who lived less than a mile away from school tended to be more justified when rating the features of the bike infrastructure.

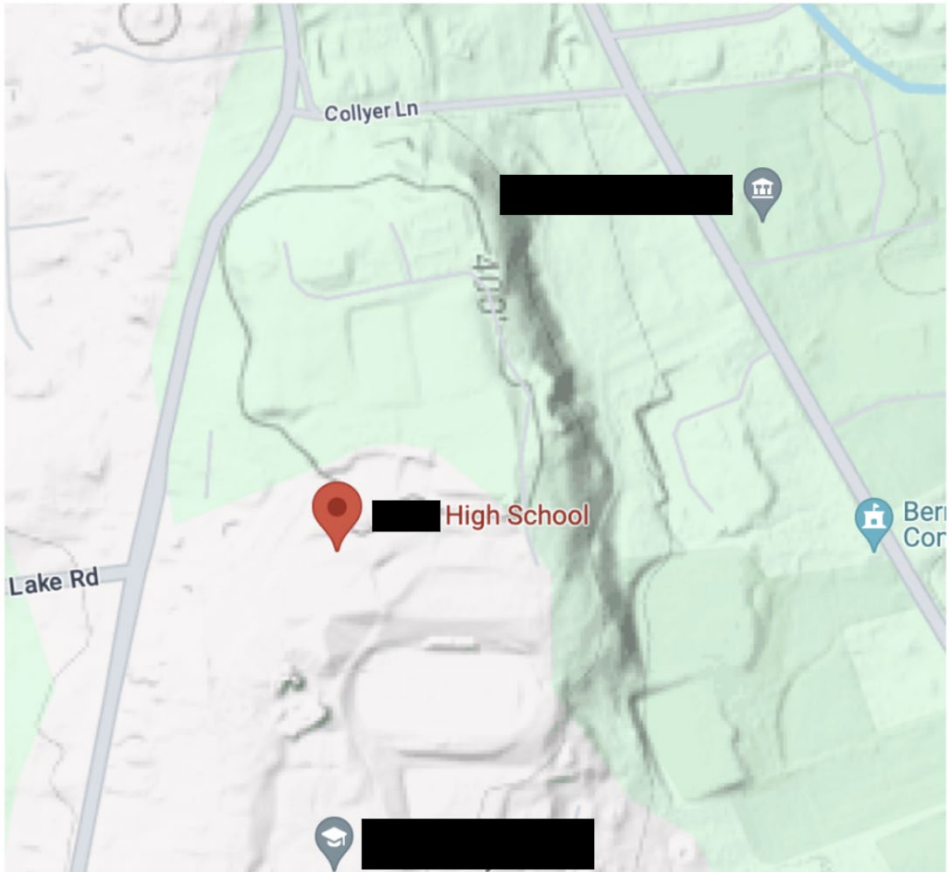

Figure 4. A topographical map of a high school, the setting of the study. This map reveals an elevation of 400 feet. This map is taken from Google Maps.

As seen in Figure 4, the school in this study has an elevation of about 400 feet. Along with the fact that participants who live less than a mile away rated the terrain with a mean of 4.5, giving preference to the idea that the terrain is inconsistent and hilly, it can be suggested that terrain also has a noteworthy impact on students as they choose their mode of transportation. The Level of Bicycle Compatibility Index also does not account for any inconsistencies in the terrain; therefore, it is possible that due to the terrain, the bike infrastructure of the high school in this study may not be fully suitable for all bikers, supporting the data that only 1 out of the 20 participants biked to and from school. This also establishes the characteristics of the terrain to be an influencing factor of biking behavior in suburban areas.

Traffic Analysis

The general view about traffic based on Figure 2, the mean ratings for all participants, shows that people generally regarded the roads of the high school to have a relatively high traffic concentration. High traffic conditions may also play into how participants perceive the infrastructure as traffic is connected with safety. As a study states regarding how traffic may affect biking behavior, perceived traffic risk is frequently cited to support the decision to not bike (Sanders & Judelman, 2018). While it is possible this phenomenon isn't present in suburban areas, it can clearly be seen that there was no difference in the perceived traffic concentration between participants who lived less than a mile away from the school and those who lived more than a mile. These

similar ratings among these different participant groups reveal that traffic is a significant factor influencing biking behavior in suburban areas.

Figure 5. A traffic map that shows the traffic speeds from 7:10 A.M. to 7:30 A.M. in the morning before the school start time at 7:35 A.M. The traffic is classified between fast and slow. Red represents slow traffic (high vehicle concentration) and green represents fast traffic (low vehicle concentration). This map is taken from Google Maps,

The figure above reveals that there is very slow traffic (high concentration) which is consistent with participants' views that traffic is very high in the high school during the morning and afternoon as students are arriving and departing. This further suggests that traffic is among the most important factors that may influence biking behavior in suburban areas.

New Understandings

As participants who lived less than a mile away tended to be more accurate when rating terrain and the facilities the school provides, it can be initially concluded that people who live closer to a destination tend to have more knowledge about the bike infrastructure. However, this conclusion is disproved by the fact that people who lived farther away and people who lived closer were both accurate when rating the traffic. These put together suggest that people who are more exposed to certain factors of the bike infrastructure are more accurate. People who live closer are more likely to notice the difficulty of the terrain and the presence of facilities than people who live farther away. This would make them more accurate with these factors. However, all students come to school and leave in the afternoon so they have all been exposed to traffic and therefore, will accurately rate it.

These conclusions both show that when people are more exposed to specific factors, they will be better at accurately rating it.

Implications

Once again, the most prevalent factors that influence biking behavior in suburban settings as found by this study are traffic, terrain, and the availability of bike-housing facilities. To address the problems these factors bring up would be a difficult task, but it may be achieved slowly. When building bike infrastructures in the future, it would be wise to take these three factors into consideration.

Primarily, the location of the bike infrastructure should be considered so that the terrain of the land does not over exhaust bikers, discouraging them from further use. Based on a study done regarding the natural environment surrounding bike infrastructures, people are likely to use pathways that allow them to take a leisurely trip (Mateo-Babiano et al., 2016). This finding in addition to the findings of this study further reveal that when dealing with urban planning and building bike infrastructures, the condition of the terrain should be considered. However, the implications of this finding are very limited as it is nearly impossible to physically change the terrain of the land. While there can be solutions to the problem with inconsistent terrain in some areas, in others, it may be difficult or impossible to implement.

Traffic should also be taken into consideration during the process of urban planning as the results of this study show that high amounts of traffic severely discourage biking in suburban communities. There can be solutions to high levels of traffic concentration such as integrating alternate roads into the highway system. There are many other solutions to reducing traffic concentration in one area, but urban planners should consider traffic as an important factor when constructing infrastructures. The implications of this may also be difficult to implement as traffic decongestion requires extensive planning and resources.

The problem with the availability of bike-housing facilities may be the easiest to solve as it doesn't require previous planning as the issues with terrain and traffic do. Buildings and services available to the people should incorporate bike racks, bike sheds, and more to give people the option to use alternative transportation methods. This would increase biking as people would have a way to keep their bikes safe.

Conclusion

The goal of this study was to determine the factors that may influence biking behavior in suburban settings. This fills a gap in the literature as existing research about this topic focuses on urban populations and settings which differ heavily from suburban settings. These differences include population density, residential density, alternative transportation methods, and more. With this, the factors that have been found to most influence biking behavior in these settings include terrain, traffic, and the availability of bike-housing facilities.

Furthermore, the extent to which these factors affect all suburban residents cannot be determined as the participants of this study were confined to a suburban high school. This means that these factors may be applied to suburban communities to some extent with regards to differences that other suburban communities may have with the sampled community. This study concludes that further research must be conducted with respect to conditions in each suburban community in order to accurately identify the most influential factors in biking behavior.

Limitations

With about twenty students participating in this study, the results and applications of the findings of this study may not be entirely applicable to the population of the high school. This participant group was also not the most

effective group to study as the results of my study concluded that those who live closer to the high school perceive the infrastructure accurately. Similarly, the diversity of this group was varied as most participants tended to be females which may have affected the outcomes and conclusions of this study (Dolati, 2014). Additionally, since not many people participated, the relationship between the amount of bikers and the bicycle compatibility using the Level of Bicycle Compatibility Index of the infrastructure could not be determined to its full extent.

There were also some responses which did not rate the factors at all, stating neutrality for all perception rating questions. While these responses were not excluded as they may have been true, it is possible that participants did not answer honestly, therefore skewing the data and the outcomes of the results. Furthermore, this study analyzed infrastructures surrounding only the high school in the study and therefore, does not take into account any external factors that may not match those of this high school and cannot be entirely applicable to all suburban schools in the state. The results of this study may also not be applicable to other areas with differing weather patterns as students attend the high school in this study throughout a cool climate year-round. Therefore, the results of this study may not be applicable to suburban communities and schools with warmer or colder climates than this high school. In a study done about pedestrians' motivation to bike, it is shown that weather can heavily influence transportation mode choices (Guinn and Stangle, 2014). Additionally, the Level of Bicycle Compatibility Index is specific to bike infrastructures within the state where the study takes place, so the findings of this study are limited to the state solely in public high schools with similar infrastructures to that of this study.

There may also be other factors that were not surveyed but have a significant impact on the decision to bike. These factors were not surveyed as they were not available for analysis, so only the most significant factors gathered from previous studies were rated by participants. Overall, the results of this study may only be applied to schools in suburban areas with infrastructures similar to that of the infrastructure in this study, and schools with similar weather settings and demographics as the school in this study.

Acknowledgments

I would like to thank my advisor for the valuable insight provided to me on this topic.

References

Barberan, A., e Silva, J. D. A., & Monzon, A. (2017). Factors influencing bicycle use: a binary choice model with panel data. *Transportation research procedia*, *27*, 253-260. https://doi.org/10.1016/j.trpro.2017.12.097

Beck, M. J., & Immers, L. H. (1994). Bicycle ownership and use in Amsterdam. *Transportation Research Record*, *1441*, 141-146. https://onlinepubs.trb.org/Onlinepubs/trr/1994/1441/1441-017.pdf

Delucchi, M., & Kurani, K. S. (2014). How to have sustainable transportation without making people drive less or give up suburban living. *Journal of Urban Planning and Development*, *140*(4), 04014008. https://doi.org/10.1061/(asce)up.1943-5444.0000172

Dill, J. (2009). Bicycling for transportation and health: the role of infrastructure. *Journal of public health policy*, *30*, S95-S110. https://doi.org/10.1057/jphp.2008.56

Dolati, H. (2014). *Biking distance: Exploring gender, race, and climate* (Master's thesis, The Ohio State University). https://etd.ohiolink.edu/acprod/odb_etd/ws/send_file/send?accession=osu1388725654&disposition=inline

Gilderbloom, J., Grooms, W., Mog, J., & Meares, W. (2016). The green dividend of urban biking? Evidence of improved community and sustainable development. *Local Environment*, *21*(8), 991-1008. http://dx.doi.org/10.1080/13549839.2015.1060409

Glazener, A., & Khreis, H. (2019). Transforming our cities: best practices towards clean air and active transportation. *Current environmental health reports*, *6*, 22-37. https://doi.org/10.1007/s40572-019-0228-1

Guinn, J. M., & Stangl, P. (2014). Pedestrian and bicyclist motivation: an assessment of influences on pedestrians' and bicyclists' mode choice in Mt. Pleasant, Vancouver. *Urban, Planning and Transport Research*, *2*(1), 105-125. https://doi.org/10.1080/21650020.2014.906907

Handy, S. L., & Xing, Y. (2011). Factors correlated with bicycle commuting: A study in six small US cities. *International Journal of Sustainable Transportation*, *5*(2), 91-110. https://doi.org/10.1080/15568310903514789

Hull, A., & O'Holleran, C. (2014). Bicycle infrastructure: can good design encourage cycling?. *Urban, Planning and Transport Research*, *2*(1), 369-406. https://doi.org/10.1080/21650020.2014.955210

Jones, C., & Kammen, D. M. (2014). Spatial distribution of US household carbon footprints reveals suburbanization undermines greenhouse gas benefits of urban population density. *Environmental science & technology*, *48*(2), 895-902. https://doi.org/10.1021/es4034364

Kahn, M. E. (2000). The Environmental Impact of Suburbanization. *Journal of Policy Analysis and Management*, *19*(4), 569–586. https://doi.org/10.1002/1520-6688(200023)19:4<569::AID-PAM3>3.0.CO;2-P

Marshall, W. E., & Garrick, N. W. (2011). Evidence on why bike-friendly cities are safer for all road users. *Environmental Practice*, *13*(1), 16-27. https://doi.org/10.1017/s1466046610000566

Mateo-Babiano, I., Bean, R., Corcoran, J., & Pojani, D. (2016). How does our natural and built environment affect the use of bicycle sharing?. *Transportation research part A: policy and practice*, *94*, 295-307. https://doi.org/10.1016/j.tra.2016.09.015

McAndrews, C., Tabatabaie, S., & Litt, J. S. (2018). Motivations and strategies for bicycle planning in rural, suburban, and low-density communities: The need for new best practices. *Journal of the American Planning Association*, *84*(2), 99-111. https://doi.org/10.1080/01944363.2018.1438849

Pucher, J., Buehler, R., Merom, D., & Bauman, A. (2011). Walking and cycling in the United States, 2001–2009: evidence from the National Household Travel Surveys. *American journal of public health*, *101*(S1), S310-S317. https://doi.org/10.2105/ajph.2010.300067

Sanders, Rebecca L., and Belinda Judelman. (2018). "Perceived safety and separated bike lanes in the Midwest: Results from a roadway design survey in Michigan." *Transportation research record* 2672.36: 1-11. https://doi.org/10.1177/0361198118758395

Smith College Institutional Review Board Templates & Forms. (n.d.). Smith College. https://www.smith.edu/academics/applied-learning-research/research-smith/institutional-review-board/forms-templates

Wild, K., & Woodward, A. (2019). Why are cyclists the happiest commuters? Health, pleasure and the e-bike. *Journal of Transport & Health*, *14*, 100569. https://doi.org/10.1016/j.jth.2019.05.008

Wuerzer, T., & Mason, S. G. (2015). Cycling willingness: Investigating distance as a dependent variable in cycling behavior among college students. *Applied Geography*, *60*, 95-106. https://doi.org/10.1016/j.apgeog.2015.03.009

Wunsch, M., Stibe, A., Millonig, A., Seer, S., Dai, C., Schechtner, K., & Chin, R. C. (2015). What makes you bike? Exploring persuasive strategies to encourage low-energy mobility. In *Persuasive Technology: 10th International Conference, PERSUASIVE 2015, Chicago, IL, USA, June 3-5, 2015, Proceedings 10* (pp. 53-64). Springer International Publishing. https://doi.org/10.1007/978-3-319-20306-5_5