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## Introduction & Background

### Universities

#### Creating Demand

Universities campuses in college towns provide unique opportunities to reduce transportation-related greenhouse gas emissions(GHGe) and other pollutants. Interest in university student travel behavior has grown among researchers and policy makers and car dependency continues to adversely impact U.S. communities[Zhou, Wang, and Wu (2018)](Khattak et al. 2011). The adverse effects of car dependency include pollution, health effects, and financial burden(Romanowska, Okraszewska, and Jamroz 2019). Universities are recognized institutions that can create awareness of climate change mitigation and sustainable transportation practices[Romanowska, Okraszewska, and Jamroz (2019)](Angelis, Mantecchini, and Pietrantoni 2021)(Zhou 2012).

Referred to as “cities inside cities”. universities are ideal learning laboratories for researching and identifying sustainability initiatives. Functioning as a large communal network that reflects a large community and function universities have a significant role in promoting sustainable development and tackling transportation concerns. The movement of students, staff and visitors is a critical factor in the growing impact of universities campuses to the surrounding area. Universities have a large footprint, accounting for up to 2% of the total annual U.S. GHGe, making it important that they participate in mitigating climate change(**parsley2022?**).

Today large university campuses are a microcosm of the urban landscape and provides a ideal environment for studying transportation policy and infrastructure. (Zhou, Wang, and Wu 2018, 133)

University students are considered a key segment of the population those travel is often understudies and weakly covered in current literature and data collection[(**kattak2011?**)](Taylor and Mitra 2021). Current research explores daily commuting patterns, factors influencing travel behavior, and the potential for shifting toward more sustainable travel modes[Romanowska, Okraszewska, and Jamroz (2019)](**zhou2011?**).

#### Trip Generation

Universities are major contributors to commuting trips averaging 20% higher than the general public, **3.69** daily tripsKhattak et al. (2011). Universities serve a large number of students and staff forming a significant portion of the local or regional population(Romanowska, Okraszewska, and Jamroz 2019). This large populations moving from and around a compact campus inherently generate a significant volume of daily trips(Romanowska, Okraszewska, and Jamroz 2019). (Khattak et al. 2011) defines a trip as moving at least 300 feet from one address to another. This definition is important for capturing travel behavior of university students living on and around campus. Undergraduate students living on campus make the most trips when compared to other university groups. University students make shorter non-motorized trips, utilizing walking and biking infrastructure. (Khattak et al. 2011).

#### Using Alternative Travel Modes

University students are moretransient living and are more likely to use alternative travel modes, marking them as notably from the general population. University students are more likely to adopt alternative travel modes, having a higher portion versus staff and general public. Students populations tend to walk and and bike more reducing car trips. Student tend prioritize housing that is affordable and close to campus, providing them more travel mode choice. The variety of quality transportation modes and high portion of alternative transportation modes creates a need for a more comprehensive transportation system, less reliant on fossil fuels. Universities increase the demand on local transportation system while providing an opportunity to expand alternative transportation modes.

The compactness suggest students are more likely to walk or bike and drive less(Zhou, Wang, and Wu 2018). A study focused on college students commuter students were more likely to use alternative and active travel modes when compared to staff and peers at urban universities(Zhou, Wang, and Wu 2018). However, 25% of commuters students living within two miles of campus drove alone, indicating that a compact form is only the only factor of satisfying all travel needs, like out of town travel(Zhou, Wang, and Wu 2018). The advantage of shorter distances, good transit, and a safe environment are not guarantees of alternative mode, suggesting the need for further strategies to manage transportation needs(Zhou, Wang, and Wu 2018).

(**romanowka2019?**) identifies access to a vehicle, trip origin, and trip distance as key factors in travel mode choice.(Angelis, Mantecchini, and Pietrantoni 2021) finds locations and travel continuity as significantly impact mode choice. The high density at Texas State increases potential for “transport infrastructure and services” supporting multi-modal travel. Compact campus design promoted higher trip rates among students. Higher density creates more complex transportation patterns. May increase the importance of efficient multi-modal transportation systems. High students density presents both challenges and opportunities for promoting alternative transportation. Studies find that improved biking and pedestrian infrastructure reduces car commuting, to up 14%(**romanowka2019?**). University students live relatively close to campus and have accessible to quality multi-modal transportation systems(Zhou, Wang, and Wu 2018, 132)

#### Window of Opportunity

For many the university campus is the A more rigorous focus on university travel will provide insight on how the built environment combined with social factors effect travel behavior(Angelis, Mantecchini, and Pietrantoni 2021). Universities are active;ly encouraging sustainable education and practices(Parsley and Waliczek, n.d.). Students are a social group with high willingness to adopt new ideas and make lifestyle changes. The knowledge, experiences, and attitudes gain during college raise awareness in for the wider public(Romanowska, Okraszewska, and Jamroz 2019). Universities can leverage this to promote pro-environmental values and prevent the development of pro-car habits in young commuters(Angelis, Mantecchini, and Pietrantoni 2021).

The university is a “window of opportunity” for significant lifestyle changes, like travel behavior. Travel behavior habits are repetitive decision made in a stable state of life based on the current knowledge and perspective of available resources. Theory of planned behavior(TPB) suggest travel behavior are habits that are significant influenced by a commuters knowledge and perceptions of the available transportation system. Travel behavior is understood to give insight to commuter belief and perspectives, and attitude towards travel modes. (**deangelis2012?**) used the Value-belief-norms(VBN) understand that an individuals moral obligation to the environment can significantly impact travel mode choice. Understanding that habitual travel behaviors are based on individual morals, explains how personal experiences and attitudes can shape travel mode choice. A commuter’s knowledge and perception of the available transportation modes will decide their travel behavior.

Study suggest habits are best broken and formed most easily during transitional period of life like have a child, relocating for a new job, or going to college. During these transitional periods individuals are inevitably induced to new environments or experiences that may influence their perspectives and grow their knowledge base. Changes adopted during this “window of opportunity” are likely to effect lifestyle choice like mode choice and last into later life beyond the university campus. (**deangelis2012?**). An commuters who uses alternative transportation option during college will view biking, walking, or public transit as favorable options later in life. Where as someone who drive most of their time on campus is likely to continue with less chance of reconsidering other options. (**okrazeska?**,) find that students are more likely than staff to choice alternative and active travel modes. About 20% University staff preferred travel modes for their directness, duration, convenience and flexibility. These travel preferences are consistent with staff demographics, representing a more stable consistent lifestyle, having dependents, and living away from campus.

#### Research Question

How can universities leverage physical factors of campus to reduce transportation emissions?

#### Methodology

This study site is Texas State University(TXST), a premier public school institution located in San Marcos Texas. As one of seven institutions in The Texas State University System, San Marcos(main) campus serves 40,678 students today. This campus is a thriving public research institution with an annual exceeding $165 million and racing to Carnegie R1 status. TXST is strategically located in the Texas Triangle, the dynamic regions of Texas that encompasses San Antonio, Austin, Dallas-Forth Worth, and Houston(**txcampplan24?**). This area is home to more than 70% of Texas population(>21 million people). The San Marcos campus itself is a characterized by its size, unique topography, and integration with significant natural features like the San Marcos River. The local transportation environment includes a pedestrian-centric core, existing parking infrastructure, and congested roadways challenges. This research focuses on understanding how to further leverage physical features of campus to reduce transportation emissions by investigating TXST students travel behavior using parking survey data.

The primary source for this research is Texas State University’s Parking Spring 2024. This parking survey questionnaire was developed using Qualtrics and administrator via university emails to all TXST students, gathering comprehensive information regarding daily commuting patterns during the previous Spring semester. This survey received (1,182/40678), responses rate of 2.9%(0.02908). According to survey found in the literature review, this is a reasonable rate for a commute survey. The data collected from the student responses is a quantitative in nature and will be used for a statistical summary analysis of travel behavior.

This study will investigate travel behavior and travel characteristics of students at TXST of travel around campus. Alternative travel modes include university(Bobcat Shuttle), city(CARTS), and private apartment shuttles, walk, bicycle, carpool, drop-off, ride-share(Uber/Lyft), and micro-mobility(SPIN scooters). Students received no incentives for completing the survey.

Identify key insights related to transportation patterns.

* Primary travel mode
* Frequency of travel
* Trip distance and length
* Parking permit ownership
* Private vehicle access
* Examine the potential impact of changes in travel behavior on greenhouse gas emissions.

Variables, Descriptions, and Count

| Varibles |  | Descriptions/Notes |
| --- | --- | --- |
| ***Dependent Variables*** |  |  |
| Drive alone |  | Primary travel mode to campus is drive alone car or motorcycle. |
| Carpool |  | Primary travel mode is to carpool. |
| Bobcat Shuttle |  | Primary travel mode is university shuttle, Bobcat Shuttle. |
| Private Shuttle |  | Primary travel mode is private shuffle provided by apartment complex. |
| Walking |  | Primary travel mode is walking |
| Biking |  | Primary travel mode is biking. |
| Micro-mobility |  | Primary travel mode is Spin scooter or other mirco-mobility options. |
| ***Independent Variables*** |  |  |
| Physical Environment | Location | ZIP code |
|  | Housing | On-Campus  Off-Campus  Bobcat Village |
| Trip Characteristics | Days per week top campus |  |
|  | Time of campus(mins) | 0-15 minutes  15-30 minutes  30-45 minutes  45-60 minutes  >60 minutes |
|  | Distance to campus | Less than 1 mile  1-5 miles  5-10 miles  10-20 miles  20-30 miles  30-60 miles  >60 miles |
|  | Main street traveled to campus | Sessom Dr.  N. LBJ at Sessom Dr.  N. LBJ at Woods St.  Old Ranch Road 12  Aquarena Springs  Thorpe Lane  N. Guadalupe  Hopkins  Hunter’  Wonder World |
| Parking Permit |  | Drives that have 2023-2024 Texas State parking permits |
| Driving from residental hall |  | Students driving from residental hall to parking lot |

#### Objectives

* Analyze transportation and travel behavior of Texas State University students using parking survey data from the Fall 2024 semester.
* Identify trends and areas for improvement in campus transportation planning using 2025-2035 Campus Master Plans.
* Provide actionable recommendations to reduce transportation-related greenhouse gas emissions.

### Expected Outcomes

* Enhanced understanding of TXST students’ travel behavior and its environmental impact.
* Identification of key factors and trends influencing transportation choices among students.
* Actionable recommendations for TXST to reduce transportation-related GHGe and promote sustainable travel options.

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