Exploring the Influence of Carbon Footprint and Health Benefits in Parking Location Decisions

Center for Transportation, Environment, and Community Health
Final Report

by

Ruey Long Cheu, Emiliano Ruiz

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16. Abstract

The objective of this project is to answer the Research Question: If the information on carbon footprint and health benefits are available, what are their influences relative to permit fee and last-mile travel time in parking location decisions? This project focused on commuter students at The University of Texas at El Paso (UTEP). In this project, the research team has:

- Selected the calories burned as the Measure for Health Benefits (MHB) of walking and carbon dioxide emission as the Measure for Carbon Footprint (MCF).
- Collected data on campus to determine the MCFs and MHBs associated with different parking zones.
- Developed a table that included the last-mile travel times, MCFs, and MHBs to display to students during the simulated parking permit purchase process.
- Surveyed students in simulated permit purchase scenarios without and with the MHB and MCF information.
- Analyzed the survey response with regards to student choices of parking zones and decision factors.

Output: This research has estimated the MHBs from all the parking zones to the center of the campus, and MCFs from the campus entrances to parking zones. The estimated MHBs and MCFs have been incorporated into an informational table. The student survey has collected responses from 430 students.

Outcome: Although the permit price, last-mile travel time, ease of finding a parking space are still the top three decision factors, the introduction of MHB and MCF have created awareness of health benefits and carbon footprints associated with parking. Health benefits and carbon footprints received the largest increase in respondents who said they were "very important" and "important" in their parking location decisions.

Impact: The provisions of MCFs and MHBs during the parking permit purchase process will shift the parking location choices of some students that will lead to a reduction of total CO2 contributed by commuter students on campus.

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EXECUTIVE SUMMARY

This research answered the question: If the information on carbon footprint and health benefits are available (when a student makes a campus parking permit purchase decision), what are their influences relative to the permit fee and last-mile travel time in parking location decisions? The University of Texas at El Paso (UTEP) was used as the study site.

The annual calories burned by walking from a parking zone to the centroid of the campus was adopted as the Measure of Health Benefits (MHB), and the annual CO_2 emitted by a vehicle from an entry point of the campus to a parking zone was adopted as the Measure Carbon Footprint (MCF).

A walking survey was conducted on the UTEP campus to estimate the MHBs. The MHBs ranged from 5,880 to 25,938 calories/student/year. The actual value is dependent on the gender, body weight, distance between the parking zone and the centroid of the campus and elevation gained.

A VISSIM simulation model was created to generate the probe vehicle's dynamic activity data which were fed into the Comprehensive Modal Emission Model (CMEM) to calculate the MCFs. The estimated MCFs ranged from 40 to 1,554 kg of CO_2/vehicle-trip/year. The actual value is dependent on the entry point of the campus (the origin), the parking zone (the destination), traffic conditions along the route, and grades.

The estimated MHBs and MCFs were incorporated into a table as part of an online survey instrument to simulate a student's parking permit purchase process without and with the presentation of MHBs and MCFs. A total of 430 students participated in this survey between 3/22/2020 to 4/9/2021.

With the MHBs and MCFs, 46% of the respondents changed their parking zones. This will lead to a 3.88% reduction in total calories burned per year (from all the commuter students), a 2.10% reduction in total CO_2 emissions per year (contributed by all the students on campus), combined with a 1.15% reduction in student permit sales revenue.

This survey has increased the respondent's awareness of a healthy lifestyle and environmental sustainability. After the presentation of the MHB data, the proportions of respondents who stated that MHB was "very important" and "important" in parking permit purchase decisions increased from 79.7% to 87.5%. After the MCF data was shown to the respondents, the proportions of respondents who stated that MCF was "very important" and "important" in parking permit purchase decisions increased from 661.% to 75.5%.

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1. INTRODUCTION

1.1. Background

University parking facilities consist of on-street stalls, off-street surface lots, and multi-story garages. They typically serve four types of users: students, faculty, staff, and visitors. Students from the largest group of parking facility users. Universities typically manage their parking facilities by a combination of (1) assigning the on-street spaces, off-street surface lots, and garages across the campus into zones; (2) limiting the type of users for each zone; and (3) selling a limited quantity of parking permits by the zones. A zone may consist of one or several blocks of on-street spaces, off-street surface lots, and garages. For example, a university may assign two adjacent surface lots into a zone to be used by students only, then sell a fixed number of student parking permits every academic year that is tied to the number of parking spaces (capacity) in the zone. Only students who have purchased the permits for this zone can park in this zone. In addition, these students cannot park in other zones.

A survey in the past (Gurbuz and Cheu, 2020) found that the most important factor in a student's parking location decision was the price of the permit. The second and third most important factors that influenced a student's parking location decision were the last-mile travel time from the zone to the final destination on campus, and the ease of finding a parking space in the zone. Student parking zones that have lower permit prices are usually located in the remote areas of the campus, which have longer last-mile travel times. Parking zones that are closer to the campus core have shorter last-mile travel times but their permits are sold at higher prices. This means that there is a tradeoff between the permit price and the last-mile travel time. The last-mile travel time may be measured by different modes of on-campus transportation, such as walking, bicycling, shuttle bus. Walking is the predominant mode. The ease of finding a parking space may depend on several factors, including the number of permits sold (relative to the capacity) and class schedule.

A university typically releases parking permits for students to purchase at the beginning of every academic year or semester. The permits are usually purchased by students through an online portal. During the purchase process, students are usually shown a list of available parking zones, their annual or semester permit prices, and a zone locations map. Therefore, the students are provided with the permit price which is the most important decision factor. In addition, the students may infer the last-mile travel times (or the relative last-mile travel times of the zones) from the location map.

The transportation sector is responsible for 29% of the greenhouse gas emissions in the country (EPA, 2021). Of the total emissions produced by the transportation sector, 58% is attributed to light duty vehicles. According to the National Center for Health Statistics (CDC, 2019), 41% of the population in the United States aged 20 and above was obese. A person is considered obese if his/her body mass index is equal of greater than 30. Obesity is obesity associate with medical problems such as cancer, coronary artery disease, and diabetes. One of the contributing factors to obesity is insufficient physical exercise such as walking.

As higher education institutions, university campuses are one of the first places to promote a healthy lifestyle and environmental sustainability. There are many aspects of a healthy lifestyle

and environmental sustainability. This research focused on the health benefits of the last-mile transportation mode by walking from/to parked vehicles and the carbon footprint of personal vehicles on a university campus. The subjects were students.

1.2. Objective

The objective of this research was to investigate the impacts of providing information on the health benefits of walking and carbon footprints in student's parking location decisions.

The research question is: If the information on carbon footprint and health benefits are available, what are their influences relative to permit fee and last-mile travel time in parking location decisions?

The University of Texas at El Paso (UTEP) was used as the study site. The students are the human subjects of this research. To answer these research questions, we assumed that students made one trip per weekday by driving alone to the campus. The carbon footprints were estimated by vehicle emissions between an entry point of the campus and a parking zone. The health benefits were estimated by walking between the parking zones and the centroid of the campus. A survey was designed to collect data on student's parking permit purchase behaviors.

1.3. Outline of Report

This report is organized as follows:

Chapter 1 (this chapter) introduces the project, defines the objective and research question.

Chapter 2 outlines the research tasks performed.

Chapter 3 reports the findings of the literature review.

Chapters 4 and 5 describe the work carried out to collect health benefits and carbon footprint data related to the student parking zones on the UTEP campus.

Chapter 6 describes a student survey designed and conducted to determine the impacts of health benefits by walking and carbon footprints on parking location decisions.

Chapter 7 analyzes and discusses the results obtained from the student survey.

Chapter 8 concludes the findings.

2. RESEARCH TASKS

This research was performed in five tasks from 10/1/2019 to 5/31/2021. The tasks were:

Task 1: Literature review.

In Task 1, literature reviews were conducted on the health benefits of walking and carbon footprint. At the end of this task, a Measure of Health Benefits (MHB) and a Measure of Carbon Footprint (MCF) were selected. The outcomes of the literature review are reported in Chapter 3. This chapter also includes a review of student parking on the UTEP campus.

Task 2: Estimation of health benefits.

A walking survey was made to collect MHB associated with each student parking zone on the UTEP campus. The survey procedure and data collected are described in Chapter 4.

Task 3: Estimation of carbon footprints.

The MCF generated by each student's vehicle (a passenger car) on campus, between the campus entrances and parking zones, was estimated using VISSIM simulations followed by running CMEM. Chapter 5 describes the implementation of the VISSIM-CMEM in the estimation of MCF.

Task 4: Student survey

An online survey was conducted to gather data on students' willingness to change their parking locations if they were provided with the MHB and MCF statistics during a simulated parking permit purchase process. The survey instrument incorporated the MHBs and MCFs estimated in Tasks 3 and 4. Chapter 6 reports the survey instrument, survey implementation, and the survey outcomes.

Task 5: Analysis of results

The fifth and last task analyses the results obtained from the online student survey (Task 4).

3. LITERATURE REVIEW

3.1. Measure of Health Benefits

In this research, health benefits are derived from walking as the last-mile transportation mode between a parking zone and the final destination on campus. By default, this "last-mile" also includes the "first-mile" in the return trip. Walking is a form of physical exercise. A person who walks at a speed of 3.5 mph (5.13 ft/s) burns about 4 calories per minute (Harvard, 2021). The actual burn rate depends on a person's gender and body weight. The U.S. Center for Disease Control and Prevention (CDC) recommends adults walk at least 150 minutes per week (22 minutes per day) (CDC, 2020). This translates into 600 calories burned per week by walking. The 2017 National Household Travel Survey (NHTS) found that only about 16% of the population walked as part of a trip every day, and those who did so walked over 35 minutes per day. The U.S. Bureau of Labor Statistics (BLS) reported that in 2015, only 19.5% of the adult population aged 15 and older exercised daily (BLS, 2017). The data from NHTS and BLS showed that at least 80% of the adult population did not walk sufficiently.

Insufficient physical exercise contributes to obesity. A person is considered obese if his/her body-mass index is equal to or greater than 30 (NIH, n.d.). According to the National Center for Health Statistics (CDC, 2019), the percent of the United States population aged 20 and above who were obese had been increasing over the years, from 30.5% in 2002 to 41.5% in 2018 (CDC, 2019). Obesity is associated with medical problems such as cancer, coronary artery disease, and diabetes. Physical exercise reduces obesity by converting a person's food and drink intake into energy, via a process called metabolism. The unit of energy is calories (Mayo, 2020). Therefore, in this research, the calories burned by walking in a year were adopted as the MHB. The MHB was first estimated at the disaggregated level. The disaggregated MHB measures a student's calories burned in a year by walking (round-trip, once per weekday), between his/her parking zone and the centroid of the campus. This is expressed as calories/student/year. The aggregated MHB, called the Total Health Benefits (THB) is the total calories burned by all the commuter students in a year by walking (round-trip, once a weekday), between his/her parking zone and the centroid of the campus.

3.2. Measure of Carbon Footprint

The U.S. EPA defines carbon footprint as the total amount of Greenhouse Gases (GHGs) emitted into the atmosphere. The U.S. EPA lists carbon dioxide (CO_2), methane (CH4), Nitrous Oxide (N_2O), and fluorinated gases as GHGs. The proportion of these GHGs in the atmosphere are 80% CO_2, 10% MH_4, 7% N2O, and 3% fluorinated gases. The transportation sector contributed 29% of all the GHGs emissions in 2019 (EPA, 2021). The combustions of fossil fuels by vehicles and electrical power plants were responsible for 92% of the CO_2 released into the atmosphere. The World Health Organization (WHO) defines carbon footprint as a person's contribution of CO_2 through the burning of fossil fuels (WHO, 2008). From the above discussions, it is clear that CO_2 has the overwhelming major share of GHGs. The transportation sector contributes to the CO_2 in the atmosphere by burning fossil fuels. Therefore, the total amount of CO_2 from tail-pipe emissions was defined as the MCF. This MCF is the individual student's annual CO_2 emission from his/her

vehicle while traveling from an entry point at the perimeter of the campus to its parking spot inside the campus. The MCF is expressed in kg/vehicle-trip/year.

3.3. Student Parking at The University of Texas at El Paso

The campus of The University of Texas at El Paso (UTEP) was used as the survey site to gather data to answer the research question. This section describes the setting of the UTEP campus with an emphasis on student parking.

The UTEP campus is located approximately one mile northwest of the downtown of El Paso, Texas. The campus has a land area that spans approximately 2.0 miles in the east-west direction and 1.75 miles in the north-south direction. The university has an enrollment of 25,151. The student population has 54% females and 46% males (CIERP, 2019). UTEP is an urban commuter university. The majority of the students drive to the campus to attend classes. The Parking and Transportation Services (PTS) is the unit responsible for the management and operations of parking facilities on campus. PTS assigns approximately 7,000 regular parking spaces into parking zones, in which 24 zones student parking zones.

Figure 3.1 is a map of the UTEP campus, with parking zones. Each parking zone has a name and a code (e.g., Sun Bowl Garage or SBG, Schuster 1, or SC1). In addition, the zones are color coded according to the types of parking facilities (open lot/garage), users (students/faculty and staff), and areas (inner campus/premium perimeter/perimeter/remote):

- Red and orange: inner campus (for faculty and staff parking only).
- Gold: parking garages.
- Purple: campus housing/dormitories.
- Silver: premium perimeter.
- Blue: perimeter.
- Green: remote areas.

The colors are displayed on permits for ease of enforcement.

PTS sells a pre-determined number of student parking permits for each zone in each academic year. The annual student permits in Academic Year 2019-2020 were priced from $165/year for zones at the remote areas to $400/year nearest to the campus core. The permits are sold via an online portal. To purchase a parking permit, a student must log into his/her university computer account. He/she will be shown a list of available parking zones and the corresponding permit prices per year. After the student has made his/her selection, he/she has the option to make a one-time payment or have the permit fee included in the university bill. The parking permit comes in the form of a hangtag which is mailed to the student's address. A student must display the parking permit on the windscreen or hang the permit at the rearview mirror of the vehicle when parking on campus. The parking permit is zone-specific. This means that a permit is only valid for parking in a particular zone. Therefore, students need to be careful when making permit purchase decisions.

Figure 3. 1 Parking zones.

4. ESTIMATION OF HEALTH BENEFITS

4.1. Data Collection Plan

The MHB, that is, calories burned by walking round-trips between parking zones and the centroid of the campus, was measured by smartphone applications. Four student volunteers (two females and two males) were recruited to collect the MHBs. Each student installed the Google Fit application (Google, 2020) in his/her smartphone, kept the smartphone in the pocket of his/her pants, and walked as a group in the designated routes/segments on campus. The two females and two males were recruited because (1) the calories burned by walking are gender-specific; (2) the Google Fit application could be installed in smartphones with the Android operating system and iOS. The difference between the two smartphone operation systems is the iOS version must be used with a wearable device (such as an iWatch) as the motion sensor.

4.2. Smartphone Applications

The Google Fit application was developed by Google Inc. in collaboration with the American Heart Association to track a person's physical activities. In this research, it was used to record the physical activities of walking, and to convert the physical activities into calories burned. The application was downloaded from Google Play or Apple's App Store. After a volunteer entered his/her physical profile, recording of the data was initiated and subsequently terminated by pressing the start and stop buttons. The data recorded in a walking session included the number of steps, difference in elevation, distance, and calories burned. Figure 4.1 shows the screenshots of the Google Fit application. Figure 4.1(a) is the user profile page. Figure 4.1(b) shows the collected data from Schuster 1 (SC1) parking zone to Leech Grove (LG) while Figure 4.1(c) shows the walking trip data from Leech Grove (LG) to Schuster 1 (SC1) parking zone.

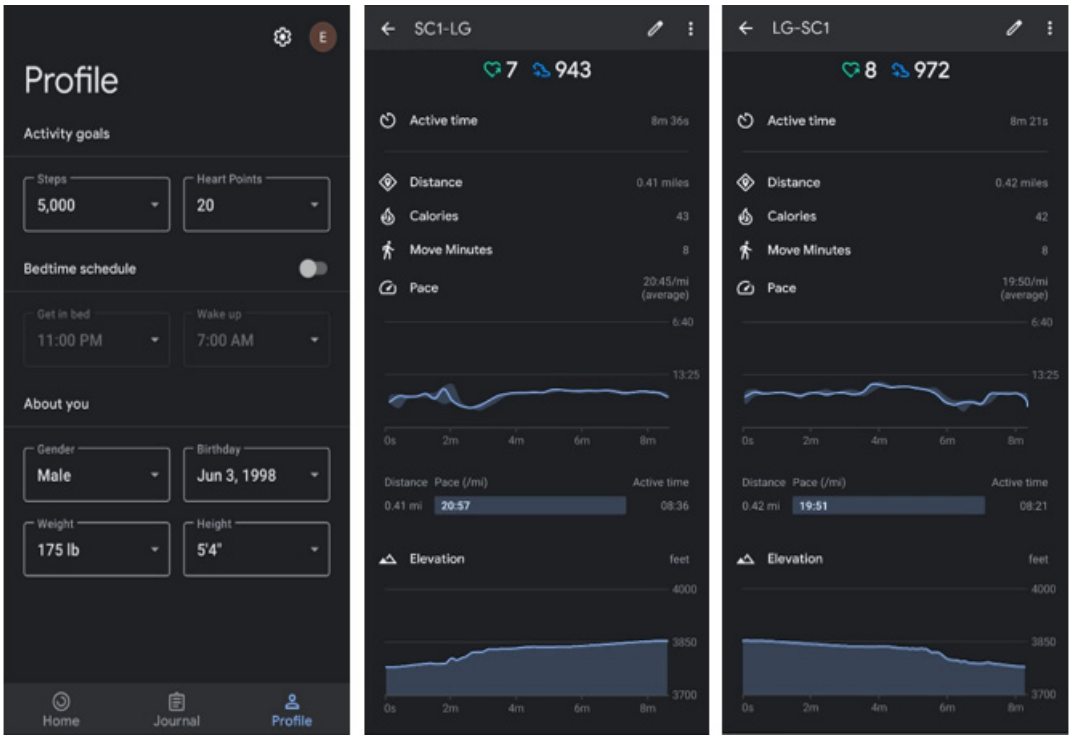


Figure 4. 1 Screenshots of Google Fit application.

4.3. Walking Routes and Segments

There are 24 student parking zones on the UTEP campus. The campus map in Figure 4.2 shows the geographical centroids of the 24 zones. These 24 centroids were one end of the 24 walking routes. The 24 routes all ended at Leech Grove, which was regarded as the centroid of the campus. Leech Grove was also used as the centroid of the campus in Gurbuz and Cheu (2021). The 24 walking routes were drawn on a campus digital map, from which overlapped segments were identified. The routes were divided into non-overlapping segments so that each segment was traversed only once in each direction by the volunteers. The individual segment data were then aggregated to form the route's statistics. Figure 4.2 is a map showing the 24 walking routes from the centroid of each parking lot to Leech Grove. The segments were grouped into five areas, each indicated by a different color.

Figure 4. 2 Walking routes.

4.4. Results

The walking survey was conducted in the week of 9/5/2020 over five days. The volunteers devoted each day to survey one area of the campus, with the fifth day allocated to the center area of the campus where most of the overlapping segments occurred (segments in green color).

The calories burned per segment in both directions collected by each volunteer were aggregated to form a route's daily calories burned value. Assuming that each student went to the campus to attend classes for 151 days in an academic year (all Mondays to Fridays in the Fall and Spring semesters), the MHBs for the 24 parking zones were calculated and are summarized in Table 4.1.

Table 4. 1 MHBs.

	Volunteer no.	**1**	**2**	**3**	**4**
	Gender	Female	Male	Female	Male
	Body weight	135 lbs	175 lbs	130 lbs	250 lbs
	Height	5 ft 3 in	5 ft 4 in	5 ft 5 in	5 ft 10 in
	Smartphone OS	Android	Android	iOS	iOS
	Parking zone	MHB (calories/student/year)			
GRG	Glory Road Garage	17,063	20,083	17,365	30,653
SBG	Sun Bowl Garage	6,342	7,550	5,738	N.A.
SCG	Schuster Garage	9,513	12,231	11,174	16,006
RA2	Randolph 2	11,778	12,986	11,023	19,177
SB2	Sun Bowl 2	6,040	8,456	6,342	10,268
SB3	Sun Bowl 3	5,889	8,305	5,889	9,362
SB4	Sun Bowl 4	7,701	10,721	8,305	13,439
DA1	Dawson 1	7,248	9,211	7,550	12,231
GR1	Glory Road 1	16,912	20,083	16,459	28,992
GR2	Glory Road 2	14,949	17,365	14,798	25,670
GR3	Glory Road 3	13,288	14,798	12,533	22,197
GR5	Glory Road 5	15,251	17,516	14,647	26,425
OR2	Oregon 2	13,288	15,251	12,835	22,197
SB5	Sun Bowl 5	10,721	14,194	12,986	18,875
SB6	Sun Bowl 6	12,835	17,063	16,308	23,254
SC1	Schuster1	9,815	12,835	12,684	18,573
SC2	Schuster 2	10,419	14,345	12,533	18,875
SC3	Schuster 3	10,872	14,194	13,137	20,083
SC4	Schuster 4	10,117	12,986	11,023	17,667
SC5	Schuster 5	10,570	13,741	11,929	19,026
ME1	Mesa 1	19,479	23,556	19,479	35,334
SB7	Sun Bowl 7	21,442	27,633	22,348	41,072
SB8	Sun Bowl 8	19,479	24,160	19,781	36,089
SB10	Sun Bowl 10	27,331	35,938	28,539	46,508

The data in Table 4.1 show that Volunteer 4 has one route where the smartphone application malfunctioned in one segment. The absolute values and the standard deviation of the MHBs recorded by Volunteer 4's iPhone were higher than those collected by three other volunteers. It was therefore decided that only the MHBs collected by Volunteers 1 and 2 be used in the subsequent tasks.

5. ESTIMATION OF CARBON FOOTPRINTS

This chapter describes the use of VISSIM and CMEM to estimate the carbon dioxide emissions for passenger cars that traveled from the five UTEP campus entry points to the 24 student parking zones inside the campus. The estimated CO_2 emissions were for one-way trips in the inbound direction. The estimated annual CO_2 emissions were used as the MCF associated with the student's use of his/her vehicle on campus.

5.1. Approach

The well-known VISSIM microscopic traffic simulation tool (PTV, 2020) was used to code the UTEP campus road network and to simulate the campus traffic operations from 8:00 a.m. to 9:00 a.m., the most congested hour on a weekday. Probe vehicles were released from five entry points of the campus and headed to the 24 student parking zones. The dynamic activity data of these probe vehicles were recorded by VISSIM into output files which were then imported into CMEM (Scora and Barth, 2006). CMEM then estimated the fuel consumption per vehicle-trip and then converted the fuel consumption into the quantity of CO_2 emitted into the atmosphere.

5.2. VISSIM Simulation

The coded road network in VISSIM is shown in Figure 5.1. The model covered an area of approximately 2.0 miles in the east-west direction and 1.75 miles in the north-south direction. It consisted of 818 links and connectors and 25 signalized intersections. The UTEP campus is in the center of the network. The five entrances to the campus are marked by red pins in Figure 5.1. The links and connectors led vehicles from outside of the entrances to the parking zones. Vehicles from different parts of the city approach the campus from the I-10 Freeway in the east and west, Border Expressway from the east and west, Paisano Drive from the east and west, and Mesa Street from the east and west. Several of these approaches share the same entrance to the campus.

Figure 5. 1 Coded road network in VISSIM.

Three types of vehicles were simulated in the network: (1) vehicles driven by commuter students, faculty and staff headed to the campus parking zones; (2) pass-through vehicles; and (3) probe vehicles. All of them were passenger cars. This was based on the assumption that the truck traffic on campus was negligible.

The traffic volumes headed to the campus parking zones were estimated as follows. The Center for Institution Evaluation, Research and Planning (CIERP) provided the research team 5,913 de-identified student records of all the parking permits sold by the PTS in the Fall semester of Academic Year 2019-20. Each record consisted of the zone of the student's parking permit and the zip code of the home address. The zip code provided information about the student's approach to the campus (i.e., the likely entry point to the campus), the parking zone indicated the trip destination on campus. Based on these data items, the approach volumes and the Origin-Destination (O-D) matrix of commuter student's vehicle-trips on campus (from the five entry points to the 24 parking zones) were derived. This assumed that every commuter student drove alone. However, not all the 5,913 commuter students traveled to the campus on the same day at the same hour. Gurbuz (2019) determined that Tuesday morning was the busiest peak period of parking demand in a week. The number of students who drove to the campus on Tuesday between 8:00 a.m. and 9:00 a.m. was estimated from the seating capacities of the classes that were scheduled at 9:00 a.m. on that day. This method estimated 3,815 commuter student vehicle-trips/hour. The original O-D matrix was scaled by 3,815/5,913=0.645. The final O-D matrix of commuter students' vehicle-trips/hour is listed in Table 5.1.

Table 5. 1 Origin-destination matrix of commuter student vehicle-trips on campus.

		From entry point (vehicle-trips/h)					
		Mesa-Sun Bowl	Mesa-Schuster	I-10 at Schuster	I-10 at Sun Bowl	Spur 1966	Row total
To parking zone	ME1	18	30	10	60	24	142
	SB10	18	30	10	60	22	140
	SB7	18	30	10	60	22	140
	SB8	18	30	10	60	22	140
	DA1	4	1	17	45	39	106
	GR1	6	0	3	19	16	44
	GR2	39	66	23	64	105	297
	GR3	2	11	1	7	3	24
	GR5	5	21	4	11	8	49
	GRG	15	60	8	30	22	135
	OR2	7	21	5	10	8	51
	RA2	9	25	6	13	9	62
	SB2	10	2	19	47	43	121
	SB3	3	1	5	25	19	53
	SB4	1	0	5	14	11	31
	SB5	6	1	19	39	32	97
	SB6	4	0	5	15	14	38
	SBG	74	17	385	120	326	922
	SC1	21	8	241	0	151	421
	SC2	4	3	55	0	33	95
	SC3	11	5	78	0	55	149
	SC4	9	4	52	0	36	101
	SC5	6	20	15	0	8	49
	SCG	28	10	226	0	144	408
	Column total	336	396	1,212	699	1,172	3,815

A similar method was used to estimate the faculty and staff vehicle-trips to the campus. There were 360 faculty and staff vehicle-trips. These trips ended in the faculty and staff parking zones in the inner campus. Because most of the faculty and staff reported to work every weekday, the O-D matrix was not scaled.

Pass-through traffic was added to the student, faculty, and staff vehicle-tips. Pass-through traffic traveled along Sun Bowl Drive, Schuster Avenue, Oregon Street, Mesa Street. Traffic counts at the signalized intersections along these streets were provided by the City of El Paso, as part of signal time plans for the 24 signalized intersections. These traffic counts, after subtracting the students, faculty, and staff vehicle-trips that were headed to the campus parking zones, formed the pass-through traffic.

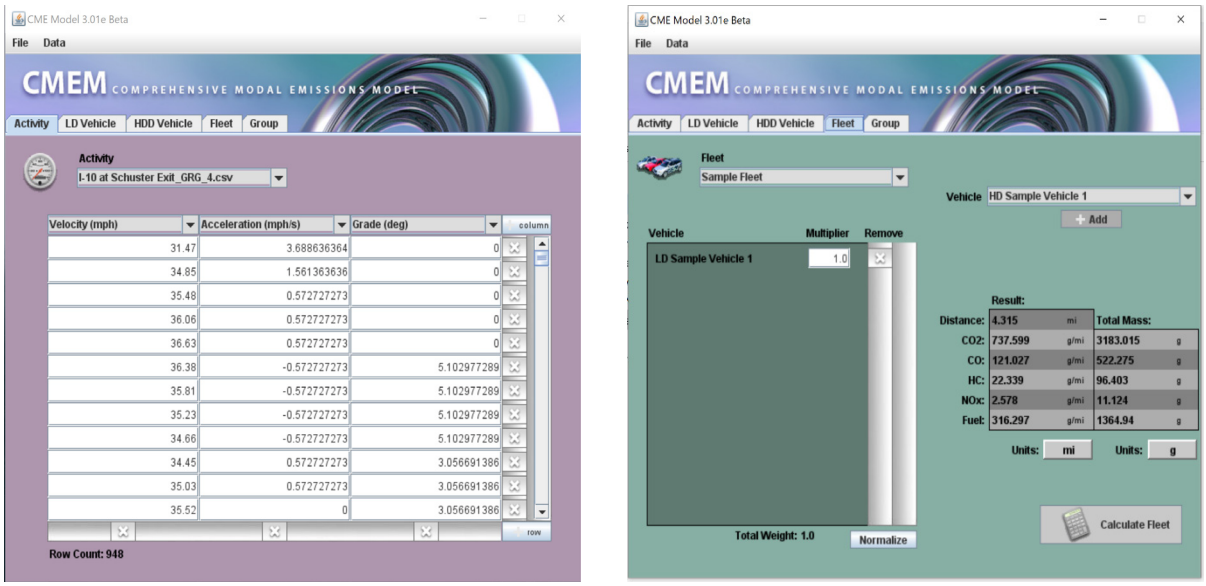
The purpose of probe vehicles in the simulation model was for VISSIM to track the movements of these vehicles and record the dynamic activity data (speed, acceleration, grade) at every second to an output file. Instead of collecting such data from all the commuter student vehicles from the same origins to the same destinations, which will result in voluminous and similar data, we introduced a probe vehicle every 10 minutes that traveled from each entry point of the campus and each student parking zone and recorded the speed, acceleration, and grade at one-second intervals.

In this simulation model, probe vehicles were created in VISSIM as a special “vehicles type”, so that instructions were corded in VISSIM for it to record the detailed outputs only for this type of vehicle.

The simulation was run with 10 minutes of warm-up time followed by 60 minutes of the data collection period. In the end, 120 O-D specific probe vehicle dynamic activity output files were produced. Each of these files was imported into CMEM to estimate the CO_2 emission of an average vehicle-trip from an entry point to a parking zone.

5.3. CMEM Emission Estimation

Figure 5.2 displays two screenshots of CMEM. The one on the left is the input panel while the one on the right is the output panel. The input panel has five tabs. The contents of the reformatted VISSIM’s probe vehicle dynamic data file were imported into the Activity tab. The properties of a light-duty vehicle (passenger car) were specified in the LD Vehicle tab. The Heavy-Duty Diesel (HDD) Vehicle tab was beyond the scope of this research and was left at the default setting. The Fleet tab is where the composition of the LD and HDD vehicles was entered. In this CMEM application, 100% LD Vehicle in the composition was specified. The final outputs of CMEM were the distance traveled, emission rate (in grams per mile), and quantity (in grams) of the National Ambient Air Quality Standards criteria pollutant and CO_2.



(a) Input panel (b) Output panel

Figure 5. 2 Screenshots of CMEM.

5.4. Results

The CMEM estimated the average CO_2 emission per one-way vehicle-trip from a campus entry point to a parking zone. are listed in Table 5.2. Assuming that a commuter student made one trip per day of instruction from home to the campus, and there were 151 days of instruction in the Fall 2019 and Spring 2020 semesters. The CO_2 emissions after multiplied by 151 vehicle-trips became the MCF (in kg/year). The MCFs from the entry points of the campus to the 24 parking zones will be presented in the survey instrument in Chapter 6.

Table 5. 2 Carbon dioxide emission per one-way vehicle-trip.

Parking lot		MCF (g/student/day) from entry point				
		I-10 at Sun Bowl	I-10 at Schuster	Spur 1966	Mesa - Sun Bowl	Mesa - Schuster
GRG	Glory Road	442	796	650	804	1,025
SBG	Sun Bowl	187	438	372	662	912
SCG	Schuster	345	186	154	1,554	537
RA2	Randolph 2	387	682	678	753	718
SB2	Sun Bowl 2	40	226	241	532	743
SB3	Sun Bowl 3	78	388	322	469	777
SB4	Sun Bowl 4	139	493	449	433	888
DA1	Dawson 1	244	622	589	576	890
GR1	Glory Road 1	289	679	603	367	1,101
GR2	Glory Road 2	334	709	616	427	1,065
GR3	Glory Road 3	361	779	717	655	737
GR5	Glory Road 5	414	789	795	665	1,015
OR2	Oregon 2	437	799	831	734	671
SB5	Sun Bowl 5	240	561	583	402	891
SB6	Sun Bowl 6	222	604	560	387	916
SC1	Schuster1	225	**77**	139	1,498	459
SC2	Schuster 2	311	164	122	1,356	400
SC3	Schuster 3	312	167	115	1,464	345
SC4	Schuster 4	301	169	132	1,426	378
SC5	Schuster 5	454	225	236	1,284	259
ME1	Mesa 1	401	709	735	282	1,289
SB7	Sun Bowl 7	406	863	781	273	1,225
SB8	Sun Bowl 8	424	709	757	285	1,244
SB10	Sun Bowl 10	476	706	743	177	1,310

6. STUDENT SURVEY

6.1. Survey Instrument

A survey instrument was created to collect data from UTEP students in a simulated parking permit purchase scenario. The survey instrument consisted of 17 questions: four questions in Section A about the respondent's demographics, followed by 13 questions in Section B about the respondent's permit phase behavior. The draft version of the survey instrument was tested with the student members of the Institute of Transportation Engineers Student Chapter, revised, and coded in QuestionsPro, a UTEP approved online survey tool. Table 6.1 summarizes the survey questions. There are four question formats:

- Multiple choice – for the respondent to select one answer per question.
- Multi-point scale – for the respondent to drag a button to the answer per statement.
- Drop-down menu – for the respondent to select one answer out of a list of many options.
- Comment box – for the respondent to type additional comments.

The entire survey instrument is attached in Appendix A.

Table 6. 1 Summary of student survey questions.

No.	Nature of Question	Format
A1	Age	Multiple choice
A2	Gender	Multiple choice
A3	Classification (freshmen, sophomore, junior, senior, graduate)	Multiple choice
A4	Enrollment status (full-time, part-time)	Multiple choice -
B1	Travel mode to campus	Multiple choice
B2	Attitude on environmental sustainability	Multi-point scale
B3	Attitude on healthy lifestyle	Multi-point scale
B4	Parking lot selection without MHB and MCF	Drop-down menu
B5	Factors driving parking lot selection without MHB and MCF	Multi-point scale
B6	Parking lot selection with MHB and MCF	Drop-down menu
B7	Factors driving parking lot selection with MHB and MCF	Multi-point scale
B8	Willingness to reduce CO_2 emissions	Multiple choice
B9	Critical percentage reduction of CO_2 emissions	Multiple choice
B10	Willingness to increase health benefits	Multiple choice
B11	Critical percentage increase of health benefits	Multiple choice
B12	Maximum last-mile walking time	Multiple choice
B13	Additional Comments	Comment box

Questions B4 and B6 were designed to capture the similarities and differences in the parking location decisions without and with the provision of MHBs and MCFs. Question B4 simulated the current permit sales and purchase scenario. Each student, when purchasing a permit online, was presented with a list of available parking zones and their respective annual permit prices. Table 6.2 was what a respondent saw on the survey instrument. The parking permit prices were a close approximation of the full annual fees in Academic Year 2019-2020 (rounded to the nearest $25).

During the student survey, each participating student was asked to select a parking zone based on this information.

Table 6. 2 Annual permit prices.

Permit Type	Price
GRG Glory Road	$300
SBG Sun Bowl	$400
SCG Schuster	$400
RA2 Randolph 2	$300
SB2 Sun Bowl 2	$300
SB3 Sun Bowl 3	$300
SB4 Sun Bowl 4	$300
DA1 Dawson 1	$225
GR1 Glory Road 1	$225
GR2 Glory Road 2	$225
GR3 Glory Road 3	$225
GR5 Glory Road 5	$225
OR2 Oregon 2	$225
SB5 Sun Bowl 5	$225
SB6 Sun Bowl 6	$225
SC1 Schuster1	$225
SC2 Schuster 2	$225
SC3 Schuster 3	$225
SC4 Schuster 4	$225
SC5 Schuster 5	$225
ME1 Mesa 1	$165
SB7 Sun Bowl 7	$165
SB8 Sun Bowl 8	$165
SB10 Sun Bowl 10	$165

The same question was asked in question B6. In this question, the participant was presented with the MHBs and MCFs on the screen. Each respondent was expected to read Table 6.3 before selecting a parking zone.

Table 6. 3 Annual permit prices, health benefits and carbon footprints.

Permit Type	Price	Walking time in minutes from parking lot to campus core (Leech Grove)	Calories burned per year		Carbon dioxide emissions in kilograms per year				
					Approaching UTEP campus from:				
			Male	Female	I-10 at Sun Bowl	I-10 at Schuster	Spur 1966	Mesa-Sun Bowl	Mesa-Schuster
Average Values (Parking Lot X)	**$245**	**10**	**16,050**	**12,848**	**47**	**79**	**75**	**110**	**125**
GRG Glory Road	$300	12	20,083	17,063	67	120	98	121	155
SBG Sun Bowl	$400	4	7,550	6,342	28	66	56	100	138
SCG Schuster	$400	7	12,231	9,513	52	28	23	235	81
RA2 Randolph 2	$300	7	12,986	11,778	58	103	102	114	108
SB2 Sun Bowl 2	$300	5	8,456	6,040	6	34	36	80	112
SB3 Sun Bowl 3	$300	5	8,305	5,889	12	59	49	71	117
SB4 Sun Bowl 4	$300	6	10,721	7,701	21	74	68	65	134
DA1 Dawson 1	$225	5	9,211	7,248	37	94	89	87	134
GR1 Glory Road 1	$225	12	20,083	16,912	44	103	91	55	166
GR2 Glory Road 2	$225	10	17,365	14,949	50	107	93	64	161
GR3 Glory Road 3	$225	8	14,798	13,288	54	118	108	99	111
GR5 Glory Road 5	$225	10	17,516	15,251	62	119	120	100	153
OR2 Oregon 2	$225	8	15,251	13,288	66	121	126	111	101
SB5 Sun Bowl 5	$225	9	14,194	10,721	36	85	88	61	135
SB6 Sun Bowl 6	$225	9	17,063	12,835	34	91	85	58	138
SC1 Schuster1	$225	10	12,835	9,815	34	12	21	226	69
SC2 Schuster 2	$225	9	14,345	10,419	47	25	18	205	60
SC3 Schuster 3	$225	8	14,194	10,872	47	25	17	221	52
SC4 Schuster 4	$225	8	12,986	10,117	46	25	20	215	57
SC5 Schuster 5	$225	10	13,741	10,570	69	34	36	194	39
ME1 Mesa 1	$165	17	23,556	19,479	60	107	111	43	195
SB7 Sun Bowl 7	$165	18	27,633	21,442	61	130	118	41	185
SB8 Sun Bowl 8	$165	17	24,160	19,479	64	107	114	43	188
SB10 Sun Bowl 10	$165	25	35,938	27,331	72	107	112	27	198

6.2. Survey Implementation

The survey protocol, informed consent form, and the survey instrument were approved by UTEP Institutional Review Board (IRB) on 2/24/2021. As most of the classes during that period were taught in the online format, the survey was implemented online from 3/22/2020 to 4/9/2021. To recruit students to participate in this survey, email requests were sent to course instructors in the different colleges to request their assistance by either (1) informing students in their classes about this survey by disseminating a standard email and the link to the QuestionPro website; (2) allowing the research assistant to appear in the class sessions to explain the survey and answer questions via Zoom Meeting or Microsoft Teams. At the end of the survey period, the survey website registered the responses from 430 participants. However, not all the participants answered all the questions. The demographic profiles of the survey respondents are summarized in Table 6.4. This information is compiled from the answers to Questions A1 to A4.

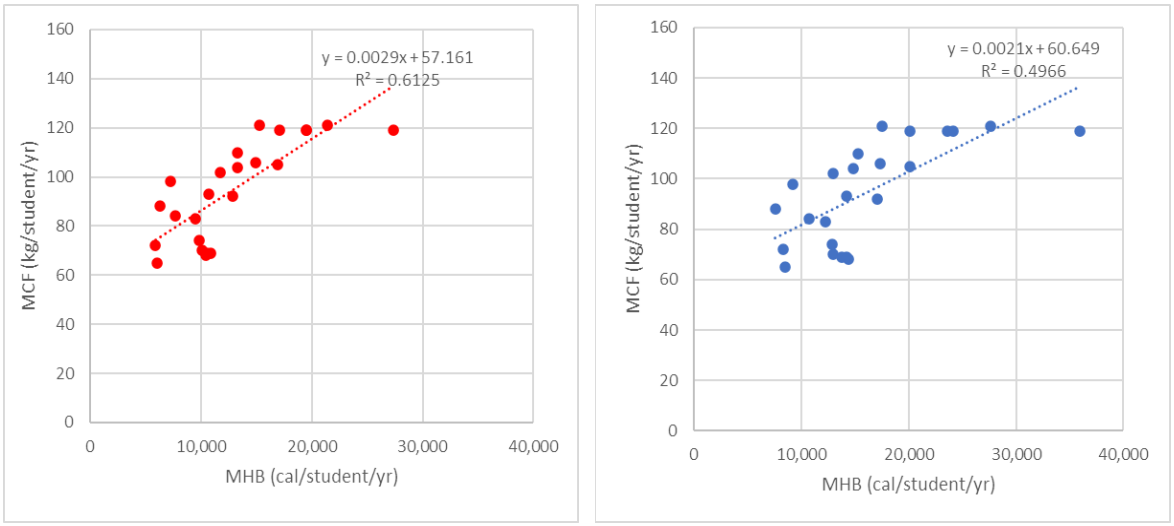
Table 6. 4 Profiles of student survey respondents.

Question no.	Attribute	No. of responses	Choice	No. selected	% selected
A1	Age	397	20 or under	161	41%
			21-23	151	38%
			24-26	48	12%
			27-29	11	3%
			30 or more	26	7%
A2	Geneder	396	Male	239	60%
			Female	157	40%
A4	Classification	396	Freshman	49	12%
			Sophomore	72	18%
			Junior	119	30%
			Senior	137	35%
			Graduate	19	5%
A4	Enrollment status	396	Full-time	348	88%
			Part-time	48	12%

7. RESULTS AND DISCUSSIONS

7.1. Tradeoff Between Health Benefits and Carbon Footprint

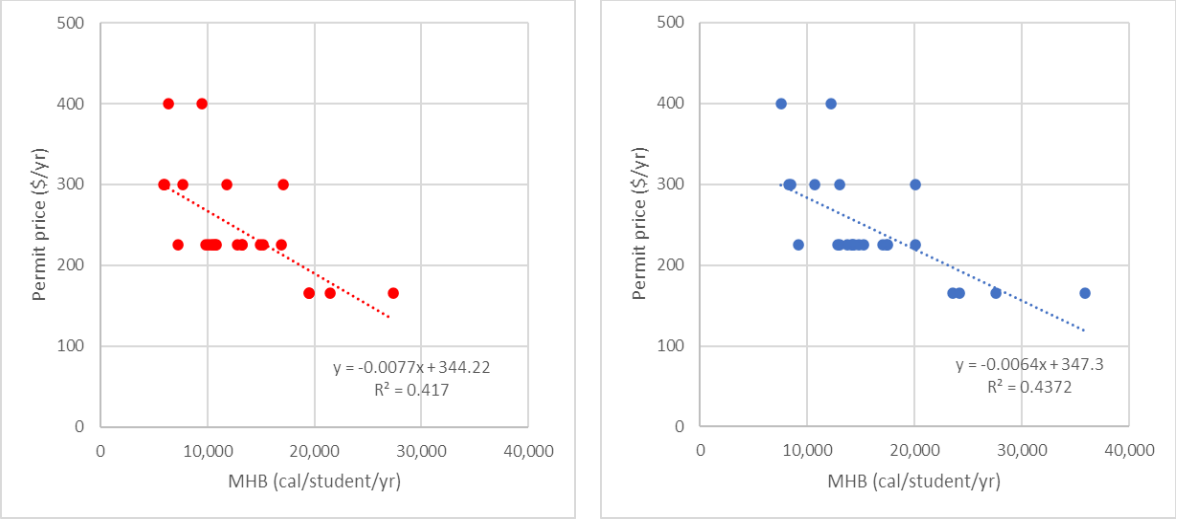
Figure 7.1 has two scatter plots of the average MCF versus MHB. Each scatter plot has 24 data points that correspond to the 24 parking zones. Figure 7.1(a) plots the average MCF against the MHB for females. Figure 7.1(b) plots the average MCF versus the MHB or males. The average MCF for a parking zone was calculated by aggregating the MCF from the five entry points, using the volumes at the five entry points as the weights. They are observable positive correlations between the average MCF and MHB in both plots. This means that a parking zone that provides better health benefits (longer walking distance to the centroid of the campus) also tends to have higher contributions of carbon footprints (further from the campus entry points).



(a) Female (b) Male

Figure 7. 1 Plots of average MCF versus MHB.

Figure 7.2 presents two scatter plots of annual permit price versus MHB. Similar to Figure 7.1, the MHB data points for the 24 parking zones are plotted separately for females and males in Figure 7.2(a) and Figure 7.2(b) respectively. It is observed that the annual permit price and MHB are negatively correlated. This means that a parking zone that has a cheaper permit will give the student a better health benefit. The parking zones with lower annual permit prices are usually located further from the center of the campus. Therefore, the longer walking distances from these parking zones to the centroid of the campus increases the health benefits. Figure 7.2 also reflects that UTEP PTS priced the parking zones according to the walking distance from the centroid of the campus.



(a) Female (b) Male

Figure 7. 2 Plots of annual permit price versus MHB.

Figure 7.3 plots the average MCF against the annual permit price. It appears that there is a negative but weak correlation between the average MCF and the annual permit price. Thus, we may interpret that, a parking zone that has a higher permit price (which is nearer to the centroid of the campus) tends to make its users contribute to smaller carbon footprints. Conversely, a parking zone that has a cheaper permit (which is at a remote area of the campus) requires long driving distances and hence makes users produce more CO_2 emissions. However, the aforementioned relationships are weak. This is related to the layout of the campus road network and the locations of the parking zones. An inspection of the UTEP campus road network and the parking zone locations revealed that the zones that were closer to the centroid of the campus were more accessible from the five entry points, whereas the perimeter and remote zones require some driving distance from the campus entry points.

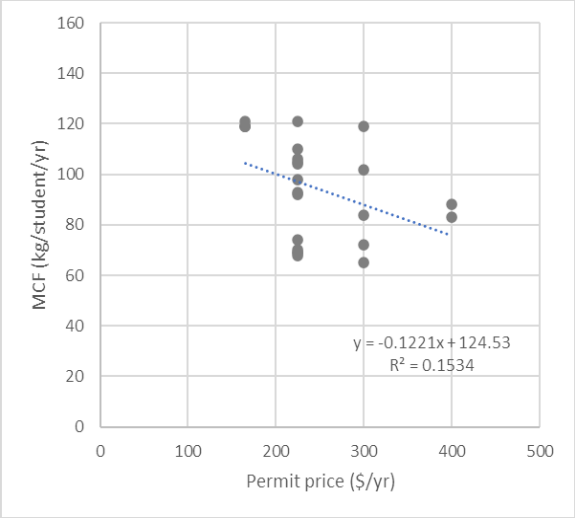


Figure 7. 3 Plot of annual permit price versus average MCF.

After analyzing Figures 7.1 to 7.3, it may be concluded that:

- The average MCF and MHB are positively correlated.
- A parking zone with a lower annual permit price tends to have a higher MHB.
- A parking zone with a lower annual permit price tends to have a higher average MCF.

7.2. Transportation Modes

Figure 7.4 shows the mode shares of all the 363 respondents who answered Question B1. These 363 respondents included those taking all modes of transportation but excluded those who stated that they parked in the off-campus neighborhood streets. Eight-two percent of the respondents drove alone to the campus. Another 6% carpooled and another 6% took public transit. The remaining 4% stated that they used other modes of transportation to reach the campus.

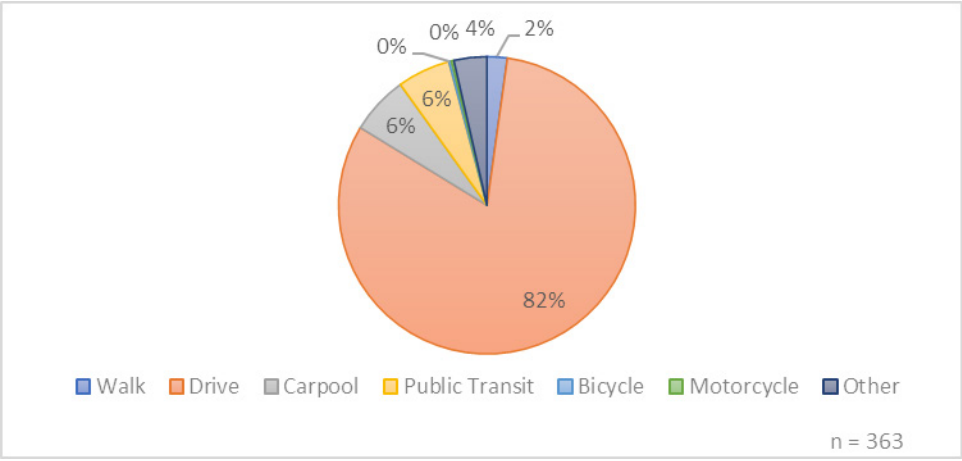


Figure 7. 4 Transportation mode shares.

7.3. Student Attitudes

Figure 7.5 below lists the responses to the five statements included in Question B2 to assess a respondent's attitude towards sustainability. For each question, the respondent was asked to select a level of agreement from five choices: "strongly agree", "agree", "neutral", "disagree "or "strongly disagree". Of the five statements, the first and fifth statements had approximately equal splits of respondents among the five choices. These two statements were related to sustainable transportation modes. The other statements were related to the day-to-day activities at home. If the percentages of respondents who answered "strongly agree" and "agree" are added and compared, recycling, saving of electricity, and buying-local had 75%, 64%, and 54%, respectively. Each of the two statements that were related to sustainable transportation modes had only 38% of the respondents who answered "strongly agree" and "agree". There was a small percentage (up to 12%) of the respondents who were not concern about environmental sustainability, and a certain percentage of them agreed with sustainable practices but their awareness or effort has not extended to transportation.

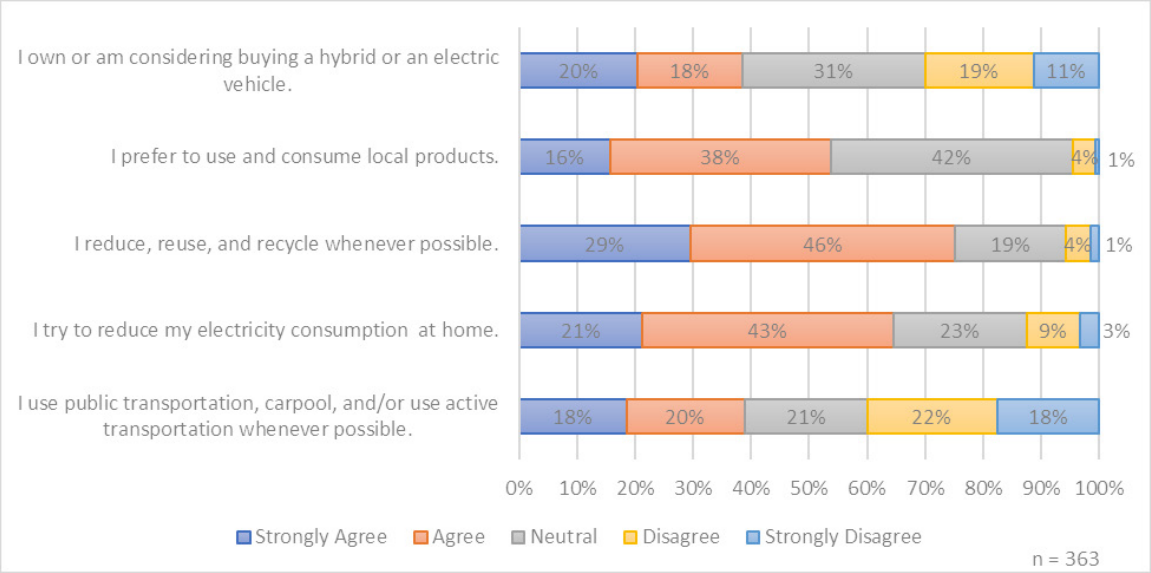


Figure 7. 5 Attitude towards environmental sustainability.

Figure 7.6 below lists the responses to the five statements included in Question B3 which aimed to assess a respondent's attitude towards a healthy lifestyle. For each question, the respondent was asked to select a level of agreement from "strongly agree", "agree", "neutral", "disagree" or "strongly disagree". Other than consistent sleeping schedule, more than 50% of the respondents selected "strongly agree" and "agree" with the statements that (1) they did not smoke and drink alcohol, or did so on rare occasions; (2) they drank plenty of water; (3) they monitor body weight and blood pressure; and (4) they watch their food intake and exercise daily. Of particular interest was the 46% of the respondents did not agree with the statement that they exercised daily. There

is a potential for this group of respondents to incorporate daily exercise into the parking location decisions.

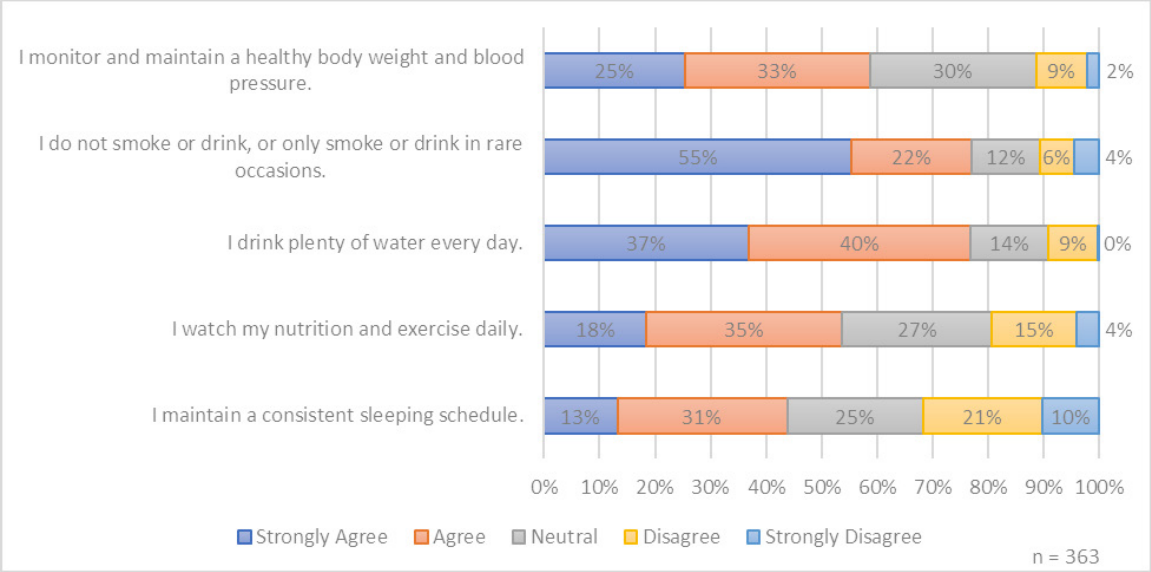


Figure 7. 6 Attitude towards healthy lifestyles.

7.4. Impacts of Health Benefits and Carbon Footprint Information

The following figure shows the distributions of student choices of parking zones (a) without the presence of the MHBs and MCFs; and (b) with the presentation of MHBs and MCFs. These were obtained from the answers to Questions B4 and B6, respectively. A total of 360 respondents answered both Questions B4 and B6. Before the presentation of the MHBs and MCFs, in Question B4, 30% of the respondents selected the three parking garages. This seemingly high popularity of the garages was because they have higher capacities compared to other parking lots. When the respondents were presented with the MHBs and MCFs, 164 (46%) respondents selected new parking zones. The remaining 196 respondents remained in the same parking zones. These 196 respondents were either (i) did not consider MHB and MCF among the decision factors, or they were satisfied with their original selections. With the shifts, the total percentage of the respondents who selected the three garages increased from 30% to 37%.

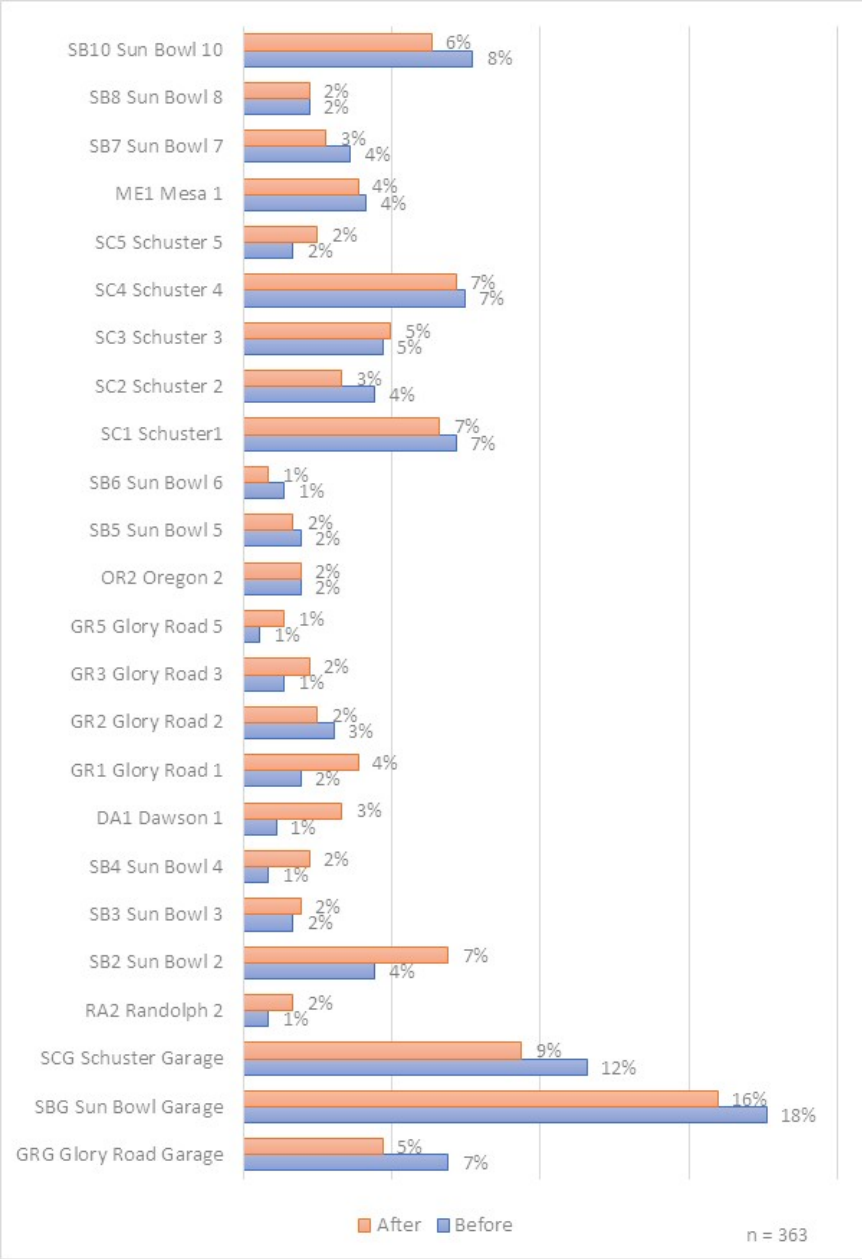


Figure 7. 7 Choices of parking zones.

Efforts were made to estimate the changes in total calories burned and CO_2 emission due to the presentations of MHBs and MCFs during the simulated permit purchase process, assumed that the purchasing behavior of the survey respondents was translated to all the commuter students. Commuter students were defined as students who drove his/her vehicles alone to the campus.

The Total Health Benefits of all the commuter students (THB) was estimated by the following steps:

HB-1. Applied the distribution of the parking zones selected by the respondents (in Figure 7.7) to the 3,815 vehicle-trips. This yielded the number of vehicle-trips attracted to each parking zone per morning peak hour on weekdays.

HB-2. Assumed that all the vehicles had single occupancy. The number of vehicle-trips attracted to each zone was the number of students who walked one round-trip per weekday between the zone and Leech Grove.

HB-3. For each parking zone, the MHB for females and males of the zone (in Table 4.1) were multiplied by 0.54 and 0.46 and then summed to obtain the average MHB of the commuter students who parked in the zone. The 0.54 and 0.46 were the fractions of female and male students obtained from the 2019 Common Data Set (CIERP, 2019).

HB-4. The THB of a zone was calculated by the multiplying the average MHB of the commuter students who parked in the zone by the number of students who walked one round-trip per weekday between the zone and Leech Grove.

HB-5. The THB of the 24 zones were summed to form the THB of all the commuter students.

The Total Carbon Footprint of all the commuter students (TCF) was estimated by the following steps:

CF-1. Applied the percent distribution of the parking zones selected by the respondents (in Figure 7.7) to the 3,815 vehicle-trips. This yielded the number of vehicle-trips attracted to each parking zone per morning peak hour on weekdays.

CF-2. Assigned the number of vehicle-trips attracted to each parking zone to each of the five entry points of the campus according to the distribution in Table 5.1. This step produced an O-D matrix that had trip distributions from an entry point to a parking zone.

CF-3. The average MCF from an entry point to a parking zone has been explained in Section 7.1. The TCF from an entry point to a zone was calculated by the multiplying the average MCF from an entry point to a parking zone by the number of trips from an entry point to a parking zone.

CF-4. The TCF of the 24 zones and the five entry points were summed to form the TCF of all the commuter students for all the inbound trips in the morning. The value was multiplied by two to approximate the TCF due to round-trips.

The above steps (HB-1 to HB-5, and CF-1 to CF-4) were repeated for the two distributions of parking zone choices in Figure 7.7. The results are summarized in Table 7.1. From the data presented in Table 7.1, we may conclude that, when the respondents were provided with the MHBs and MCFs when they purchased permits, the distribution of the selected parking zones were different that resulted in a 3.88% reduction in the total calories burned by walking per year among the commuter students and a 2.10% reduction in total CO_2 emissions by commuter students.

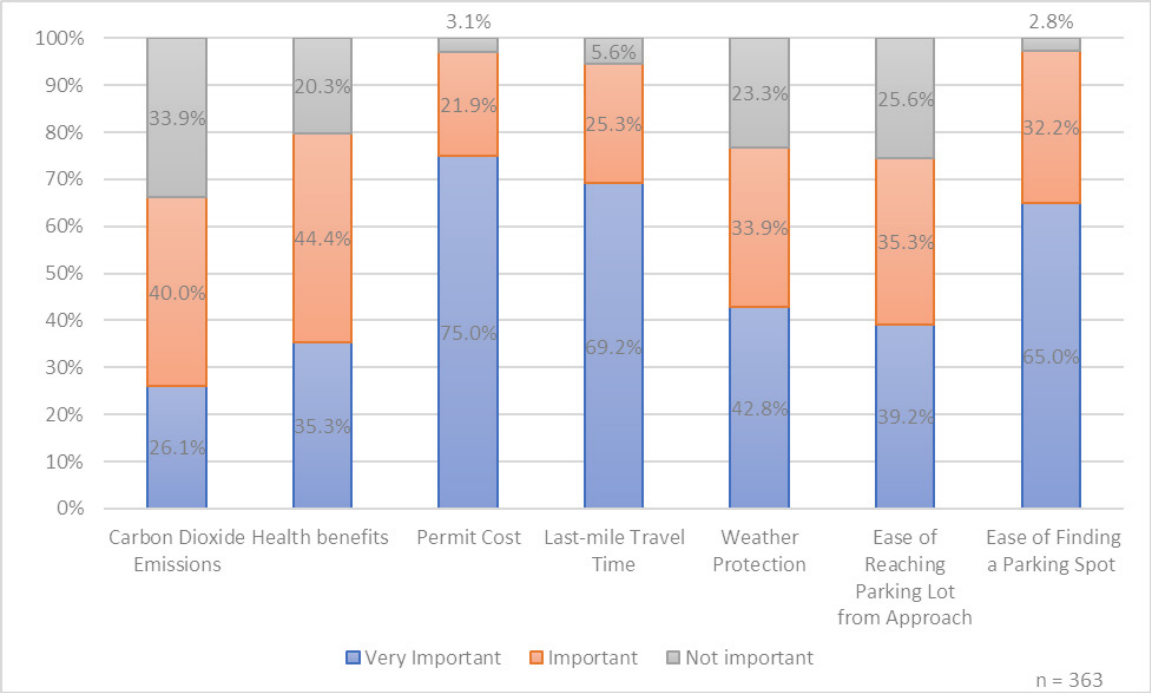
Table 7. 1 THB and TCF.

Data provided to respondents	THB of commuter students (calories/year)	TCF of commuter student drivers (kg of CO2/year)
Without presentation of MHB and MCF	52,961,036	3,272,660
With MHBs and MCFs	50,905,356	3,203,806
Difference	-2,055,679	-68,854
% change	-3.88%	-2.10%

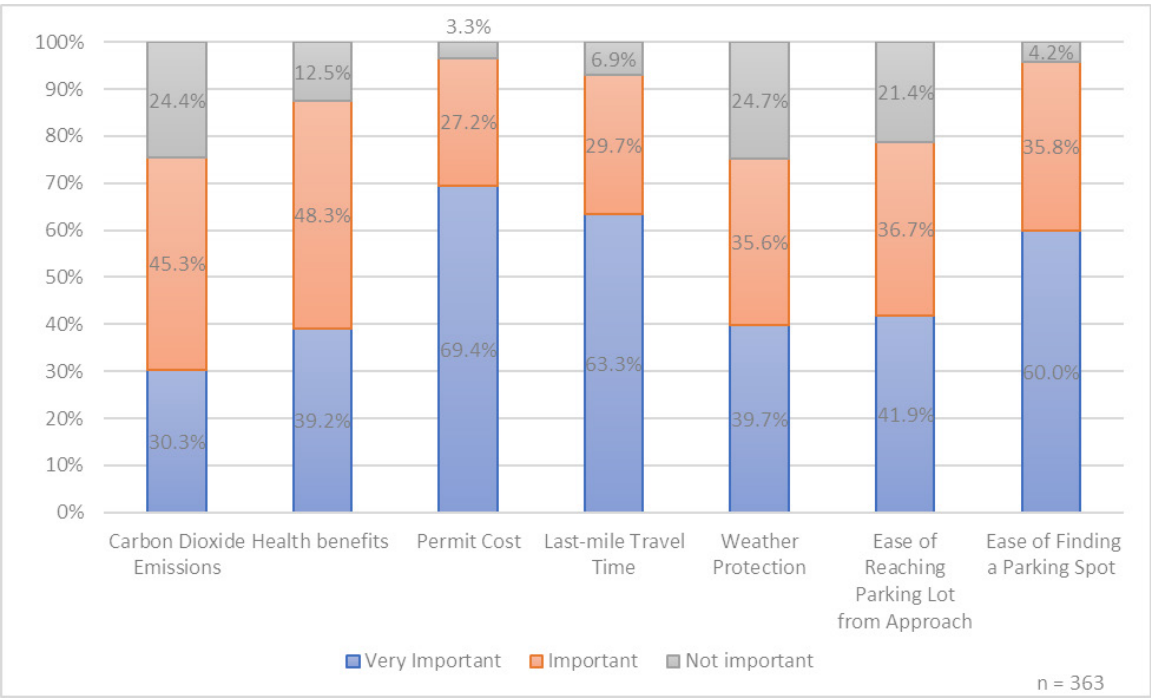
It has been stated (in association with Figure 7.1) that MHB and MCF were positively correlated. An increase in MHB would see an increase in MCF. The same observation is made in Table 7.1, where a reduction in THB is associated with a reduction in TCF. Overall, when presented with MHBs and MCFs during the simulated permit purchase process, 46% of the commuter students will change their parking locations, with a net increase of 7% moved to the garages. The overall effect will lead to a 2.10% reduction in total CO_2 emission, at the expense of the 3.88% health benefit of walking.

7.5. Parking Location Decision Factors

Figure 7.8 presents the levels of importance of the seven factors in parking location decisions. These are based on the answers received in Questions B5 and B7 in the survey. In these two questions, each respondent was asked to, after he/she had picked the parking zone without and with the MHBs and MCFs, the importance of each factor in his/her answers to Questions B5 and B7. The respondent was asked to rate each factor as “very important”, “important”, or “not important”.



(a) Without MHB and MCF



(b) With MHBs and MCFs

Figure 7. 8 Levels of importance of parking location decision factors.

Table 7.2 compares the seven parking location decision factors using the data taken from Figure 7.5. For each factor, the percentage of respondents who stated that the factor was "very important" and "important" were summed. These percentages before and after the presentations of the MHBs and MCFs were compared. When the respondents were presented with the MHBs and MCFs during the simulated permit purchase process, the percentages of the respondents who stated "CO_2 emissions" and "health benefits" were "very important" and "important" to them increased by 9.5% and 7.8% respectively. For other factors, the percentages of respondents who regarded the factor as "very important" and "impotant" changed by 4.1% or less.

Table 7. 2 Levels of importance of parking location decision factors.

Parking location	**Percent of respondents who stated very important and important**		
Decision factor	Without MHB & MCF (%)	With MHBs & MCFs (%)	Difference (%)
CO2 emissions	66.1	75.5	+9.5
Health benefits	79.7	87.5	+7.8
Permit cost	96.9	96.6	-0.3
Last-mile travel time	94.5	94.0	-0.5
Weather protection	76.7	75.8	-0.9
Ease of reaching the parking lot	74.5	78.6	+4.1
Ease of finding a parking space	97.2	95.8	-1.4

7.6. Thresholds for Change in Parking Locations

Question B8 in the survey asked if the respondent was willing to change his/her parking zone to reduce his/her carbon footprint. Two hundred eighty-two respondents answered "yes" and 78 respondents answered "no".

Question B9 followed up by asking those who were willing to change the parking zone what level of reduction in MCF would motivate him/her to make the change. The respondents were given six choices: "10% or less", "11% to 20%", "21% to 30%", "31% to 40%", "41% to 50%", "51% or more". The number of respondents who selected the answers are listed in Table 7.3. The most popular threshold to change was "21% to 30%". This was selected by 79 respondents. This means that, for those respondents who were willing to change parking zones, 79 out of 282 respondents would make the switch if it can result in a 21% to 30% reduction in CO2 emissions.

Question B10 in the survey asked if the respondent was willing to change his/her parking zone to improve his/her health benefits by walking. Two hundred eighty respondents answered yes and 78 respondents answered no. The percentages of yes/no splits between MCF (Question B8) and MHB (Question B9) are practically the same.

Question B11 followed up by asking those who were willing to change the parking zone what level of reduction in MHB would motivate him/her to make the change. The respondents were given six choices: "10% or less", "11% to 20%", "21% to 30%", "31% to 40%", "41% to 50%", "51% or more". The number of respondents who selected each of the answers are listed in Table 7.3. The

most popular threshold to change was 21% to 30%. This was selected by 79 respondents. This means that, for those respondents who were willing to change parking zones, 79 out of 280 respondents would make the switch if it can result in a 21% to 30% reduction in CO2 emissions. The distributions of thresholds that will trigger changes in parking zones due to savings in MCF (Question B8) and improvements in MHB (Question B9) are practically the same.

Table 7. 3 Willingness to change parking zones.

Question	B8, B9 MCF		B10, B11 MHB	
No. of responses	360	100%	360	100%
Willing to change parking zone				
Yes	282	78%	280	78%
No	78	22%	80	22%
Threshold to change (for those who were willing)				
10% or less	33		29	
11% to 20%	53		50	
21% to 30%	79		79	
31% to 40%	48		44	
41% to 50%	25		26	
51% or more	44		52	

8. CONCLUSIONS

8.1. Summary of Major Findings

The **objective** of this research was to investigate the impacts of providing information on the health benefits of walking and carbon footprints on student's parking location decisions. An online survey was designed to simulate the student parking permit purchase process at UTEP. The survey asked a participant to purchase a student parking permit first without showing the MHBs and MCFs, and then repeat the purchase process with MHBs and MCFs. The survey was implemented from 3/22/2021 to 4/9/2021 and received responses from 430 student participants. It was found that, when MHBs and MCFs of the available parking lots were shown to the participating students, 46% changed their parking zones. The percentages of students who selected parking garages increased from 30% to 37%. These changes suggested that the provision of MHBs and MCFs caused some students to make conscious decisions to move from surface lots which were further away from the entry points and the centroid of the campus, to parking garages that are closer to the entry points and the centroid of the campus. They preferred to reduce their carbon footprints at the expense of health benefits (shorter walking distance). This shift would result in a 2.10% reduction of total CO_2 emission contributed by all the commuter students. The total calories burned by these students would be reduced by -3.88%.

The **research question** was: "If information of carbon footprint and health benefits are available, what are their influences relative to permit fee and last-mile travel time in parking location decisions?" Part research (Gurbuz and Cheu, 2020) found that the three most important decision factors in a student's decision on parking location on campus were, in decreasing order of importance: (1) permit price; (2) last-mile travel time; and (3) ease of finding a parking spot. Before the survey respondents were shown the MHBs and MCFs, the top three decision factors, in decreasing percentages of respondents who selected them as "very important" and "important", were: (1) ease of finding a parking space (97.2%); (2) permit cost (96.9%); last-mile travel time (94.5%). Health benefits and CO2 emissions were selected by only 79.7% and 66.1% of the respondents. When the MHBs and MCFs were shown during the simulated online permit purchase process, the top three decision factors remained the same but the order switched because of slight changes in percentages: (1) permit cost (96.6%); (2) ease of finding a parking space (95.8%); and (3) last-mile travel time (94.0%). Health benefits and CO_2 emissions did not improve to among the top three decision factors, but they had the largest improvements, by 9.5% and 7.8%, to 87.55 and 75.5% respectively. There have been relative shifts in the importance of health benefits and CO_2 emissions as factors in parking location decisions. This may explain the changes in the parking lot/garage distributions of student choices in Figure 7.7.

8.2. Outputs

This research has produced the following outputs:

The MHB and MCF were defined after the literature review. It was decided that:

- The MHB experienced by a student was the calories burned by walking round-trip on each weekday between his/her parked car on campus and Leech Grove, the centroid of the campus.

- The MCF contributed by a commuter student was the CO_2 emissions by driving a one-way trip from an entry point of the campus to the parking zone where he/she has the permit to park.

Chapter 4 reports the work performed in Task 2. A table (Table 4.1) has been constructed using data recorded in a walking survey from the centroids of the 24 student parking lots to Leech Grove. This table lists the gender-specific MHBs in calories/student/year if a student consistently walks round-trips from the same parking zone to Leech Grove on every weekday in the Fall and Spring semesters.

Chapter 5 reports the work performed in Task 3. A table (Table 5.1) has been constructed using output data of the VISSIM-CMEM estimation approach. This table lists the MCFs in kg CO_2 /vehicle-trip/year when a student drives his/her vehicle consistently from the same entry point of the campus to the permitted parking zone on every weekday in the Fall and Spring semesters.

8.3. Outcomes

Chapters 6 and 7 report on an online student survey that collected data from 430 participants. When the MHBs and MCFs were presented to the respondents during a simulated permit purchase process, 46% of the respondents changed their parking zones. This resulted in a 2.10% reduction in the total carbon footprints contributed by commuter students on campus. However, this will also lead to a 3.88% reduction in calories burned per year by all the commuter students.

8.4. Impacts

Two of the student survey questions asked the respondents to rate the level of importance of the factors in their parking location decisions, before and after the presentations of the MHBs and MCFs. When the MHBs and MCFs were presented to the respondents, the number of respondents who said that MHB and MCF were very important and important in their decisions increased by 7.8% and 9.5%. The magnitudes of changes were much higher than the percent change in other decision factors. However, the three most important decision factors remained the same (they were permit price, last-mile travel time, and ease of finding a parking spot). Nevertheless, the introduction of MHBs and MCFs in the permit purchase process not only shifted the distribution of parking zones selected by commuter students but has created an awareness of the health benefits of walking and the carbon footprint of vehicle use. This has increased the relative importance of these two factors in the parking location decision problem.

REFERENCES

BLS (2017). Men's and women's participation in sports and exercise, 2003-15. Spotlight on Statistics, U.S. Bureau of Labor Statistics. https://www.bls.gov/spotlight/2017/sports-and-exercise/home.htm

CDC (2019). Health, United States, 2019. National Institute for Health Stastistics. Center for Disease Control and Prevention. https://www.cdc.gov/nchs/hus/index.htm.

CDC (2020). Walking. Physical Activity. Center for Disease Control and Prevention. https://www.cdc.gov/physicalactivity/walking/index.htm.

CIERP (2019). Common Data Set 2018-2019. Center for Institutional Evaluation, Research and Planning. The University of Texas at El Paso.

EPA (2021) U.S. Transportation Sector Greenhouse Gases Emissions 1990-2019. United States Environmental Protection Agency. https://www.epa.gov/sites/production/files/2021-06/documents/420f21049.pdf.

Google (2020). Google Fit. Google Inc. https://www.google.com/fit.

Gurbuz, O. (2019). Decision Support Tools for Parking Management at University Campuses. Ph.D. Dissertation. Department of Civil Engineering, The University of Texas at El Paso.

Gurbuz, O. and Cheu, R. L. (2020). A survey to explore behavior, intelligent transportation systems needs and level of service expectations for student parking at a university campus. Transportation Research Record – Journal of the Transportation Research Board, 2674(1),168-177.

Gurbuz, O. and Cheu, R. L. (2021). "Zoning and Zone Permit Pricing Methodology for Smart Parking Management at University Campuses." Smart City Symposium in Prague (SCSP2021), accepted.

Harvard (2021). Calories burned chart by activity and weight, including walking, sports, and everyday household activities. Harvard Medical School. https://www.health.harvard.edu/diet-and-weight-loss/calories-burned-in-30-minutes-of-leisure-and-routine-activities

Mayo (2020). Metabolism and weight lost: how you burn calories. Mayo Clinic. https://www.mayoclinic.org/healthy-lifestyle/weight-loss/in-depth/metabolism/art-20046508

NIH (n.d.). Calculate Your Body Mass Index. National Institute of Health. U.S. Department of Health and Human Services. https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmi-m.htm

PTV (2021). PTV VISSIM 2021. PTV Group. https://www.ptvgroup.com/en-us/solutions/products/ptv-vissim.

Scora, G. and Barth, M. (2006). Comprehensive Modal Emissions Model (CMEM), Version 3.01. User guide. Centre for Environmental Research and Technology. University of California, Riverside.

WHO (2008). Reducing your carbon footprint. Fact Sheet. World Health Organization. https://www.who.int/globalchange/publications/factsheets/Kit2008_annex1_2.pdf.

APPENDIX A SURVEY INSTRUMENT

Section A. Demographics

A1. What is your age?

- ○ 20 or under
- ○ 21-23
- ○ 24-26
- ○ 27-29
- ○ 30 or more

A2. What is your gender?

- ○ Male
- ○ Female

A3. What is your current classification?

- ○ Freshman (completed 0-29 semester-credit hours)
- ○ Sophomore (complete 30-59 semester-credit hours)
- ○ Junior (completed 60-89 semester-credit hours)
- ○ Senior (completed 90 or more semester-credit hours)
- ○ Graduate or PhD

A4. What is your current course load status?

- ○ Full-time (12 or more credits for undergraduates, 9 or more credits for graduates)
- ○ Part-time (11 or fewer credits for undergraduates, 8 or fewer credits for graduates)

Section B. Parking Location

B1. How do you travel to the UTEP campus?

- ○ I live in a dormitory or I walk to campus
- ○ I drive my car (drive alone or give someone a ride)
- ○ Carpool (get a ride from someone or someone drop me off, including Uber)
- ○ I use public transportation (Sun Metro, Brio, streetcar etc.)
- ○ I ride a bicycle
- ○ I ride a motorcycle

Other (please specify): _____

B2. Please specify your level of agreement to each of the following statements.

Sustainable behaviors	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I use public transportation, carpool, and/or use active transportation (biking, walking, etc.) whenever possible.	○	○	○	○	○
I try to reduce my electricity consumption at home.	○	○	○	○	○
I reduce, reuse, and recycle whenever possible.	○	○	○	○	○
I prefer to use and consume local products.	○	○	○	○	○
I own or am considering buying a hybrid or an electric vehicle.	○	○	○	○	○

B3. Please specify your level of agreement to each of the following statements.

Health behaviors	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I maintain a consistent sleeping schedule.	○	○	○	○	○
I watch my nutrition and exercise daily.	○	○	○	○	○
I drink plenty of water every day.	○	○	○	○	○
I do not smoke or drink, or only smoke or drink on rare occasions.	○	○	○	○	○
I monitor and maintain healthy body weight and blood pressure.	○	○	○	○	○

B4. The following table displays the list of parking lots in the UTEP campus and the assumed annual cost of a student parking permit for the 2021-2022 academic year. You may see the location of the parking lots in the map below. If you must purchase a parking permit now, which parking lot will you select?

Permit Type	Price
GRG Glory Road	$300
SBG Sun Bowl	$400
SCG Schuster	$400
RA2 Randolph 2	$300
SB2 Sun Bowl 2	$300
SB3 Sun Bowl 3	$300
SB4 Sun Bowl 4	$300
DA1 Dawson 1	$225
GR1 Glory Road 1	$225
GR2 Glory Road 2	$225
GR3 Glory Road 3	$225
GR5 Glory Road 5	$225
OR2 Oregon 2	$225
SB5 Sun Bowl 5	$225
SB6 Sun Bowl 6	$225
SC1 Schuster1	$225
SC2 Schuster 2	$225
SC3 Schuster 3	$225
SC4 Schuster 4	$225
SC5 Schuster 5	$225
ME1 Mesa 1	$165
SB7 Sun Bowl 7	$165
SB8 Sun Bowl 8	$165
SB10 Sun Bowl 10	$165

Please select 1 of the 24 parking lot options listed in the drop-down menu below.

THE UNIVERSITY OF TEXAS AT EL PASO

CAMPUS DIRECTORY

Academic Advising Center	104
Administration Building	1
Bell Hall	55
Benedict Hall	28
Bioscience Research Building	16
Biology Building	200-B
Bequilles Hall	274-A
Brumbelow Building	91
Business Administration Building	109
Campbell Building (Inset A)	96
Carl Hertzog Building	34
Centennial Museum	21
Centennial Plaza	275
Center for Inter-American and Border Studies	95
Central Energy Plant	57
Central Receiving	113-B
Chemistry and Computer Science Building	256
Chihuahuan Desert Gardens	252
Classroom Building	200-C
Cotton Memorial	18
Don Haskins Center	90
Education Building	47
Engineering and Sciences Complex	200
El Paso Natural Gas Conference Center	48
Facilities Services	113-A
Foster - Stevens Basketball Center	253
Fox Fine Arts Center	80
Geological Sciences Building	35
Glory Field	116
Glory Road Transfer Center and Parking Garage	276
Graduate Business Center (Inset B)	258
Graham Hall	3
Health Sciences and Nursing Building	255
Helen of Troy Softball Complex	93
Heritage House	17
Hilton Garden Inn	212
Holliday Hall	2
Honors House	43
Hudspeth Hall	39
Interdisciplinary Research Building	266
Kelly Hall	59
Key Shop/Hawthorne Building	73
Kidd Field	23
Kidd Memorial Seismic Lab	14
Larry K. Durham Sports Center	22
Leach Grove	118
Lhukhang	257
Liberal Arts Building	8
Magoffin Auditorium	99
Memorial Gym	201
Metallurgy Building	200-M
Mike Loya Academic Services Building	35
Military Science Building	110
Miner Canyon Student Housing	234
Miner Heights Student Housing	217
Miner Village Student Housing	94
Miners Hall	32
Multipurpose Field	251
North Energy Plant	106
Old Main	9
Parking and Transportation Services	
Customer Service Office	38
Administrative Office	112
Peter and Margaret de Wetter Center	25
Physical Sciences Building	36
Prospect Hall	60
Psychology Building	61
Quinn Hall	6
Ross Moore Building	84
Schuster Parking Garage	259
Stanlee and Gerald Rubin Center/ Searson Hall	11
Student Health Center	40
Student Recreation Center	93
Sun Bowl Parking Garage	214
Sun Bowl Stadium	58
Undergraduate Learning Center	99
Union Building	24
University Bookstore	215
University Heights Early Learning Center	216
University Field	221
University Library	111
University Police	113-P
University Relations	42
University Ticket Center	254
University Towers	260
Vowell Hall	7
Wendell Hall	33

MINER METRO SHUTTLE

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Legend

- Drop-off/Pick-up Point
- Emergency Telephone
- Miner Metro Shuttle Stop
- Metered Parking
- Traffic Control Station
- Electric Control Gate
- Construction Zone
- Parking Lot (Valid University parking permit required in designated zones)

V3.1 Revised 12/11/2020

B5. Select the level of importance for each of the following factors that contributed to your decision to your selection of the parking lot in the previous question.

Factors	Very Important	Important	Not Important
Carbon dioxide (CO_2) emissions	○	○	○
Health benefits due to walking from the parking lot to the final destination	○	○	○
Cost of the permit	○	○	○
The time it takes from the parking lot to the final destination	○	○	○
Protection of car from the weather (e.g., shade)	○	○	○
Ease of reaching the parking lot from I-10, Border Highway, or Mesa St.	○	○	○
Ease of finding a parking spot	○	○	○

B6. The following table displays the list of parking lots on the UTEP campus and the assumed annual cost of a student parking permit for the 2021-2022 academic year. In addition, the table displays for each parking lot the estimated health benefits associated with walking from the parking lot to the campus core and back, and the CO_2 emission from the respective entrance of the UTEP campus to the parking lots. For example, the average female student at UTEP driving her car from I-10 at Schuster exit to parking lot X, in one year will burn 11,948 calories and contribute 79 kg of CO_2 to the atmosphere. You may see the location of the parking lots on the map below. If you must purchase a parking permit now, which parking lot will you select?

Permit Type	Price	Walking time in minutes from parking lot to campus core (Leech Grove)	Calories burned per year		Carbon dioxide emissions in kilograms per year				
					Approaching UTEP campus from:				
			Male	Female	I-10 at Sun Bowl	I-10 at Schuster	Spur 1966	Mesa-Sun Bowl	Mesa-Schuster
Average Values (Parking Lot X)	**$245**	**10**	**16,050**	**12,848**	**47**	**79**	**75**	**110**	**125**
GRG Glory Road	$300	12	20,083	17,063	67	120	98	121	155
SBG Sun Bowl	$400	4	7,550	6,342	28	66	56	100	138
SCG Schuster	$400	7	12,231	9,513	52	28	23	235	81
RA2 Randolph 2	$300	7	12,986	11,778	58	103	102	114	108
SB2 Sun Bowl 2	$300	5	8,456	6,040	6	34	36	80	112
SB3 Sun Bowl 3	$300	5	8,305	5,889	12	59	49	71	117
SB4 Sun Bowl 4	$300	6	10,721	7,701	21	74	68	65	134
DA1 Dawson 1	$225	5	9,211	7,248	37	94	89	87	134
GR1 Glory Road 1	$225	12	20,083	16,912	44	103	91	55	166
GR2 Glory Road 2	$225	10	17,365	14,949	50	107	93	64	161
GR3 Glory Road 3	$225	8	14,798	13,288	54	118	108	99	111
GR5 Glory Road 5	$225	10	17,516	15,251	62	119	120	100	153
OR2 Oregon 2	$225	8	15,251	13,288	66	121	126	111	101
SB5 Sun Bowl 5	$225	9	14,194	10,721	36	85	88	61	135
SB6 Sun Bowl 6	$225	9	17,063	12,835	34	91	85	58	138
SC1 Schuster1	$225	10	12,835	9,815	34	12	21	226	69
SC2 Schuster 2	$225	9	14,345	10,419	47	25	18	205	60
SC3 Schuster 3	$225	8	14,194	10,872	47	25	17	221	52
SC4 Schuster 4	$225	8	12,986	10,117	46	25	20	215	57
SC5 Schuster 5	$225	10	13,741	10,570	69	34	36	194	39
ME1 Mesa 1	$165	17	23,556	19,479	60	107	111	43	195
SB7 Sun Bowl 7	$165	18	27,633	21,442	61	130	118	41	185
SB8 Sun Bowl 8	$165	17	24,160	19,479	64	107	114	43	188
SB10 Sun Bowl 10	$165	25	35,938	27,331	72	107	112	27	198

THE UNIVERSITY OF TEXAS AT EL PASO

CAMPUS DIRECTORY

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Liberal Arts Building	8
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Memorial Gym	201
Metallurgy Building	200-M
Mike Loya Academic Services Building	35
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Miner Canyon Student Housing	234
Miner Heights Student Housing	217
Miner Village Student Housing	94
Miners Hall	32
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University Bookstore	215
University Heights Early Learning Center	216
University Field	221
University Library	111
University Police	113-P
University Relations	42
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Legend

- Drop-off/Pick-up Point
- Emergency Telephone
- Miner Metro Shuttle Stop
- Metered Parking
- Traffic Control Station
- Electric Control Gate
- Construction Zone
- Parking Lot
  Valid University parking permit required in designated zones

V3.1 Revised 12/11/2020

Please select 1 of the 24 parking lot options listed in the drop-down menu below.

B7. Select the level of importance for each of the following factors that contributed to your decision to your selection of the parking lot in the previous question.

Factors	Very Important	Important	Not Important
Carbon dioxide (CO_2) emissions	○	○	○
Health benefits due to walking from the parking lot to the final destination	○	○	○
Cost of the permit	○	○	○
Time it takes from the parking lot to the final destination	○	○	○
Protection of car from weather (e.g., shade)	○	○	○
Ease of reaching the parking lot from I-10, Border Highway, or Mesa St.	○	○	○
Ease of finding a parking spot	○	○	○

B8. Would you be willing to reduce your CO_2 emission by choosing a different parking lot?

- ○ Yes
- ○ No

B9. If yes, what percentage reduction in CO_2 emission would motivate you to choose a different parking lot?

- ○ 10% or less
- ○ 11% to 20%
- ○ 21% to 30%
- ○ 31% to 40%
- ○ 41% to 50%
- ○ 51% or more

B10. Would you be willing to increase your health benefits by burning more calories by choosing a different parking lot?

- ○ Yes
- ○ No

B11. If yes, what percentage increase in calories burned would motivate you to choose a different parking lot?

- ○ 10% or less
- ○ 11% to 20%
- ○ 21% to 30%
- ○ 31% to 40%
- ○ 41% to 50%
- ○ 51% or more

B12. How many minutes are you willing to walk from the parked vehicle, drop-off location, or transit stop to the final destination on campus (classroom, office, laboratory, etc.)?

- ○ 5 minutes or less
- ○ 6 minutes to 10 minutes
- ○ 11 minutes to 15 minutes
- ○ 16 minutes to 20 minutes
- ○ 21 minutes or more

B13. Please feel free to share any comment with us.

APPENDIX B SURVEY QUESTION 17: WRITTEN COMMENTS

Survey Comments

1. CO2 is food for the trees it is only poisonous in confined areas. You should be conducting studies on real pollutants.
2. Because I am physically active outside of school, I prefer not to walk as much. However, if it means it helps the environment, I will walk whatever it takes.
3. I am an active person but I tend to err on the side of running late or being barely on time to class. As such, I do not really factor in my possible health benefits to my choosing a parking spot, seeing as I can get my exercise in during other times of the day.
4. Very insightful. Will definitely consider when purchasing a new permit.
5. This survey was helpful and very efficient.

6. I had not considered all those factors when choosing a parking spot.
7. The most important factor, personally, is to find parking and to not walk a long distance. Since health issues can be addressed at other place different than school, I believe calories burned do not matter on the prices of the parking permits.
8. I feel like the cost of the parking permit it's just a little overpriced
9. Thanks for the info! Always important to remember health.
10. This survey was very informative, thank you so much!
11. Parking costs too much, the passes run out and the commute around campus takes too much time. Additionally, the parking lots are also run down and is poor condition. We need change.
12. I would have never imagined the factors one must consider when choosing a parking spot at UTEP. When I get my parking permit, I will definitely take this into consideration.
13. Even though health benefits from walking is very important, that would not influence my decision of parking spot. I care more about ETA than health benefits (because I am a very healthy person) and CO2 emissions because I use my bicycle a lot. Distance to campus does not matter in my case because I use my bicycle (I have a mount on my car). Therefore, I would suggest that you recommend people getting a bike, or some other small transportation (scooter perhaps) if they care about time.
14. It would be great if parking spots would be cheaper.
15. No comments, it would be very helpful.
16. I feel parking is expensive and not enough for all the students
17. Parking permits should be more accessible
18. I do not mind walking, if my health allows me to. I do want to lose weight and cut back on CO2 emissions. Personally, I am not worried about gender/sex, but I know the upcoming generation do not fall under neither male nor female, minimally should be allowed to select "prefer not to say" or "other." Thank you.
19. I usually live on campus so I buy a permit for whichever dorm facility I'm in.
20. As a student, it is very difficult to think first in other aspects than your economy to motivate you to buy a parking spot.
21. I mostly walk whenever I go to campus; I am a border commuter so I walk close to an hour whenever I have to go.
22. Although I do care about the amount of CO2 emissions, parking too far from campus gives me anxiety from being molested, raped, or hurt in some way. Call me paranoid, but that is the reality women have to live with, unfortunately, especially when having to walk outside after sunset. I would rather purchase a parking space closer to campus than what I have selected, but I do not have the financial means to do so.
23. Reducing the cost of parking permit will be helpful to students
24. I am not happy with parking centering the campus
25. Do you see the results of the experiment as it would pertain to trying to limit carbon emission and have more active people be compromised by accessibility?
26. I believe we contribute to pollution in many other ways and this situation of parking and CO2 levels is not one that I believe we will change. We might recycle more or buy energy efficient appliances rather than to consider our CO2 emissions. I believe that considering our CO2 contributions against the permit cost and walking "longer" distances will not make a big change in our thought process.
27. The lots behind the Sun Bowl are too far and the walk can be a pain in the heat.

28. There is need to reduce carbon emission into the atmosphere and be physically more active.
29. I would be great if free scooters were available in campus and surrounding areas.
30. I just feel most of us would like to contribute to CO2 and calories but a lot of us have to work right after class which doesn't allow us to walk the 10 plus minutes to our cars due to us being on a time schedule due to work!
31. For me price is the biggest factor I don't care much for anything else
32. When choosing my parking spot I would first choose to park in a centralized area where I could reach all my class locations in a reasonable time of 10 to 15 min maximum. Exercise or money reasons come second. Getting to class on time is the most important decision to me.
33. I find this research very interesting as climate change is a present issue and human health. It kills two birds with one stone by giving better options or solutions to the problem.
34. I simply want to find parking to make it to class on time.
35. My parking selection did not change. It compared favorably against average CO2 emissions, and not too far from the average of calories burned.
36. I prefer for my parking to be close to the building I will be in so I may get there on time when I am in a hurry.
37. Parking lot decision is largely influenced by its proximity to the building(s) in which I can expect most of my classes to take place. Health benefits are not given much consideration as I exercise independently.
38. More about the time that takes to travel from one point to another, I care more about the security on campus. I have heard some experiences from girls related to sexual assault on parking lots on our campus and I care about that. For me, it does not matter how far the parking lot from my destination is, but I want to walk on campus safely, especially if I finish at noon my classes or maybe some study group.
39. I think it would be nice to enter data that may include transgender or non-binary people. I know it is based on cisgender data but having that inclusion present may be helpful to some.
40. This was a really interesting survey; it made me realize the importance and influence I have regarding where I park. That is something I never thought of before until now.
41. My first semester I took a parking like 40 minutes away from my buildings where I had classes and I didn't like it
42. I would be willing to reduce calories and carbon emission if I can so that my health would be okay. I believe this would depend on what classes I take and where it is as well as if I can afford the permit for the parking spot that are close to my classes.
43. I have a knee and ankle injury
44. I understand the importance of cars producing less CO2 and the health benefits of parking away from UTEP core. However, some professors are very strict with timing. There is no guarantee that by parking further away to consume less C02 will get a student to class in time, which is very important to a student.
45. Weather is another factor after walking that’s probably the second thing I think about when parking before how much time is going to take me to get to my class faster