The Socio-Economic Factors of Transportation

at Dalhousie University

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EXECUTIVE SUMMARY

The goal of our research was to increase knowledge and understanding of how Dalhousie University students commute to and from Studley Campus, with a focus on the socio-economic factors that influence their choices. This particular focus was chosen because few pieces of literature and research focus on the socio-economic factors influencing transportation habits. Our project aims to fill a gap in both literature and public knowledge. Transportation is one of the main causes of greenhouse gas emissions on university campuses (Klein-Banai & Theis, 2011). Therefore by reducing unsustainable transportation, methods which produce high levels of greenhouse gases, universities campuses can become more sustainable and reduce their carbon footprint. Understanding these factors is an important step in moving towards a more environmentally focused campus. Knowing why students use the methods of transportation that they do as well as the reasons behind it can allow for the University to implement positive changes and promote increased sustainable transportation.

Through our research we recommend that Dalhousie University takes initiative into encouraging students to use more sustainable methods of transportation. This could be through improvement of existing infrastructure that encourages sustainable transit methods, such improving and expanding upon bike lanes. Our research indicated that environmental factors do not act as a main influence to students transportation habits. Consequently, in order to promote more sustainable choice of transportation habits, factors that were shown to influence students' actions including time and distance of commute, cost, and reliability must be focused on.

Furthermore, the conducted research could inform improvements of transportation options across the city of Halifax. Our research shows that a high percentage of students rely on public transportation in their commutes despite many appearing dissatisfied with the service. By utilizing this knowledge of use, combined with the factors that individuals prioritize and value when selecting their transit method the Municipality can increase choice-ridership and better serve public transit users.

Overall, this study aims to provide information on the factors that influence students in their choice of transportation in commuting to and from Dalhousie. Through our focus on the socio-economic factors that influence these decisions, we aim to fill a gap in the available literature and intend to provide information that can improve the available methods of transportation on Dalhousie's campuses.

1.0 INTRODUCTION

1.1 Background

In regards to environmental issues, such as climate change, transportation is one of the driving forces (Klein-Banai & Theis, 2011). Specifically, the increase of single occupancy vehicle usage being the primary method chosen by individuals around the world. Car travel accounts for around 80% of all road travel in the United Kingdom, and 60% in the United States (Gardner & Abraham, 2010). This indicates, that society as a whole has a heavy reliance towards private vehicle use. Moreover, with frequent usage of certain transportation methods can lead to significant environmental changes (Gardner & Abraham, 2010). In the United States alone private travel emitted approximately 175 million tonnes of carbon dioxide per year (Gardner & Abraham, 2010). Despite this increasing trend of single occupancy vehicle use, there are methods that can be further implemented to mitigate any changes. It is important to do so as to ensure the sustainable use of transportation methods. More specifically, transportation methods used to travel to higher education institutions.

1.2 Literature Review

A great deal of research on transportation methods exists to inform the study. Specifically, the available literature has helped to inform the direct purpose and intention of the study, allowing it to focus on utilizing existing findings to extend knowledge on the subject on sustainable transportation choices.

1.2.1 IMPORTANCE OF TRANSPORTATION

For one, the available literature justifies the importance of transportation methods in increasing sustainability, specifically in reducing carbon dioxide emissions (Klein-Banai & Theis, 2011; Saelens, Sallis, & Frank, 2003). Multiple sources identify that different modes of transportation such as automobile, public transit, or active transit affect an individual's carbon footprint and the amount of carbon dioxide in the atmosphere (Klein-Banai & Theis, 2011; Saelens, Sallis, & Frank, 2003). Others evaluate the influence of specific forms of transportation such as walking, cycling, and public transit; gathering that the use of these more sustainable forms of transportation are beneficial not only in their reduction of carbon dioxide emissions but also the quality of the local environment (McGovern, 1998; Saelens, Sallis, & Frank, 2003). A study conducted by Klein-Banai and Theis (2011) in fact, investigates an urban university's ecological footprint and effect in the larger picture of climate change, gathering that post-secondary institutions act as micro-social-climates that are indicative of larger scale trends. From this basis, it was interpreted into our study that different modes of transit play a role in achieving sustainability and that the issue can be productively studied through the context of a university.

1.2.2. IMPORTANCE OF POST SECONDARY INSTITUTIONS

Previous studies indicate that institutions of higher education have the capacity to implement policy changes surrounding transportation (Jauch, Ogden, Betzen, Stumpff & Bigley, 2009; Hancock & Nuttman, 2014). A study conducted by Hancock and Nuttman (2014), investigated the challenge surrounding sustainable transportation on a university campus, finding distance, time, and convenience to be major barriers to sustainable transportation. The noted barriers informed our study to further understand the decision surrounding transportation choices and the importance of transportation to the students and staff. Moreover, higher education institutions have the ability to implement change to further reduce their environmental impact. A study conducted by Balsas (2003), investigated the changes required to encourage sustainable transportation within college campuses. Changes such as an increase modes of active transportation such as walking and biking were beneficial *. Balsas (2003) found that college campuses are "de-marketing" automobile commuting through promoting alternative transportation modes. The switch to alternative transportation is dependent on understanding and awareness. McGovern (1998) found that there is an increasing concern surrounding sustainable transportation in urban areas due to the evident relationship between congestion and air pollution. Both Balsas and McGovern further inform our study by outlining the importance of sustainable transportation.

1.2.3 FACTORS INFLUENCING TRANSPORTATION CHOICES

Available research has investigated factors that can influence transportation methods. In many cases, this is identified as Transportation Demand Management, in which a specific body seeks to motivate a population to choose a form of transportation over another, for the benefit of a greater good (Beutel et al., 2015). Studies have reviewed the influence of reserved parking spaces and priority lanes, distance and location of commute, social norms, and parking pricing on transportation choice (Beutel et al., 2015; Dong, Ma, & Broach, 2015; Ng et al., 2014). Research has also been conducted which specifically investigates a mode of transportation, such as public transit, to review which factors can yield the greatest influence on public transportation usage (Ferris, Borning, & Fox, 2011). These sources were extremely important in compiling not only the research purpose and scope, but also in informing the best choices for survey questions and answer options. As the format being used was a closed-ended survey, it was extremely important to understand what possible answers should be provided for each question. In questions that asked participants which factors most motivate their choice of transportation, for example, it was integral that the available answers be informed by existing studies as to properly capture participants' experiences.

Motivation surrounding transportation modes can be further investigated through a study conducted by Oberhofer and Furst (2013). The study examined the themes of sustainable development and environmental policy, and the effects that they have had towards transportation strategies (Oberhofer & Furst, 2013). In the end, the study found that there is awareness surrounding sustainable development however, of the population studied, environmental performance was lacking (Oberhofer & Furst, 2013). This indicates that the factors perceived to influence transportation methods have no significant weight towards users decisions. However, sustainable values can be further understood through the study conducted by Kormos, Gifford, and Brown (2015), which examined social normative beliefs in conjunction with environmental behaviours that influence transportation. The study found that there was a significant linear trend, indicating that prevalent social norms do indeed increase sustainable transportation decisions (Kormos, Gifford, & Brown, 2015). The disparities between the two studies highlights that the research was inconclusive, and that more research should be done to conclusively prove or disprove the influence of environmental behaviours.

As previously noted, parking spaces and parking prices have an influence towards transportation choice. These factors are seen in a dissertation by Ng et al. (2014), where the impact of prices were examined in regards to transportation mode choice and behaviour. The intent of the study was to find whether or not policy changes can impact a commuters transportation choice (Ng et al., 2014). In the end, the research found that parking prices can have a significant impact towards regulating transportation modes (Ng et al., 2014). Furthermore, a study conducted by Beutel et al. (2015) further analyzed the influence of demand towards reserved parking spaces and priority lanes. The study found that targeted incentives have the possibility to influence people's transportation behaviours (Beutel et al., 2015). Proving to be beneficial as it further informs our study, that behaviours are able to be altered to positively influence transportation decisions.

Lastly, a dissertation written by Ferris, Borning & Fox (2011) examined ways to improve the usability and ridership of public transit. The dissertation examined OneBusAway, which is a transit tool that provides real-time information to transit riders (Ferris, 2011). OneBusAway was created to reduce the barrier to widen the usage of public transit (Ferris, 2011). It was found that the tool improved the overall satisfaction of transit riders, and saw a reduction in wait times (Ferris, 2011). This will further inform our study as it provides a framework that universities and communities can utilize to see a change towards public transit usage.

1.2.4 TRANSPORTATION AT POST-SECONDARY INSTITUTIONS

While research on transportation methods was broad and informative, it was generally investigated in city-wide or neighbourhood contexts. Literature on transportation in the context of post-secondary institutions was less prominent. Most sources than investigated transportation in this context were qualitative studies such as those that discussed the potential for active transportation at a metropolitan commuter campus (Rybarczyk & Gallagher, 2014). Others were mixed methods, utilizing statistics on UPass users at the University of British Columbia in conjunction with the qualitative effects that were seen. A study conducted by Rybarczyk and Gallagher (2014) looked at the potential for cycling and walking as active transportation methods for university campuses. There are many barriers that inhibit the use of bicycles. Rybarczyk and Gallagher (2014) found that safety and visibility were major concerns among participants. This can be further understood through the study conducted by Bonham and Koth (2010), which specifically looked at cycling culture at an Australian campus. The study found that in order to address the safety concerns of cyclists, many social and contextual changes must be made (Bonham & Koth, 2010). Moreover, a study utilizing global position system software conducted by Millward, Spinney, & Scott (2013) further investigated behavior surrounding walking among university students. The study examined the individual trips of the participants, and found that there is a wide variety of destinations that are used on a daily basis (Millward, Spinney, & Scott, 2013). The use of active transportation and the concerns surrounding cycling can further inform our study through providing insight into the barriers that are currently in place for many transportation methods.

Research indicates that affordability and convenience is the greatest barrier surrounding public transit ridership for university students. The University of British Columbia conducted a study that examined travel behaviour with the implementation of a UPass (Senft, 2005). The study found that ridership increased by 50 percent and single occupant vehicle usage decreased by 20 percent after the introduction of the UPass (Senft, 2005). A study conducted by Shannon et al. (2006), further strengthens the understanding of the influence of implementing a UPass system. This study found that the UPass system has the potential to reduce costs and increase the convenience for public transit, while ultimately increasing ridership (Shannon et al., 2006). However, Shannon et al. (2006), concludes that time remains a barrier for public transit as information regarding schedules can vary greatly. The study by Senft (2005) and Shannon et al. (2006), both provide an important basis to understanding the advantages of a mandatory UPass for university students.

1.2.5 DALHOUSIE- AND HALIFAX-SPECIFIC RESEARCH

At Dalhousie in particular, there is existing but limited research that has been conducted on transportation methods. Specifically, the DalTRACK office has investigated issues related to advancing active transit and has, in the past two years, gathered quantitative data on methods of transportation in conjunction with demographic data on transportation users (Dalhousie Transportation Collaboratory, 2013). The latter, however, has not been released at the time of this study. Although conducted as part of the University, the DalTRACK study investigated transportation users in Nova Scotia as a whole (Forbes & Ahsanul Habib, 2013). Although this does not provide information specific to the University context, it still provides relative data to inform the study from a provincial context. The study finds that the majority of commuters are using personal automobiles, with under 20% using public or active transportation methods. (Forbes & Ahsanul Habib, p. 4, 2013) Additionally, a Dalhousie-specific study on the results of the Dalhousie Commuter Survey investigates general responses from commuters (Davidson, 2016). The study identifies that time, distance, weather, and safety were the primary barriers to transportation (Davidson, 2016). Incorporating this existing knowledge on transportation habits and barriers of Dalhousie students and Halifax residents was extremely valuable in creating a useful survey.

1.3 Goals and Objectives

The overarching objective of the study is to gain knowledge on the socio-economic influences of transportation choices, and to expand on the understanding of how to create more sustainable transportation systems. The previous research on the topic of transportation amongst university students indicates that methods are often influenced by a variety of factors. It was found that these determining factors did not have a strong focus on the socio-economic influences, yet many had a focus towards the impact on the environment. The following study intends to find a relationship between socio-economic characteristics and the primary method of transportation among undergraduate students at Dalhousie. Ultimately the research will provide an important perspective as it allows institutions of higher education the ability to understand not only the importance of transportation in a post-secondary institution's ecological footprint but also the factors that influence transportation habits, specifically of University students. This new understanding will support institutions in creating programs and policies to better meet the needs of their population. In summation, the project itself will provide a new and necessary perspective surrounding the transportation choices of students, while simultaneously building upon the previous research conducted.

1.4 Statement of Purpose

The purpose of this study is to understand whether or not socio-economic factors have a role in the decision of transportation methods among undergraduate students at Dalhousie University. The following report will provide an in depth analysis, that will either address the research question or conclude that more analysis is required. The research question being, how do socio-economic factors correlate with the transportation methods of Dalhousie University undergraduate students? The question itself provides the framework of the study, which was further developed to find a connection between socio-economic status and method of transportation used. The report will further explain the methods used to fulfill the intended objectives of the study. Moreover, the report will examine in detail the results accumulated throughout the methodological procedures. Finally, the results generated will provide the opportunity to examine the connection between socio-economic distinctions and primary mode of transportation. In the end, the report intends to provide an analysis that further strengthens this area of research.

2.0 METHODS

2.1 Description of the Study Design

The research tool of an online survey was chosen, as this research method allows for a wide range of participants to complete it. The survey was generated through an online questionnaire using the GoogleForms Software. The survey included structured questions in the format of single-response and categorical-responses to provide quantitative data. Categorical-responses are beneficial in data analysis as they allow for comparison between responses and provide a complete range of answers (Palys & Atchison, 2014). As stated by Palys & Atchison (2014), exhaustive and mutually exclusive are two characteristics that categorical-response items must have. The survey questions are exhaustive by covering all categories or providing an "other" option for any questions that might be limiting to responses. The categories that include numbering are mutually exclusive, in that they do not have a number in two categories which would provide confusion to the surveyor and error in our results. Overall 12 questions were created to obtain the necessary information from the sample population.

The survey was distributed to a sample frame of the population which includes all 14,685 students enrolled in undergraduate programs at Dalhousie (Dalhousie, 2016). The probabilistic sample for our project is 0.5% of the target population, the equivalent amount of which is 73 individuals. The data was

then surveyed and collected into a third party program. Using this system the data was analyzed using a chi-squared test. This presented the relationships and significances between the data collected.

2.2 Justification of the Study Design

The survey method was chosen in order to increase comfort and willingness of participants to contribute to the research. The format of an online survey also supported a minimal environmental footprint for the research through the elimination of unnecessary paper. The sample size of 73 was chosen because of its appropriate size for the chi-squared tests. A larger sample may have an impact on the significance of the results from the data while a smaller sample may have affected the validity of the research. The chi-squared test was chosen due to its ability to show statistical relationships considering the data was in qualitative format. Using SPSS systems as the software for the statistical analysis was an asset because of the supervising professor's familiarity and the program's ability to display information in clear ways for anyone who is not fluent in statistical analysis.

To ensure that there are no ethical concerns there will be consent and confidentiality in each survey. Each participant will be asked if they wish to fill out a survey, upon their response consent (or nonconsent) will be obtained. Confidentiality will be maintained in our project by not asking the participant any identifying information such as their name or identification number.The lack of personal identity information, will minimize any ethical concern that could arise in the data collection process. To further ensure that our survey is ethically correct, our group had analyzed the context of each question in the survey and submitted an ethics review application to the University (see Appendix B). We investigated including an way for participants to withdraw their information, however it was found that this was not possible due to the online, inperson nature of the survey. Creating this option under the aforementioned conditions would have compromised the anonymity of the research and was thus avoided.

2.3 Procedure

The survey was conducted at the Dalhousie Killam Library in Halifax, NS during an average school day. The procedure took place on March 15th, 16th and 17th between 11 and 2PM in attempt to gather and adequate sample of Dalhousie's full-time undergraduate population. Every tenth person that walked through the main doors of the library was asked if they wished to fill out a survey. If the person declined to fill out the survey, then the counting proceeded, starting at one. If the person agreed to fill out the survey, then the counting stopped to allow time assist the participant if they had any questions. To

ensure that there was no ethical concern, the recruitment script (Appendix B) was read in full to allow for understanding and consent. Following this, the participant was presented a laptop that had the online version of the survey available for them to fill out. This process was repeated until 73 completed surveys were obtained.

2.4 Data Analysis

The survey provided us with quantitative data about different socio-economic factors that motivated students choice of transportation methods. The data collected was analyzed for significance using a chi-square test in the statistical software system SPSS (Statistical Package for the Social Sciences). The significance level of a = 0.05 (95% chance of being statistically correct) was used to reduce any risk that the results were due to chance. This analysis provides insight about the observed distribution and how it compares to the expected. In other words, it tests the null hypothesis that the variables are independent of each other. A significant result can provoke discussion on why the observed distribution did not occur as expected which is specifically helpful when determining how different motivators affect transportation.

2.5 Reliability and Validity

The survey was conducted at Dalhousie's Killam Library on the Studley campus. This location was determined due to the dynamic of people who have access to the library to ensure random selection and prevent systematic error. Locations like the LSC or Rowe would result in too many of the participants being part of a similar faculty which would result in an inaccurate representation of the population. Although complete random selection has not been achieved, the error involved has been minimized in an attempt for equal probability and to validate the research. The chi-squared test was chosen as the method for analysis of the data because of its effectiveness in testing the independence of the observed distributions. Chi-squared is prefered over the other methods of statistical analysis because of its use on nominal data as well as being easy to interpret. Due to this it was the best choice considering our group used a survey to collect the data. SPSS software systems was chosen to analyze the chi-squared tests because of its comprehensive management tools, its simplification of graphical displays, and the supervising professors fluency in using it.

2.6 Limitations and Delimitations

One limitation that was faced in relation to our sample size was that it focused on the students located on the Studley campus at Dalhousie, since no data was taken from the Carlton or Sexton campus. We did not ask participants which campus they were from, providing a further limitation, as our data may not exclusively represent the Studley campus. Other limitations were due to the fact that classes were in

session during the time when the survey was conducted, meaning the same students could have been asked to participate on different days.

The study was also limited by the lack of resources available. Having funding for motivators such as food or a drawn prize may have increased participation in the survey. Additionally, the lack of time available to conduct the study limited the sample size and therefore may have created potential inaccuracies.

A delimitation of our research was size of the study. We chose to only collect 73 surveys as, mentioned previously, that is a sample size of 0.5% of Dalhousie's undergraduate population. The specific focus on the undergraduate population also created a delimitation, along with the focus on Studley campus. The specific concentration on Dalhousie itself provided boundaries for the study to work within.

3.0 RESULTS

3.1 Total, Primary and Preferred Mode of Transportation

Following the completion of the surveying period, the 73 surveys were analyzed to determine what specific socio-economic factors motivated Dalhousie undergraduate students' decisions of transportation methods to campus. Table 1 represents the total usage, primary mode and preferred mode of each transportation methods for the 2017 school year. If an individual had more than one primary mode of transportation (i.e. walked 40% of the time and used public transit 40% of the time), then both methods were considered a primary mode. This happened a total of five times, resulting in a total of 78 different primary modes of transportation. In this table, preferred mode of transportation only includes the 73 answers provided from the survey and is described to be the mode chosen if there is no limitations or barriers.

Table 1. The total usage, primary mode and preferred mode of each transportation method represented as a percentage. The largest method of transportation for each category is highlighted in red.

	Total	Primary	Preferred
Walking	36.7	34.6	37.0
Biking	0.1	-	13.7
Public Transit	35.6	38.5	8.2
Driving	27.3	26.9	38.4
Other	0.3	-	2.7

Primary mode of transportation is compared to that individual's preferred mode of transportation in Figure 1. To do so, the preferred method was duplicated for each of the five co-primary methods. Upon analysis, 28.2% of the population preferred their primary mode of transportation and the remaining would prefer to use a different method. Specifically, 48% of the people that walked preferred to walk, and 43% of the people that drove preferred to drive. However, the difference is largely due to public transit where 0% of the people who use it preferred to use it. Due to the large difference in primary and preferred methods of transportation, the factors that drive people to choose a specific mode must be considered.
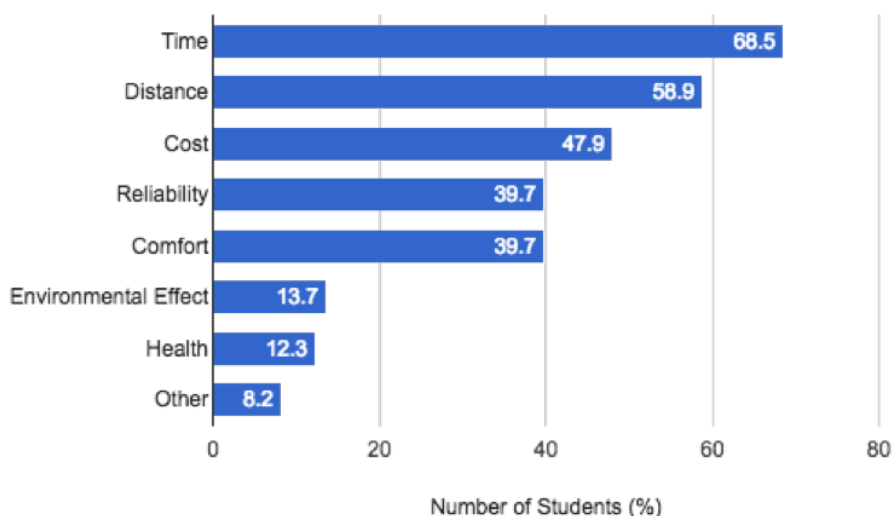

Figure 1: Preferred mode of transportation categorized based on the individual's primary mode of transportation (x-axis) and represented as a percentage.

3.2 Motivators for Transportation Choice

Secondly, we compared the socio-economic factors that motivate the population's choice of transportation to try and understand the difference between people's primary and preferred choices. The results are represented in Figure 2 and the top four factors that motivate choice of transportation are time, distance, cost, and reliability. These factors are analyzed further in Figure 3 by categorizing the different responses by primary mode of transportation. To do so, the same process was used when comparing primary and preferred mode of transportation. In the sense that, the comparison response was duplicated for each of the five co-primary methods for a total of 78 responses. However, two individuals did not respond to the questions regarding income and distance, which resulted in a total of 76 responses in those categories. A chi-square test was conducted on each of the top four motivators to test if our results are as expected or if there is a significance in the observations.

Figure 2. Different factors that motivate student's transportation methods at Dalhousie University represented as a percentage.
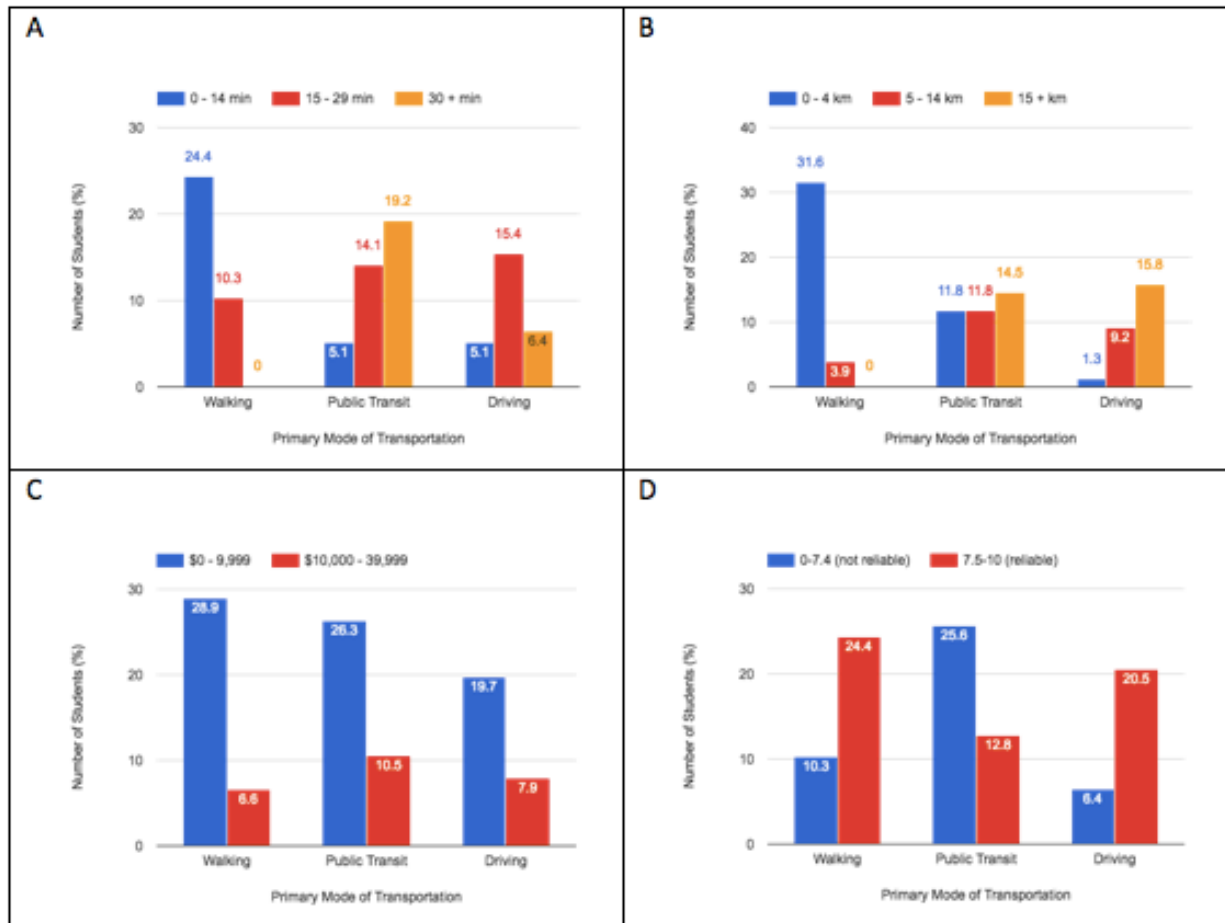
Figure 3. Graphical representation of the top four factors that motivate transportation methods: A. Time of commute to campus, B. Distance of commute to campus, C. Individual Income, D. Reliability of primary mode of transportation. All categorized based on the individual's primary mode of transportation (x-axis) and represented as a percentage.

3.2.1 TIME AS A MOTIVATOR

As the top motivation for choice of transportation method, time was found to have a significant relationship with transportation in the sense that the expected results did not equal the observed. With a p-value<0.001, it can be stated that there is a 99.999% chance in being statistically correct. Results show that public transit takes students the longest amount of time to commute to campus with 50% of public transit users taking 30 minutes plus to arrive to campus. Walking takes students the least amount

of time to arrive to campus with 70% taking 0-14 minutes. These results are also dependent on the distance students live from campus.

3.2.2 DISTANCE AS A MOTIVATOR

Distance, the second largest motivator, was found to have a significant relationship with transportation. This means that the expected results did not equal the observed with a p-value<0.001, these results have 99.999% chance in being statistically correct. Results show that a similar percentage of people who drive and take public transit live 15 km or more away from campus. However, on average it takes a longer amount of time to arrive to campus when public transit is used (Figure 3A) .

3.2.3 INCOME AS A MOTIVATOR

Income did not have a significant relationship when categorized among transportation methods (p>0.05). For this reason, we analyzed different areas of our study and noticed that about 47% of students are unemployed, and 44.5% of student rely on guardians as a source of money for University expenses. Figure 4 represents the different sources of money that students use to pay for much of their University Expenses with guardians and student loans being the top two. With this information, it can be inferred that financially dependency may also be a factor.
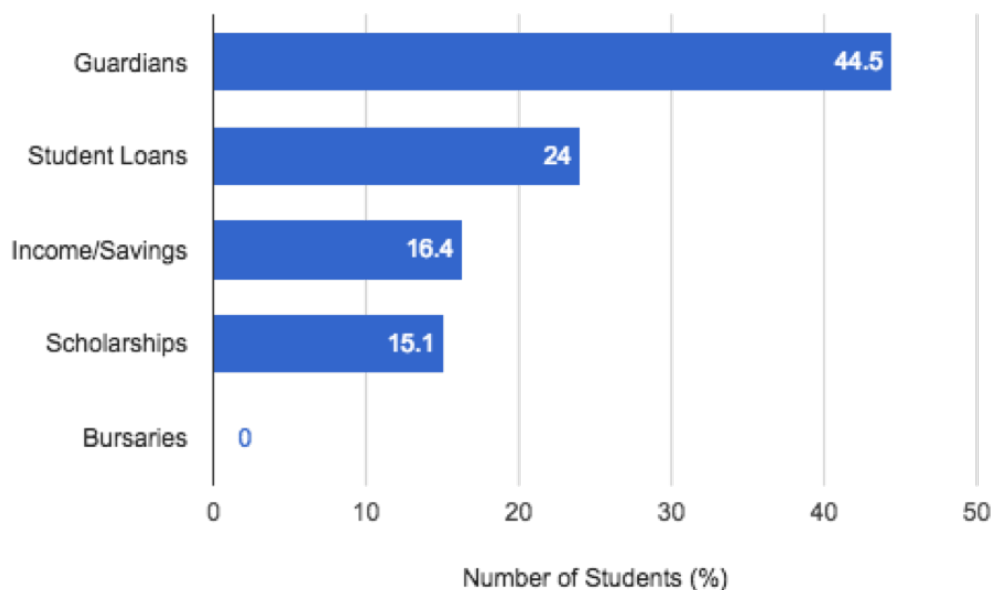

Figure 4.Different sources of money that students use to pay for the majority of their university expenses, represented as a percentage.

3.2.4 RELIABILITY AS A MOTIVATOR

Reliability as a motivator when choosing a specific transportation method was found to be significant (p=0.002). Thus, the observed responses did not equal the expected responses. Reliability was categorized as 75 -100% of the time, and unreliable was categorized as 0-74% of time to campus. Both walking (70% of the time) and driving (76% of the time) were considered a reliable source of transportation. However, the difference is due to public transit when students considered it an unreliable source of transportation 67% of the time.

4.0 DISCUSSION

The purpose of the research project, was to help identify the underlying factors that impact Dalhousie undergraduate student's transportation habits. With this information our group was able to discover what seemed to be the determining factors that affected the choice of transportation of the undergraduate student body.

4.1 Summary of Research Question

Although other studies have been conducted highlighting transportation and Universities, none were as specific as the study conducted in this report. Additionally, this report will be the first, of its kind, that will be available to the public and focused on Dalhousie University. Because transportation methods are a considerable contributing factor to a university's ecological footprint (Klein-Banai & Theis, 2011), we believe Dalhousie University has the capacity to decrease its carbon footprint, along with increasing more accessible transportation methods to and from its campus.

4.2 Summary of Results

Students in our survey reported that time, distance, cost and reliability were the four largest factors that affected their choice of transportation to and from the Dalhousie campus. The income vs transportation method chi-squared test did not prove to be statistically significant, leaving time, distance and cost as the primary factors affecting transportation choice. In some ways, the results of the survey, particularly with respect to students' preferred option, were predictable. Biking to school appeared to be a choice that not many students had really considered, even though for a larger percentage of respondents it was a preferred option. The survey revealed that for the students who lived too far away to walk and did not have a car, using public transit was a necessity but was preferred by no one. It is likely that if these students had the ability to drive to school, they would prefer to do so.

4.3 Analysis of Significant Findings

Although the income level of students did not play a significant role in their choice of transportation, finances likely dictated where students lived and consequently, their proximity to the Dalhousie campus. The results indicated that 47% of the students surveyed were unemployed and a total of 44.5% of those surveyed relied on parents or guardians for their financial support. From these statistics, it might be inferred that the degree of financial support provided could influence where students were able to find housing and thus had a bearing on their transportation choices. As a result, it was not surprising to find a high percentage of students used walking as both their primary and preferred options of transportation to campus. In fact, it would have been surprising to find that students who lived within walking distance of campus preferred to drive.

While no one reported their primary transportation method as biking, 13.7% of students reported they would prefer to bike if there were no barriers. Currently, Dalhousie University has many bike-friendly opportunities, so it would be no great cost to promote an increase in cycling commuters. This finding would suggest that increasing awareness around the cycling facilities, such as the Dal Bike centre, where students can rent bikes for free might motivate more students to choose cycling. The Mona Campbell building also has an indoor bike storage room with lockers and showers and additional outdoor storage racks. Furthermore, Dalhousie could consider snow removal around the outdoor bike racks in the winter to help promote all season cycling. For students to alter their transportation choices and choose cycling, an awareness campaign would likely be required. Consideration should also be given to how the city could be made more hospitable to cyclists.

While 38.5% of students surveyed take public transit, zero identified it as their preferred mode, of those who rated transportation as their primary mode of transport. This finding raises the question of why public transportation is so disliked by students. According to our survey, the most common response was that students found public transportation unreliable. As income versus transportation method did not prove to be statistically significant, we can only speculate that other factors, such as the mandatory UPASS which provides students with unlimited 'free' transit, might have contributed to the unexpectedly high ridership numbers. It would be reasonable to conclude that a student would use the 'free' transit system rather than paying for a cab or investing in a car, despite the extended duration of trips and frequent unreliability.

A statistically significant group of students surveyed – 26.9% -- used cars as their primary mode of transportation to and from the Dalhousie campus. Moreover, 38.4% (exactly the percentage of students

who take public transit) chose driving as their preferred option. While these statistics are understandable, they are discouraging since cars cause congestion (slowing down the buses) and pollution, and are generally the least sustainable option available. In order to reduce the number of cars on campus and improve the University's ecological imprint, Dalhousie should give serious consideration to instituting changes that would promote more sustainable transportation options and make driving to school less attractive to students.

4.4 Considerations

The survey found that students considered public transit an unreliable source of transportation 67% of the time; however, public transportation is likely to be the most reasonable alternative to driving for those students living far enough away from campus to need some form of motorized transportation. Considering the high percentage of students in our survey who find Halifax Transit unreliable, consideration should be given to instituting changes that would make transit service more dependable. Currently, Halifax Transit is in the midst of a pilot project involving Gotime, a live tracking feature. In addition, they have begun adding voice-stop announcements with a visual banner to display the stop name. While Gotime and the increased accessibility features are a step in the right direction, Halifax Transit should investigate the feasibility of bus-only lanes on highways, also known as Bus Rapid Transit, to reduce trip duration in addition to reducing the amount of time idling.

Halifax Transit could also consider a scanning pass system to enable data collection. Currently, students enrolled in post-secondary educational institutions around the HRM are given a UPASS sticker to be placed in their student card. Every time students use the bus they simply show the sticker to the bus driver and proceed onto the bus. This system of student passes does not allow for any data collection or analysis of the frequency with which students use the buses, the numbers of students who use public transit, or where they might be located. If Halifax Transit were to consider implementing a pass-scanning system to enable better data collection, more targeted changes could be identified.

Dalhousie could also give more serious consideration to changes that would reduce the number of students driving to school. While discriminatory practices should be avoided, the university could consider implementing a test to determine commuting distance and award parking passes only to students commuting from areas beyond normal transit routes. While such a change would no doubt be met with considerable resistance, an awareness campaign based on the need to achieve sustainability objectives, coupled with changes to improve the reliability of Halifax Transit, could be successful in reducing the number of cars on campus.

4.5 Examination of Findings that Failed to Support the Hypothesis

When conducting a Chi- squared test, the null hypothesis is that the variables being tested are independent of each other. The hypothesis for this study was that the tested variables would be found to be dependent on each other. As previously stated, Income versus Method of Transportation was not found to be statistically significant. Consequently, this means that Income does not depend on Mode of Transportation and vice versa, thus failing to support the alternate hypothesis. We would speculate that the results were not significant because of an inadequate sample size (N=73). Alternatively, Mode of Transportation could in fact not be dependent on Income, as there could be underlying lurking variables, such as the UPASS, that have a greater influence on Mode of Transport than previously thought.

5.0 CONCLUSION

Overall, this project aimed to gain a more detailed understanding of how Dalhousie University students commute to Studley campus and the influences motivating their choices. In understanding these influences the University and Municipality can work to better support and promote more accessible and sustainable modes of transportation. As previously mentioned, Dalhousie could implement policies that would discourage students from driving to school if they did not need to, as well as encourage students to use more active forms of transportation.

Based on the research and results compiled in this study, Dalhousie can aim to make sustainable changes that will influence the transportation habits of students in the future. With Halifax being a city home to multiple universities, there is the possibility that changes made at Dalhousie, as at other institutions, could influence the city to make sustainable changes to its transportation methods as well. As mentioned previously, by conducting further research on transit ridership in the HRM, bus services have the potential to become more reliable. This would be beneficial as none of the participants listed bus transit as their primary, or most reliable method of transportation. Furthermore, this research we hope can be built upon, with more in depth research as to why Dalhousie students choose the methods of transportation that they do. Through further research such as this as well as productive changes, Halifax as well as Dalhousie University can make the transition into becoming a more sustainable community.

6.0 ACKNOWLEDGEMENTS

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8.0 APPENDICES

Appendix A. Student Surve

ENVS/SUST 3502 SURVEY

1. What is your gender?
   a. Male
   b. Female
   c. Non-Binary/Gender Fluid
   d. Prefer not to say

2. How old are you?

   Age: _____

3. Do you have any financial dependents (dependent = An individual for whom you are financially responsible)?
   a. Yes
   b. No

4. Are you employed?
   a. Part-time/Seasonal
   b. Full-time
   c. Unemployed

5. What percentage (adding up to 100%) do you use each mode of transportation to commute to campus?

Method:	Percent:
a. Walking	%
b. Biking	%
c. Public Transit	%
d. Driving	%
e. Other: _____	%
Total Percentage	**100%**

6. On a scale from 0 (not reliable) to 10 (fully reliable), what percentage of the time is your primary mode (method indicated with the highest percentage in question 5) of transportation reliable?

0	1	2	3	4	5	6	7	8	9	10

7. How far from campus do you live (if necessary, refer to provided map)?
   a. 0-4km
   b. 5-14km
   c. 15-29km
   d. 30-60km
   e. Over 60km

8. How long is your commute to campus, on average?
   a. 0-4min
   b. 5-14min
   c. 15-29min
   d. 30-60min
   e. Over 60min

9. Check the factors that motivate your choice of transit method(s) when commuting to school.
   a. Time ☐
   b. Cost ☐
   c. Distance of commute ☐
   d. Reliability ☐
   e. Comfort ☐
   f. Effect on the environment/personal morals ☐
   g. Health ☐
   h. Other _____ ☐

10. What is your annual income (salary and/or allowance)?
    a. $0-9,999
    b. $10,000-19,999
    c. $20,000-39,999
    d. $40,000-60,000
    e. Over $60,000

11. How do you pay for the majority of your university expenses?
    a. Parents/Guardians
    b. Student Loans/Line of Credit
    c. Scholarship (academic-based)
    d. Bursary (income level-based)
    e. Pay from personal income/savings

12. If there were no barriers, which mode of transportation would you prefer to commute to campus?
    a. Walking
    b. Biking
    c. Public Transit
    d. Driving
    e. Other: _____

RESEARCH ETHICS BOARDS APPLICATION FORM

Section 1 has been discluded for the confidentiality of the researchers.

SECTION 2. PROJECT DESCRIPTION

2.1 Lay summary

2.1.1 In lay language, describe the rationale, purpose, study population and methods. Include the background information or literature to contextualize the study. Mention what new knowledge is anticipated, and whether this is a pilot project or fully developed study. [500 words]

The problem at hand, is how can Dalhousie University create an environment that is more sustainable, as a whole. An aspect that we will be focusing on, is the issue of transportation, and how the students at Dalhousie get to and from Studley campus. The objective of the research project is to determine how students are getting to school, meaning which method of transportation they use, and why that method in particular. More specifically, we want to know if there are specific socio-economic factors that influence students to use the method of transportation that they do. This is important, specifically for Dalhousie, as, if there is information and data on how and why students commute to school, there is the opportunity to make changes that encourage and promote more active modes of transportation. The data from this research can contribute to the decision making process of what can be done to create a more environmentally friendly and sustainable campus, here at Dalhousie. The scope of this project will be limited to undergraduate students, including graduate students, as well as staff, would provide too much information for the level of research that is being done.

2.1.2 If a phased review is being requested, describe why this is appropriate for this study, and which phase(s) are included for approval in this application.

[x] Not applicable

2.2 Research question

State the hypotheses, the research questions or research objectives.

What socio-economic factors influence how Dalhousie students get to school?

2.3 Recruitment

2.3.1 Identify the study population. Describe how many participants are needed and how this was determined.

Study Population: Undergraduate students on Dalhousie studley campus

This study would need 50 participants. This number was determined through analyzing the current Dalhousie undergraduate (roughly 13,000) population and deciphering which number will have the most diversity amongst individuals. A determining factor that helped with this decision, was also the likelihood to reach a larger population. With surveying a population of 50, would provide the opportunity to accurately sample a mix of individuals, and find a correlation between socio-economic factors and methods of transportation. If the population size was fewer than 50, it would significantly hinder the ability to reach the intended outcomes of the project.

2.3.2 Describe recruitment plans and append recruitment instruments. Describe who will be doing the recruitment and what actions they will take, including any screening procedures. Describe and justify any inclusion / exclusion criteria.

In order to recruit individuals to participate in the research project, two to three group members will be surveying individuals as they pass through the Killam library. This will be done in a professional and friendly manner. Through asking every 10th person if they are willing to participate in a quick survey for a class project. Once an individual has consented to participating in the survey, the team members will bring the participant to the computers set-up with the surveys on them. The screening procedures involved to assess whether or not the participant meets the criteria, will be done through the preliminary general knowledge questions in the survey. Seeing as how the project has a focus on undergraduate students, if an individual does not identify as one, we will not include that survey in the research project.

2.3.3 Describe any community or organizational permissions needed to recruit your participants (attach support letters). Describe any other community consent or support needed to conduct this research. (If the research involves Aboriginal participants, please complete section 2.10).

[x] Not applicable

2.4 Informed consent process

2.4.1 Describe the informed consent process, including any plans for ongoing consent (how and when the research will be described to prospective participants, by whom, how the researcher will ensure prospective participants are fully informed). If non-written consent is proposed, describe the process. Address how any third party consent (with or without assent) will be managed. Append copies of all consent/assent documents, including oral consent scripts.

The formal consent process will be the initial moment when the participants are asked if they would like to participate, however, there will be a few sentences at the beginning of the survey explaining the purpose of the survey. The explanation would be similar to this - Through agreeing to completing the survey, you are consenting for this information to be used for a research project for ENVS/SUST 3502. Overall, with the participants providing verbal consent would be sufficient enough in this process, as they are not coerced into participating in the study.

2.4.2 Discuss how participants will be given the opportunity to withdraw (their participation and/or their data) and any limitations on this.

The only opportunity that will allow participants to withdraw is at the beginning of the study, when asked to participate in the survey, participants are more than able to decline when asked if they would participate. However, once the survey has already been completed the data cannot be withdrawn due to anonymity factored into the study and the survey itself. Since there are no opportunities within the survey to provide name or any other contact information the ability to withdraw any data would compromise the nature of the study.

2.4.3 If an exception to the requirement to seek prior informed consent is sought, address the criteria in TCPS article 3.7A.

[x] Not applicable

2.5 Methods and analysis

2.5.1 Describe the study design, where the research will be conducted, what participants will be asked to do and the time commitment, what data will be recorded using what research instruments (append copies).

The survey will be conducted on Wednesday, March 8th, 2017 at the Dalhousie's Killam Library in Halifax, NS. The procedure of the test will take place on an average school day close to the lunch hour to attempt to gather an adequate sample of the Dalhousie undergraduate population. The place of the survey is decided due to the dynamic of people who have access to the library. Locations like the LSC or Rowe would result in many participants of a specific faculty which would not be a proper representative sample. The time of day was decided to optimize the amount of traffic in the area in hopes to also increase the representation.

Every 10th person that walks into the main doors of the library will be asked if they wish to fill out a survey (Appendix A). This will be done until fifty surveys are obtained. When a person declines, the counting will continue and when a person agrees, the counting stopped until after that person had completed the survey. The counting will stop to allow time to talk and assist the participant while they filled out the survey. The target of the survey is towards undergraduate students at Dalhousie

University, therefore the first question of the survey addresses this and the survey will stop after that question if the participant does not meet that condition.

2.5.2 Describe plans for data analyses.

2.5.3 Describe any compensation that will be given to participants and how this will be handled for participants who do not complete the study. Discuss any expenses participants are likely to incur and whether/how these will be reimbursed.

Since this is a fairly small survey, and will not require a significant amount of time for the participants, the group has chosen not to compensate participants. The participants will not incur any expenses, therefore, will not be required to be reimbursed.

2.5.4 Describe and justify any use of deception or nondisclosure and explain how participants will be debriefed.

[x] Not applicable
2.5.5 Describe the role and duties of local researchers (including students and supervisors) in relation to the overall study. Identify any special qualifications represented on the team relevant to the proposed study (e.g. professional or clinical expertise, research methods, experience with the study population, statistics expertise, etc.).
[x] Not applicable

2.6 Privacy & confidentiality
2.6.1 Describe any provisions for ensuring privacy and confidentiality (or anonymity). Describe who will have access to data and why, how data will be stored and handled in a secure manner, how long data will be retained and where. Discuss any plans for data destruction and/or de-identification.
[ ] This research involves personal health records (ensure section 2.12 is completed)

The steps in which the group took in creating the survey to ensure privacy and confidentiality, was through creating questions that provided results such as age and employment status. Those questions alone would not be able to provide any distinguishing characters to identify the participant, and will further increase the anonymity of the individual. Throughout the process, the only individuals who will have access to the data are the group members that are conducting the research project and once the data has been compiled and analyzed the professor and teaching mentors will have access to the

data. The data will be stored on one group member's laptop; this would limit the potential risk of any other person obtaining the results of the survey. If we were to share the data on a google doc, or any other document sharing website could potentially increase the possibility of someone other than the group members obtaining access of the information. Furthermore, if we are unable to use the web-link method to survey participants, the physical paper copies will be protected in an envelope and kept secure by one group member. If the situation arose, that it was necessary to have paper copies to destruct the data, the step would include potentially shredding any relevant information.

2.6.2 Describe how participant confidentiality will be protected when research results are shared. Discuss whether participants will be identified (by name or indirectly). If participants will be quoted address consent for this, including whether quotes will be identifiable or attributed.

Confidentiality and anonymity is one of the main concerns of this study. The survey has been deliberately created to have no possible way of identifying the individuals who have participated. The analysis and final report does not require identifying any of the participants, either by name or indirectly. This is because we will be using quantitative data and assessing the values of each of the results in the survey. Throughout the entirety of the process, the identity of the participant will not be available or pertinent to the study.

2.6.3 Address any limits on confidentiality, such as a duty to disclose abuse or neglect of a child or adult in need of protection, and how these will be handled. Detail any such limits in consent documents.

[x] Not applicable

2.6.4 Will any information that may reasonably be expected to identify an individual (alone or in combination with other available information) be accessible outside Canada? This includes sharing information with team members, collecting data outside Canada, use of survey companies, use of software.

[x] No

[ ] Yes. If yes, describe how you comply with the University *Policy for the Protection of Personal Information from Access Outside Canada*, such as securing participant consent and/or securing approval from the Vice President Research.

2.7 Provision of results to participants

[x] Not applicable

2.8 Risk & benefit analysis

2.8.1 Discuss what risks or discomforts are anticipated for participants, how likely risks are and how risks will be mitigated. Address any particular ethical vulnerability of your study population. If applicable, address third party or community risk. Risks to privacy from use of identifying information should be addressed.

The potential risks or discomfort that might arise for participants would be a language barrier, as the survey itself would be written in english. If it came down to an individual not being able to understand the question or task because of language, we would not require there to complete the survey. That being said a possible method to mitigate this would be to have the survey available in an assortment of languages, however, that being said we are under the assumption that we will be able to reach the intended number of participants where we will not be required to formulate surveys in other languages. Another possible risk for the participants would be if someone potentially could see there answer for the question on personal income. This could be a risk as many people do not want that to be public knowledge. The risk of identifying personal income of participants would be mitigated through having participants complete the survey in an area that will not be easily accessible to view the results from people passing by. This could be done in a variety of ways depending on which method of survey we will use. If the group uses an online method and a laptop as the vessel to complete it, they will be set up in a manner that only the participant can view the information. A potential risk for the group through undertaking this research study would be participants not taking the survey seriously, as it is hard to know if they put truthful information.

If someone potentially saw there income – potential risk of knowing that information

2.8.2 Identify any direct benefits of participation to participants (other than compensation), and any indirect benefits of the study (e.g. contribution to new knowledge)

Once the study has been completed and the data has been analyzed, the group intends to create a website and email available for participants to reach out and obtain the results of the study. In this case the benefits of participation would be able to physically see the results and potential changes that could be made, and the direct involvement in the entirety of the project. Ultimately, this would be contribution to new knowledge to research on the topic. Many participants might find that their involvement as a positive experience.

2.9 Conflict of interest
[x] Not applicable

2.10 Research with Aboriginal peoples
[x] Not applicable – go to 2.11

2.12 Use of personal health information
[x] Not applicable

Appendix C. Chi Results

A.1 Time

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Primary Mode of Transportation * Time	78	100.0%	0	0.0%	78	100.0%

Primary Mode of Transportation * Time Crosstabulation

			Time			Total
			0 - 14 min	15 - 29 min	30+ min	
Primary Mode of Transportation	Driving	Count	4	12	5	21
		Expected Count	7.3	8.3	5.4	21.0
		% of Total	5.1%	15.4%	6.4%	26.9%
	Public Transit	Count	4	11	15	30
		Expected Count	10.4	11.9	7.7	30.0
		% of Total	5.1%	14.1%	19.2%	38.5%
	Walking	Count	19	8	0	27
		Expected Count	9.3	10.7	6.9	27.0
		% of Total	24.4%	10.3%	0.0%	34.6%
Total		Count	27	31	20	78
		Expected Count	27.0	31.0	20.0	78.0
		% of Total	34.6%	39.7%	25.6%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	31.626[a]	4	.000
Likelihood Ratio	36.086	4	.000
N of Valid Cases	78		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.38.

A.2 Distance

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Primary Mode of Transportation * Distance	76	100.0%	0	0.0%	76	100.0%

Primary Mode of Transportation * Distance Crosstabulation

			Distance			Total
			0 - 4 km	05 - 14 km	15 + km	
Primary Mode of Transportation	Driving	Count	1	7	12	20
		Expected Count	8.9	5.0	6.1	20.0
		% of Total	1.3%	9.2%	15.8%	26.3%
	Public Transit	Count	9	9	11	29
		Expected Count	13.0	7.3	8.8	29.0
		% of Total	11.8%	11.8%	14.5%	38.2%
	Walking	Count	24	3	0	27
		Expected Count	12.1	6.8	8.2	27.0
		% of Total	31.6%	3.9%	0.0%	35.5%
Total		Count	34	19	23	76
		Expected Count	34.0	19.0	23.0	76.0
		% of Total	44.7%	25.0%	30.3%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	37.926[a]	4	.000
Likelihood Ratio	47.122	4	.000
N of Valid Cases	76		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.00.

A.3 Income

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Primary Mode of Transportation * Income	76	100.0%	0	0.0%	76	100.0%

Primary Mode of Transportation * Income Crosstabulation

			Income		Total
			0-9,999	10,000-39,999	Total
Primary Mode of Transportation	Driving	Count	15	6	21
		Expected Count	15.8	5.3	21.0
		% of Total	19.7%	7.9%	27.6%
	Public Transit	Count	20	8	28
		Expected Count	21.0	7.0	28.0
		% of Total	26.3%	10.5%	36.8%
	Walking	Count	22	5	27
		Expected Count	20.3	6.8	27.0
		% of Total	28.9%	6.6%	35.5%
Total		Count	57	19	76
		Expected Count	57.0	19.0	76.0
		% of Total	75.0%	25.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	.938[a]	2	.626
Likelihood Ratio	.970	2	.616
N of Valid Cases	76		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.25.

A.4 Reliability

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Primary Mode of Transportation * Reliability	78	100.0%	0	0.0%	78	100.0%

Primary Mode of Transportation * Reliability Crosstabulation

			Reliability		Total
			0-7	8-10	
Primary Mode of Transportation	Driving	Count	5	16	21
		Expected Count	8.9	12.1	21.0
		% of Total	6.4%	20.5%	26.9%
	Public Transit	Count	20	10	30
		Expected Count	12.7	17.3	30.0
		% of Total	25.6%	12.8%	38.5%
	Walking	Count	8	19	27
		Expected Count	11.4	15.6	27.0
		% of Total	10.3%	24.4%	34.6%
Total		Count	33	45	78
		Expected Count	33.0	45.0	78.0
		% of Total	42.3%	57.7%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	12.015[a]	2	.002
Likelihood Ratio	12.218	2	.002
N of Valid Cases	78		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.88.