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MEMORIAL UNIVERSITY OF NEWFOUNDLAND ON-CAMPUS CYCLING STUDY

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Abstract: Cycling meets the criteria of strong sustainability and is one of the most ideal modes of transportation because it is health promoting, low cost, low pollution emitting, and low greenhouse gas emitting. The purpose of this study was to investigate what was needed to increase the participation in bicycling at the university in St. John's and thereby help address issues such as health, sustainability, climate change, and biodiversity loss. This objective was achieved by, in sequence, studying places that have more advanced cycling cultures and how they achieved this, interviewing experienced cyclists at Memorial University of Newfoundland (MUN), surveying members of the university community, polling students and employees within the Faculty of Engineering and Applied Science since this is where the largest proportion of campus cyclists are located, and considering if there were any existing places in the engineering building where indoor bicycle parking could be an economical option. It was concluded that important improvements to support cyclists to the campus would include indoor secure bicycle parking, facilities to wash up, especially for those commuting long distances, more outside bike racks, and separate bike lanes with lighting for bicycling after dark. A few deficiencies were discovered in the survey that could be improved upon if future work is undertaken or other universities decide to follow this approach.

1 INTRODUCTION

Much has been written on the topic of sustainability and it is necessary to distinguish between weak sustainability, which is most prevalent in the literature, and strong sustainability. The former is especially related to incremental changes such technological improvements and increases in efficiency that will slow the rate of environmental degradation, and the latter is focused on transformative changes and low-consumption lifestyles that will bring the world to a place where resource constraints and the wellbeing of humans and other species that share the planet are respected (Lorek and Fuchs, 2013).

Using renewable energy, renewable resources and bicycles for mobility are all elements of strong sustainability. Bicycling is one of the most environmentally friendly forms of transportation and while it can make a great contribution to the health of its user it does not damage the health of others (Gatersleben and Appleton, 2007). This is important because environmental justice requires that those engaged in active transportation, such as walking and cycling, be given higher priority than those who employ more polluting means of transportation, and environmental justice is the most important aspect of strong sustainability (Pawlowski, 2008). A carbon tax beginning in Canada in 2018 should help address this current inequity.

Transportation along with energy and agriculture are the main areas where the habits of sustainability need to be introduced (Zhang et al. 2015). Bicycling is a key component of sustainable mobility and it is an area where progress has been made due to the persuasion of municipalities and universities though overall universities have played the greater role in introducing, maintaining and promoting bicycle use (Beuhler and Pucher, 2012). Universities need to be at the forefront of environmental change for their role in promoting knowledge and the large number of students they attract can be highly

adaptable and forward thinking. Therefore this type of study might be considered relevant at other universities that have not yet done as much as they could have to promote active transportation.

The interest in cycling has been growing among governments and planners in recent years and the benefits of reduced traffic congestion and emissions have been a key reason. Electric bicycles or e-bikes are also seen as a better option than automobiles and are considered a potentially innovative means to reduce air pollution while being less physical demanding to use (Wolf and Seebauer, 2014).

Public health organizations and medical journals are recommending cycling to improve health and avoid the harmful impacts of car use including an excessively sedentary lifestyle in many developed countries (Giles-Corti et al., 2016). Many cities have been introducing infrastructure, programs and policies to promote cycling including providing separate bicycle paths for off-street and separate lanes for on-street cyclists. From 1990 to 2008 Washington DC tripled the use of bicycles after expanding its cycling infrastructure and Denmark and the Netherlands have increased bicycling among their populations (Beuhler and Pucher, 2012; Thomas and DeRobertis, 2013).

Pucher et al. (2011) studied nine cities in the United States and Canada to observe bicycling trends and found in Montreal, Vancouver, and Toronto the percentage of university students who bicycled were 10.7%, 10.1% and 5.2%. Large cities, city centers and university campuses had the highest bicycle densities and the cyclists were most often from the middle and upper middle classes (Pucher et al., 2011). The cities that had actively promoted bicycling ended up seeing the largest numbers of cyclists (Pucher et al., 2011).

Memorial University of Newfoundland (MUN) has taken some steps to help the bicycling community and encourage new bicycle users though there is still much more needed. In this paper, steps that have been taken and that can be taken to promote the bicycling culture at MUN are discussed.

2 BICYCLING BENEFITS

Bicycling is reliable, effective, faster over short distances, very convenient during heavy traffic, consumes almost zero energy, requires some of the lowest maintenance costs, improves the health of the user, causes no adverse effects on the health of others, and could significantly reduce GHG emissions (Gonzalez et al., 2015; Gatersleben and Appleton, 2007). The costs of operating all motorized vehicles in Canada are $14-36 billion per year and include environmental damage, deterioration of people's health, and GHG emissions (Börjesson and Eliasson, 2012). Cycling can also prolong health and cyclists may be able to continue into their 80's, 90's and beyond while inactive seniors will be more likely to spend the end of lives in wheelchairs. In the UK it was concluded that bicycling could be the most reliable and affordable form of transportation for most sectors of the population (Gatersleben and Appleton, 2007).

Compared to bicycles, motorized vehicles over their life cycles produce more air, noise, water and visual pollution. Carbon monoxide has a local impact while methane, ozone and carbon dioxide emissions have large global impacts. Engine acceleration, tire/road contact, braking, honking, and theft alarms are the sources of annoyance and discomfort while bicycling can create a more peaceful environment (Campbell and Wittgens, 2004). Bicycles can be a good option for tourists and do less damage to scenic, conservation and historically important areas. They can also help people adopt slower paced and higher quality lifestyles (Zhang et al., 2015).

Busses may also be more expensive than bicycles as a monthly transit pass in Montreal is $100. The Canadian Automobile Association estimates that maintaining a car costs about $6200 annually excluding fuel and parking costs (Willis et al., 2013). Bicycle transport also can reduces traffic congestion and delay. Every motor vehicle trip made can increase the time in traffic experienced by other vehicles which can be especially costly if goods are delayed. In Ontario congestion to cost approximately $6.4 billion annually in 2001. Without alternatives to the motor vehicle and increased investment, the time an average commuter takes in the Greater Toronto Area could increase 50 percent by 2021 (Campbell and Wittgens, 2004).

3 CYCLING IN SELECTED CITIES AND IN CHINA

3.1 Copenhagen, Denmark

Over the past 75 years' bicycles have been more dominant in Copenhagen than cars, since 2000 the city has been actively promoting cycling, in 2007 they set the goal of becoming the "best city for cyclists" and every two years they audit their progress towards this goal (Gössling and Choi, 2015). In Copenhagen there are plans to expand the network of three lane fast track "bicycle highways" which are able to narrow the travel speed gap between cyclists and automobile drivers (Gössling and Choi, 2015). Gössling and Choi (2015) considered 13 factors including environmental costs (air pollution, climate change, and noise pollution), health costs (fitness, fewer sick days, increased longevity and safety), vehicle and infrastructure costs (vehicle operation and road deterioration), and travel time costs and showed that bicycling was clearly the more economical alternative.

3.2 Seville, Spain

Seville, Spain, with a city proper population of 700,000 (or 1,500,000 in the metropolitan area) is impressive for its rapid recent growth in bicycling. Prior to 2006 less than 1% of the people cycled and there were only 12 km of bike paths. However, in 2006 a survey predicted that the cycling population could reach 89,000 (or greater than 10%) and this began infrastructure improvements for cyclists. By 2010 the bicycle network included 120 km and by 2013 it reached 164 km. In 2006 through to 2011 the millions of annual bicycle trips were 3.07, 6.48, 9.29, 14.0, 15.9 and 17.1 respectively and in 2013 Seville was considered the fourth most bicycle friendly city in the world (Marqués et al., 2015).

The proportion of cyclists among the Seville University population of 70,000 is now double that for the city as a whole and this is due partly to the large student numbers. Even before 2000 the university had provided enclosed and secure bike parking areas at all of its buildings for a total of 1,618 bicycles and free parking for 771 bicycles. From 2006 onward the university developed initiatives that were complimentary to those of the city of Seville including a bike lending program with 400 bicycles (Marqués et al., 2015).

3.3 St. John's, Canada

The City of St. John's has a Cycling Master plan in which bicycling has been accepted and recognized as a part of the transportation system, giving cyclists more status and legal support (MacDonald, 2009). Currently St. John's has very few on-road and off-road bicycle lanes and the province of Newfoundland and Labrador has the highest rates of heart disease, cancer, diabetes and stroke in Canada as explained in the Newfoundland and Labrador Department of Health and Community Services 2006-2008 Strategic Plan. The Cycling Plan is a healthy solution and would help fulfill residents' needs for physical and recreational activity (MacDonald, 2009). Since the province is currently experiencing financial hardship, promoting cycling could be particularly advantageous at this time.

3.4 China

China is one of the leaders in cycling. In the 1980's in the city of Fuzhou, with a population of 1,460,000, the bike modal share was 65.91%. Around the mid 1990's bicycle use peaked and then declined. However, more recently due to traffic congestion, accidents and environmental concerns, there is renewed interest in cycling and especially in electric bikes and bike sharing programs. From 1998 to 2010 the number of e-bikes grew from 30,000 to 30 million, and bike sharing programs have been linked to public transit so that each can use the same smartcard and bike share users can receive a discount. So far it appears that non-profit bike share may be the most successful approach (Zhang et al, 2014).

4 CURRENT BICYCLE FACILITIES AT MUN

MUN provides some basic facilities for cyclists. There are a total of 54 bike racks most of which are in sheltered areas, and 18 of which were installed in 2015. There are five bike lockers located between the Science and Chemistry buildings and they are available for rent by semester. Then there is the volunteer operated MUN Bike share program that aims to provide help to cyclists by lending tools and providing bikes for rent (personal communication, Mrs. Toby Rowe, Sustainability Co-ordinator, Department of Facilities Management, MUN, 2017).

5 MUN CYCLISTS WHO WERE INTERVIEWED

One science professor, one engineering professor and one administrative staff specialist in science were interviewed for their views on cycling conditions at MUN and what types of improvements could be made to make the university more cyclist friendly.

5.1 Dr. Len Zedel

Dr. Len Zedel, Associate Dean of Science (Research) has bicycled to MUN for 25 years all year round. The three most important improvements for him would be providing indoor parking facilities, more bike racks around the campus and wash-up facilities. Due to the unpredictable weather in St. John's outside bicycle racks, even the sheltered ones, are not very weather friendly and he suggested that some of the space in the underground parking in the Earth Science building could incorporate a fenced bicycle parking facility with a security camera for safety. Creating bike lanes and proper lightning around would help the existing cyclists and attract more people. There are virtually no shower facilities around the campus for cyclists and it gets especially messy after cycling in extreme weather. Snow and rain is a big challenge if there are no wash-up facilities. He also suggested that the showers in the Physical Education building for the gym users should be made available to cyclists. In a perfect world there should be cycling storage and lockers in the building by the showers so that cyclists could conveniently store their cycles and clean themselves up.

5.2 Mr. Kerry Hiscock

Mr. Kerry Hiscock, Facilities Coordinator in the Department of Earth Sciences, bicycles 8 km from Mount Pearl to the university every day all year round. It takes him 25 minutes one way, and he has been doing it for 27 years. He avoids rush hour traffic by arriving before and leaving after the majority of the other road users. The main problems he sees are not having enough bicycle storage and parking facilities for students and employees which creates bike security issues. He has had two of his bikes stolen from the campus. He is also concerned about bike lanes and poor lighting on campus and feels that cycling on and around campus is the most dangerous part of his commute.

5.3 Dr. Tariq Iqbal

Dr. Tariq Iqbal is an Electrical Engineering professor and the biggest problem he faced when cycling to the university was not having proper bicycle parking or storage available to him. He would have to store his bike in his office but the cleaning staff were telling him to leave it outside. He thinks this issue could be solved with indoor bicycle parking while taking care not to increase the burden too much on the cleaning staff. He recommends that the university provide incentives for people who cycle to work or school as a form of promotion, such as bookstore credit, a free bike or bike contests, and free bike repairing.

6 THE SURVEY AND POLL

A survey of 10 questions was administered to 40 individuals at MUN and it is in the Appendix. Its main purpose was to understand the problems of cyclists and determine what enhancements could make cycling more attractive. In an effort to target cyclists who might be the best qualified to answer the questions, the survey was administered near outdoor bicycle racks at the engineering building main and east side entrances, the science building main and west side entrances, and the library main and north side entrances.

Through the process of conducting the survey and analyzing and sorting the results some weaknesses in the questions were discovered and they are mentioned briefly below along with the findings. Occasionally when an answer was not provided or did not make sense then these responses were omitted from the analysis. Where questions were not answered exactly as intended, some changes were made in analysing the results to account for this variation, as explained below.

The bicycle poll was a single question directed at approximately 1000 undergraduate students, 650 graduate students, and 150 staff and professors or a total of 1,800 people in the Faculty of Engineering and Applied Science. The question was simply whether they would like to have indoor bicycle parking facilities in the engineering building.

6.1 Survey Results

Question 1 identified the participants and they consisted of 29 undergraduate students, 8 graduate students, and 3 faculty and staff. Of the total, 35 were male and 5 were female. From question 2 it was found that 92% of the participants owned a bicycle.

In answering question 3 about how they usually travelled to the university if only one mode of transport was selected, it was weighted 100%, if two modes were selected they were each weighted 50%, and if three modes were selected they were each weighted 33.3%. Only the first five categories were included as there was no explanation as to what an "other" category might have been. Among the five modes bicycling represented 40.6%, public transit represented 23.6%, walking was 18.5%, automobile was

17.3%, and taxi was 0%. These responses showed that a high proportion of those completing the survey were cyclists.

The results of question 4 indicated that 37% of those surveyed lived less than 1.5 km from MUN, 29% lived between 1.5 and 3 km from MUN, 10% lived 3 to 5 km away, and 24% had to commute more than 5 km. Some people were not sure of the exact distance and one improvement would have been to provide a map of St. John's with the question to assess accurate distances.

In answering question 5 where people had to estimate what percentage of the time they bicycled to MUN, 25% said never, 32.5% said up to 20% of the time, 35% said up to 50% of the time, and 7.5% said they bicycled up to 100% of the time. These statistics correspond well with bicycling being the mode of transportation 40.6% of the time (in question 3) for this group of individuals. It was noted (in question 2) that only 8% did not own a bicycle so this meant that 17% did not use their bicycles to travel to MUN.

Question 6 asked the participants to rank in order the three most important obstacles to cycling. Of the 40 respondents 18 ranked their choices, many selected three choices but did not rank them, and a small number considered only one of the choices important. A first choice was weighted 50%, a second choice was weighted 33.3%, and a third choice was weighted 16.7%. Unranked responses were equally weighted (as in question 3).

The most important reason for not bicycling was unpredictable weather at 26.6%, followed by poor facilities for washing up at 25.4%, living too far from MUN at 17.8%, fear of bicycle theft at 17.5%, cloths they would normally wear were not suitable for bicycling at 9.4% and not having a bicycle at 3.3%. Under "other", one person mentioned traffic. Leaving out "traffic" as one of the choices was unfortunately a weakness in the study. Some people who exercise indoors on stationary bicycles are afraid to use the main roads because of traffic and in this way motorists are depriving potential outdoor cyclists and their enjoyment of fresh air.

Question 7 asked what problems cyclists faced on campus. The answers were weighted as was done for question 3. Lack of bicycle lanes was most important at 30%, inadequate bicycle parking was 25.8%, bicycle theft was 24.6%, and having to park outdoors in winter was 19.6%.

In question 8 those surveyed were asked to rank, or in some cases respondents simply indicated, the improvements that MUN could make to promote cycling. Providing indoor parking facilities was the most important at 31.2%, and this was followed by washing up facilities at 18.4%, more bicycle parking racks at 18%, bicycle theft prevention at 14.0%, education on bicycle safety at 9.6%, and develop a network of bicycle pathways on campus at 8.8%.

If lack of campus "cycling lanes" was the most important deficiency in question 7 why was "developing a network of bicycle pathways on campus" the least important improvement in question 8? This might have been due to inconsistent wording among the two questions. Cycling lanes might be thought of as following the main access roads. A network of bicycle pathways might be thought of as including those along the main access roads as well as many interconnecting pathways on campus, which some may have thought was going beyond what was the most essential. There is also the possibility that in completing the survey some may have decided to focus on what they thought might have seemed to be the easiest and least expensive changes to make.

Question 9 asked individuals what they felt were the best benefits they were getting from cycling and 66.7% said health, 19.4% said saving money, and 13.9% said helping the environment. Ranking was not asked for in this question and people selected either one, two or all three of the benefits. Education on how bicycling improves health might be a good way to promote it.

Results from question 10 revealed that 56.8% of cyclists said that having high quality, secure and weather safe bicycle parking on campus would increase their frequency of bicycling to MUN, 35.1% said it might increase their frequency of bicycling, and 8.1% said it would not make them bicycle to MUN more often.

6.2 Poll Results

Of the 1,800 people polled, 36 or 2% said they would like to have indoor bicycle parking in the engineering building. Three people identified themselves as undergraduate students, 10 identified themselves as graduate students, 6 were employees, and it was unclear who the remaining 17 people were. It is expected that an email poll would get a lower percentage of responses, so this poll shows

good support for indoor bike parking. It was mentioned earlier that the number of enclosed bicycle parking areas at Seville University was more than double the number of free bicycle parking places and they had been spread throughout the campus at each building.

7 RECOMMENDATIONS AND POTENTAIL BICYCLE PARKING FACILITES

7.1 Recommendations

MUN has a responsibility to ensure that its students and employees are safe and the university needs to provide the proper facilities and services just as the motorized parking facilities are properly managed and enforced. The Campus Enforcement and Patrol is an administrative body with its own regulations, penalties, full time staff and budget. The cycling society at MUN is less well attended and under-serviced. The survey was a useful tool in pointing out some of the problems and potential improvements.

These improvements include better bike parking facilities, proper storage with security cameras, wash-up facilities with storage nearby, and cycling lanes on campus with proper lighting. However, indoor parking facilities was the most emphasized improvement. Winter cycling can be very demanding with the snow, water, salt and the daily cycles of freeze-thaw that are rapidly wearing out bicycles and extra maintenance and care is required to keep the bikes functional.

Cyclists must protect themselves from the slush and wet weather and need good storage for bicycle clothing and wash-up facilities to clean up afterwards. Many bicycles that are stolen in St. John's, are stolen while parked at MUN. Secure indoor parking to keep bicycles safe and dry and provide a place for maintenance would be helpful and would attract more participants. Currently many cyclists are left to store their bikes in slush and their clothing in places where they are not meant to be stored. Showers and change facilities can also strongly attract cyclists and especially those who have a long commutes.

The showers at the gym in the Physical Education building might be brought into use for cyclists and a recommendation of bicycle racks or storage near the gym showers was made by quite a few respondents of the survey. There are showers available to the male and female professors and staff in the engineering building but it would be helpful if similar facilities could also be provided for the student population.

7.2 Potential bicycle parking locations 1 and 2

There are some unused spaces on the first floor of the engineering building, mostly under the staircases, that were assessed for bicycle parking but the City of St. John's Fire Chief, Mr. Mike Maher indicated that they would require blocking access from the staircase by putting a wall of the same material as other walls, and having a separate exterior access door. The pathways leading to the parking and storing facilities should be clear and not used for heavy foot traffic.

One of these locations was in the engineering building by exit door #25 on the north east corner of the building. There is some space here for the area to be converted into an indoor bicycle parking facility but the modifications required would be costly. On the other hand the general area would make an ideal location for bicycle parking. The floor area available is 16 feet by 8 feet excluding the space under the stairs, and the ceiling height is 7'-6" where an exterior entrance door would be required for this place to be used. This area is shown in Figure 1.

A second location on the northwest corner of the engineering building by exit door #2, is a mirror image of the first location, has the same dimensions, and so might be similarly modified.

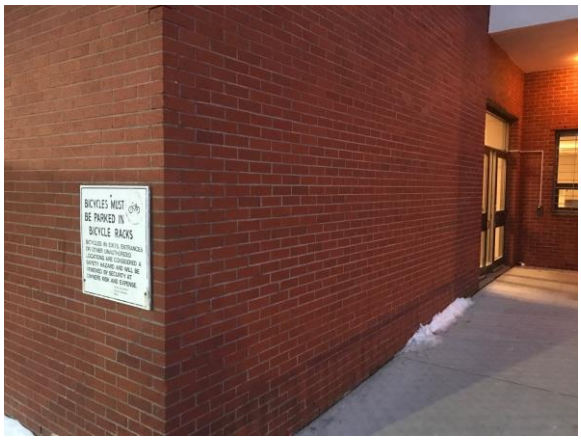

Figure 1. The Engineering building at door number 25 showing outside and inside views.

7.3 Potential bicycle parking location 3

The third potential location in the engineering building is located on the southeast corner facing the business building. There is not heavy foot traffic here and the area is much wider than the total entrance door area and the corridor door area. The space is wide enough to put vertical wall mounted bicycle racks, on the right wall facing out or on the left wall facing in. Of the three locations this one presents a low cost solution for an area that is underutilized and would require the least amount of modifications. The location is shown in Figure 2.

This study has been brought to the attention of the Dean of Engineering, Dr. Greg Naterer and so there is a good possibility that some indoor bike parking will be considered in the engineering building. There are also future lab expansion renovations planned and this would be a good time to make room for indoor bicycle parking facilities with this new construction.

Figure 2. Inside the Engineering building at the south east entrance facing the business building.

8.0 Conclusions

Strong sustainability requires that resource consumption be adapted to long term resource availability. Most of the literature is focused on weak sustainability which will buy some time but will not resolve the most critical challenges. A transformation in attitudes and behaviors is required and increasing participation in bicycling is a part of strong sustainability. Some of the statistics from China and elsewhere are showing that a much higher proportion of cyclists would be possible in St. John's if they were only treated as fairly as automobile drivers and it seems clear that they should be considered an even higher priority.

The study showed that people are being held back by restrictive conditions and an outdated and expensive transportation system. Improvements which would be recommended for MUN are secure indoor bike parking which would also prevent theft and which was one of the concerns, facilities for washing up after arrival, more bicycle racks outside, and separate bikes lanes along the main access routes with lighting for travel after dark. A search though the engineering building found one less used location where indoor bicycle parking could be effectively and economically introduced.

Universities can play a key role in promoting sustainable mobility and students are likely to be highly receptive. The process outlined in this study was to survey the literature, consult with experienced cyclists, survey members of the university community and especially cyclists, and poll those who were potentially the most progressive. One benefit of the study was an increased awareness among the participants.

The automobiles on the road and their drivers are preventing people from participating in bicycling as long as the traffic policy does not fully accommodate cyclists on the road and does not make conditions safe and convenient for them. The numbers of cyclists could be greatly increased and conditions need to be made much more favorable. When a carbon tax is introduced in Canada it will help but both the introductory amount of the tax and the rate at which it will be increased are so small that it could take a long time to be really effective and other measures are needed at the same time.

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Appendix

ON CAMPUS BICYCLE PARKING FACILITIES SURVEY

Name: _____

Gender: ___ Male___Female

1. **Please indicate whether you are?**

___Undergraduate Student ___Graduate or PHD Student ___Faculty Member ___Staff

2. **Do you own a bicycle?**

___Yes ___No

3. **How do you usually travel to and from MUN?**

___Private Automobile ___Walk ___Public Transit ___Taxi ___Bicycle ___Other

4. **Approximately how far do you live from MUN?**

___Less than 1.5 km ___1.5 - 3 km ___3 - 5 km ___> 5 km

5. **Approximately what percentage of your trips to MUN have been made on bicycle?**

___0% ___1%-20% ___21%-50% ___More than 50%

6. **Please rank (in order of importance, 1 being most important) the three most applicable reasons why you do not ride a bicycle to MUN:**

___Do not own a bicycle ___Distance is too far ___Fear of bicycle theft

___Clothes not suited for cycling ___Poor wash up facilities ___Weather is unpredictable

___Other

7. **What problems do students face on campus who bicycle?**

___No Cycling lanes ___Outdoor parking in winter ___Less or improper parking

___Bicycle theft ___All of the above

8. **Please rank (in order of importance, 1 being most important) the three most beneficial improvements MUN can make to encourage students to bicycle?**

___Provide improved wash up facilities ___Provide indoor parking facilities

___Develop a network of bicycle pathways on campus ___Prevent bicycle theft

___Provide more bicycle parking racks ___Education on bicycle safety

9. **What is the best benefit you are getting from bicycling?**

___Environmental benefits ___Health benefits ___Money saving ___Other benefits

10. **Would the availability of high quality, Secure and weather safe parking increase the frequency with which you ride a bicycle to MUN?**___Yes ___No ___Maybe