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Research Proposal

Abstract

Traffic problems have always been a challenge for cities and urban areas. City planners have continually developed methods and strategies to cope with these problems by improving transportation systems. One of the strategies they have developed is the use of bus-only lanes where it eliminates cars from riding in the bus lanes, thus allowing the bus to run more smoothly. However, in crowded areas such as San Francisco, do bus-only lanes really help traffic problems and reduce travel time? Are these bus only lanes helpful during peak hours where traffic problem is most prominent? My research question is to find out how effective is the current bus-only lanes system in reducing traffic congestion problems during peak hours in San Francisco. I have hypothesized that bus-only lanes do help reduce travel times and thus are effective in reducing traffic congestions if they meet two conditions. First, bus-only lanes are effective in reducing travel time, if signs and street markings are updated and made consistent. Secondly, bus-only lanes are effective in reducing travel time if enforcement is enhanced. Results from this research will provide important implications on how bus-only lanes will help reduce traffic problems in other urban areas.

Introduction

Traffic problems have always been a challenge for cities and urban areas. City planners have always developed methods and strategies to cope with these problems by improving transportation systems. One of the strategies they have developed is the use of bus-only lanes where it eliminates cars from riding in the bus lanes, thus allowing buses to run more smoothly. However, in crowded areas such as San Francisco, these bus only lanes may have limited effectiveness during peak hours due to various factors. My research team wants to make sure that the current bus-only lanes are effective in reducing the traffic problems and that governmental funds are spent appropriately on the right programs. My research question is to find out how effective the current bus-only lanes

are in reducing traffic congestion problems during peak hours in San Francisco. I have hypothesized that bus-only lanes do help reduce travel times and this is effective in reducing traffic congestions if they meet two conditions; if signs and street markings are updated and made consistent and if enforcement is enhanced. Currently there are two projects being studied to improve traffic conditions on Van Ness Avenue and Geary Boulevard by implementing Bus Rapid Transit (BRT), where a dedicated lane similar to our existing bus-only lanes prohibit vehicles from riding in the same lane. However, I want to focus my study on bus-only lanes in the downtown area because these lanes affect many professionals and riders who rely on the bus to get to work on time and get home sooner after a long day of work.

Literature Review

Many studies discuss how congestion problems are a big concern for urban areas and strategies and policies have been used to try to reduce traffic problems. However, most of them have focused on expanding transportations systems to help improve commute among suburban areas such as building or improving the "highways," or building train systems such as BART. Meanwhile, little research has been done on analyzing how to resolve traffic and transportation problems within urban areas. Furthermore, policies have often used variables in their analysis that do not necessarily alleviate congestion problems. As Cao & Mokhtarian (2005) suggest, many transportation policies that we adopted have been "of limited effectiveness." They find that many variables that reflect individuals' responses to travel-related strategies are rarely measured and incorporated into demand models. Thus, "understanding the role of

such variables will improve our ability to design effective policies" in helping transportation problems (Cao & Mokhtarian, 2005)

Merewitz (2001) also tells us that engineers always respond to social problems by constructing "fixed structures like dams, highways, or rail rapid transit lines" which are often big projects that are very costly. These high cost projects such as BART are usually designed to help residents in suburban areas to go to work. However, such systems and projects do not help residents living in crowded cities like San Francisco. An interesting point that Merewitz makes is, "if we are concerned with rush-hour traffic, why have large investments in facilities devoted 7 days per week, 24 hours per day, to solving a problems which exists only about 20 hours of a 168-hour week?" (2001). This is very true because traffic congestion is at its worst during peak hours and we need to have a transportation system that specifically targets traffic problems during those hours. Furthermore, "if anyone hoped for intra-city transportation via BART, they were to be disappointed. BART is currently oriented almost exclusively to the East Bay suburbs. It is more like a commuter railroad than urban rapid transit. It serves neither Chinatown nor North Beach, two densely populated residential areas of the city" (Merewitz, 2001). The goal and the operation of BART have simply contributed little positive effects in helping congestion problems for residents in the city of San Francisco.

Cervero (2006) also agrees that planning organizations "maintain and routinely update large-scale travel demand models to guide capital investments." Cervero (2006) points out that recently, there is a "smart growth movement" in travel forecasting. Instead of focusing on big capital investments, focus has shifted in which it encourages people to "drive less, and walk, bike and ride transit more." Both Cervero (2006),

Schwanen and Mokhtarian (2005) see a relationship between one's residential locations and their commuter behavior and say that "households whose members prefer to travel by public transit choose to reside for that very reason in a location that provides easy access to transit infrastructure" (Schwanen and Mokhtarian, 2005). Cervero (2006) says that a recent study done in the San Francisco Bay Area suggests a 40% increase in ridership is associated with "residential self-selection." Therefore, if we can understand the relationship between people's residential choice and their commute mode, we can use this information to enhance travel forecasting demands.

Another interesting point that Schwanen and Mokhtarian make in their study is the concept of neighborhood type dissonance. A neighborhood type dissonance is "a mismatch between a commuter's current neighborhood type and her preferences regarding physical attributes of the residential neighborhood" (2005). Schwanen and Mokhtarian mailed a survey in May 1998 to 8,000 randomly selected households to three neighborhoods in San Francisco Bay Area. Their study shows that 83% of their samples display a mismatch or dissonance in their behavior, meaning "dissonant urban residents are more likely to commute by private vehicles than consonant urbanites." As Schwanen and Mokhtarian (2005) suggest, this incongruence or dissonance among urban residents "may have adverse consequences for residents of such developments with a true preference for higher density living. If public transit patronage remains below expectations, service may be limited, which may force true urbanites to shift back to private automobiles." Therefore, understanding this relationship is essential as it allows us to better understand why some people choose to ride public transportation while others choose to drive their private vehicle. This information can help better improve the

transportation system so that people who normally like to ride their own vehicles would be attracted into taking public transportation.

Public transportation is not going to get better if more and more urban residents drive their own private vehicles in the city. Patankar, Kumar & Tiwari (2007) tell us that, "the uncontrolled growth of private vehicles is certainly at the cost of public transport and there is no viable option but to augment public transport services and simultaneously restrain car ownership." This statement is very true except we simply cannot restrain car ownership as Patankar suggests. However, by improving our current transportation system, such as achieving "time savings, make bus schedules more predictable and dependable, and in general redefined the image of bus transit," it would make public transportation "more attractive and competitive with the automobile" ("Annual Report," 2004).

Goral (2007) says that "auto pollution is a major contributor to greenhouse gases and global warming. Unfortunately, the government and the auto industry have done little to control the situation" (Goral, 2007). He believes that we all have a "social responsibility" to find alternatives to "vehicle overpopulation and our dependency on oil (Goral, 2007). Goral studied congestion problems in colleges and universities and found out that mass transportation is a great solution to vehicle overpopulation within many colleges and universities areas. This is very true in the case of urban cities where mass public transit can help decrease the number of vehicles on the road significantly. According to Sierra Club Yodeler (2006), "during peak hours a bus lane can move many more people than a lane of cars. The maximum for a car lane is about a thousand people

per hour; just 10 loaded articulated buses can carry this many passengers" (Sierra Club Yodeler, 2006).

In 2003, Proposition K Expenditure Plan was approved by voters and has made Bus Rapid Transit, (BRT) one of the top priority projects for the city. In 2004, San Francisco County Transportation Authority initiated technical studies on implementing BRT, bus lane corridors on Geary Boulevard and Van Ness Avenue and its goals are to promote the use of "dedicated lanes, traffic signal priority for busses and stations similar to those for light rail lines. The objective is to achieve time savings, make bus schedules more predictable and dependable" ("Annual Report," 2004). With BRT; it would have bus only lanes so that other vehicles cannot block the traffic. Sierra Club Yodeler (2006) tells us that "the central idea of BRT is to move buses nearly as fast on city streets as a subway would run underground."

Geary Boulevard and Van Ness Avenue are two of the busiest and most heavily congested streets in San Francisco ("Executive Summary," 2005). It takes an average of 22 minutes to travel the Van Ness Avenue from one end to the other and there are about 80,000 commuters riding along Van Ness Avenue each day (San Francisco Examiner, 2007). Traffic is always congested on these two streets. Currently the "roadway layout and traffic signal infrastructure on Geary benefit motorists at the expense of transit riders and pedestrians. The Geary expressway allows motorists to travel at relatively high speeds, while buses are channeled onto narrow and ineffectual service roads" ("Executive Summary," 2005). The average speed of private vehicles is 17 to 22 mph while it is only 7 to 10 mph for transit, thus transit speeds are 50 to 60% slower than the speed of private vehicles, which means that it takes about twice as long to travel on public transit as it

does in private vehicles and the trip length is even longer due to bus delays. Bus delays are caused by "time spent loading and unloading passengers, waiting for green lights at signals, and the difficulty of getting back into traffic" ("Executive Summary," 2005). With so many problems with the road conditions, the goal of BRT is to have "significant reductions in transit travel time, increased transit reliability, and improved passenger comfort" ("Executive Summary," 2005). The target of BRT is to have a 15 to 30% reduction in total travel time and 25-50% reliability. Executive Summary (2005) explains that a "dedicated lane will eliminate the time the bus spends trying to merge back into traffic after it pulls over at the bus stop" and also "transit signal priority will reduce the time the bus spends stopped at traffic signals." According to the Examiner (2007), many riders view positively about the implementation of BRT. Many believe that BRT lanes will effectively eliminate private cars from the bus lanes and therefore would reduce travel time as a result.

Through a micro simulation model, Patankar, Kumar & Tiwari (2007) have found positive effects in traffic as a result of BRT lanes in India. Their simulation model compares the proposed BRT system with the current mixed traffic systems. They used traffic quality parameters such as traffic flows, speed, travel time, delay time, stop time, and fuel consumption in their model to see the effects of BRT lanes. They found that all the quality parameters, "travel time, delay time, and stop time has significantly decreased in the BRT system with respect to the present situation. Fuel consumption efficiency has improved for all modes of vehicles" (Patankar, Kumar & Tiwari, 2007). Patankar, Kumar & Tiwari (2007) say that the BRT corridor allow public transportation to run at its optimum speed and that it shows an overall improvement in speed by more than 100%

over the existing mixed lane traffic system. According to their simulation model, travel time in the existing mixed lane traffic is 7 to 8 minutes per kilmoter whereas in the BRT system, the average travel time is about 1 to 2 minutes per kilometer (Patankar, Kumar & Tiwari, 2007). As a result, Patankar, Kumar & Tiwari (2007) strongly believe that "commuter mobility will increase due to the increased speed of public transport, and will encourage people in large numbers to choose public transport." They believe their findings plays a significant role in developing transport system in congested cities of India.

While the Geary Boulevard and Van Ness Avenue projects target on relieving traffic problems for riders in Northern San Francisco, the current bus-only lanes are installed to achieve the same goals in downtown San Francisco. They are installed to help buses run more smoothly without interruptions from the mixed traffic. Though BRT corridors sound very enticing and may seem like a very effective and feasible manner to reduce congestion problems in San Francisco, unfortunately not every street in the downtown area is wide enough to install BRT corridors. In order to alleviate congestion problems in downtown San Francisco, the City installed bus-only lanes in the core of the downtown area. However, Kiesling & Ridgway (2006), note there are some problems with our existing bus-only lanes that hinder the full intent of bus-only lanes. They say that the "efficient operation of bus-only lanes often is compromised by non-transit vehicles violating the exclusive lane. The City has not received many of the transit service benefits it anticipated when it installed the bus-only lanes" (Kiesling & Ridgway, 2006). Violators who either ride or park in bus lanes block traffic for buses which results in bus delays. Kiesling & Ridgway (2006) point out that "more than one-quarter of

vehicles violate the bus-only lane during the day; more than 60 percent of vehicles violate the outbound bus-only lane in the p.m. peak hour." Some of these vehicles ride in bus-only lanes simply because they do not obey traffic regulations. We need to have better patrol and enforcement of these bus-only lanes to make them effective. Enforcement of bus-only lanes is handled by the San Francisco Police Department specifically assigned to MUNI. According to Kiesling and Ridgway (2006), as of 2004, there were only 13 officers assigned to cover all MUNI enforcement which includes both fare evasion and transit lane violation. This is truly not enough officers to handle so many violators on the roads.

California legislature recently adopted a legislation that would make buses become "mobile ticketing machines" to catch bus lanes violators. If this legislation is signed into law, "digital video cameras would be installed on city buses" and the "city would use the automated systems to mail $100 tickets to owners of vehicles" who block buses (Assembly Bill 101). In order to make bus-only lanes effective, some kind of enforcement needs to be enhanced, whether it means having more patrol cars on the road or having mechanisms such as these "mobile ticketing machines," so that we will have less violators riding in these bus-only lanes and buses will be able to run more smoothly.

Another problem is that these bus-only lanes vary in type and hours of operation and they have actually caused ineffective rather than effective impact on buses. Among the different types of bus lanes, we have some that are peak-hour curbside lanes; some are all-day or full-time curbside lanes; and the remainders are all-day or full-time dedicated lanes. Some even allow taxis to operate in the lanes with buses. Kiesling & Ridgway (2006) point out that the effectiveness of these bus-only lanes is hindered by

"the lack of consistency in operating hours and uneven signage guidelines. The inclusion of taxi operation in the existing lanes also is not uniform across the city."

One type of bus lanes, curbside lanes is designed so that vehicles have to enter bus-only lanes in order to make right turns. As Federal Transit Administration (2006) explains, "it is hard to keep curbside lanes uncongested. The major threats to smooth curbside bus lane operation are (1) illegal parking and standing and (2) right turning vehicles waiting for pedestrains." These lanes are ineffective and causes major delays for buses as they have to wait behind other vehicles that are making right turns and often times, these vehicles have to wait for large volumes of pedestrians that are crossing the road. Another problem with curbside lanes is that bicyclists are usually permitted which sometimes block the traffic in bus lanes as well. Thus, these lanes have not been very effective in reducing travel time for buses.

Another problem with our existing bus-only lanes is that they have inconsistent and outdated signs and street markings of bus lanes, which have caused some drivers to accidentally ride in the bus-only lanes. For example, bus-only lanes are often marked with a diamond shape, which is commonly known as carpool lanes throughout California. This causes major confusions for many drivers who are either not familiar with bus-only lanes system or they may be travelers who are visiting from another town. Therefore, to make bus-only lanes effective, these signs and street markings need to be more updated and consistent throughout the downtown area. As Kiesling & Ridgway (2006) say, "all these problems can be overcome, leading to efficient bus-only lanes and speeding MUNIs service in the city." Hopefully with enforcement enhanced and street signs updated, travel time on buses can be reduced and help riders in San Francisco get to work on time.

Method

Participants

My sample size is 400 and these consist of workers and employees who ride the MUNI in the downtown area. My unit of analysis will be individual commuters in San Francisco. My target population is all San Francisco residents who ride the bus to work during peak hours. However, since it will be impossible survey all these riders in the city of San Francisco, my study population will be riders within the downtown area specifically during the peak hours between 7-10am and 4-7pm. These subjects are to be found on weekdays where traffic is most congested during these peak hours.

Variables

The independent variable that I will focus on is the implementation of bus-only lanes. However, there are other independent variables such as weather, time of day, day of week, speed limit of bus lanes that also affect travel time, which I will have to control. My dependent variable is reduction in travel time or time savings during bus rides. After controlling all the variables including weather, time of day, day of week, and speed limits, I have found that signs and street markings indicating bus lanes combined with appropriate enforcement on the roads truly has a positive impact on time savings on buses. Thus consistent signs/street markings and enforcement are effective operational measurements of an effective bus-only lane. If bus-only lanes meet these criteria, then they are effective in reducing travel time on buses. Finally, travel time savings or reductions will measured by the number of minutes actually saved riding in a bus-only lane as opposed to riding in a mixed traffic lane.

Research Method

My research method is to perform a cross-sectional study using a survey to get riders' opinion about the current bus-only lanes system. I will design a survey with both open-ended and close-ended questions to get opinions from San Francisco riders. My sampling method will be convenience sampling where I would simply approach riders in the downtown area in which I have an easy access. Convenience sampling will be used because this method would not impose a huge cost on my research team. I will simply approach people who are waiting at bus stations during the two peak hour time frames and ask them to volunteer in my survey. I will conduct an in-person survey by briefly introduce to them the purpose of my survey and explain why their participation will be valuable to the public. I will ask them if they have 15 minutes to do my survey, otherwise I will give them a pre-stamped survey for them to complete and mail back to my research center. I believe that my pre-paid stamped survey will help increase the response rate because it makes it easier for people to return the survey. By having given them a brief introduction at the bus stop before I hand them my survey, I can have a better sense of whether or not my survey is applicable to them. If I feel that the concept of bus-only lanes is not applicable to them, then I will not give them my survey and simply thank them for their time. Also, I hope that by giving them a brief introduction about the purpose of my survey at the bus stop, they will be less likely to forget about my survey.

In addition, a focus group will also be used to discuss the effectiveness of the bus-only lanes system. We will simply ask five or six San Francisco riders to volunteer to give us one hour on one evening to get their opinions about the current transportation system and how they view the bus-only lanes system. Then we will ask two

representatives from our research team to help facilitate and record the discussion. A facilitator will be present to conduct the group discussion and ask several open-ended questions while another representative will record the respondents' answers during the discussion. The advantage of this focus group study is that it is not costly, not time consuming and we can get in-depth information and opinions from riders.

Analysis

After we get all the data from in-person surveys and mailed surveys back from respondents, we will enter their data into a database for analysis. Also, with the responses from the focus group, our facilitator and recorder will sit together with our research group and we will summarize the findings from the respondents to try to find any important information that will answer our research questions. Together with the data from in-person and mailed surveys, we will then compare the answers with the information from the focus group to see if they are similar in their opinions about our existing bus-only lanes. This is important because often times people who participate in surveys may "answer questions they really do not understand or give cursory answers without attending to their accuracy or completeness" (OR&B, 2003). Especially in this case, participants who participate in my in-person survey at the bus stop may not be attentive due to distractions on the road.

Discussion

Some validity issues may be threatened in this research due to the fact that convenience sampling simply does not provide us a perfectly random sample. Due to lack of time and funding, our research team cannot get opinions from riders of all bus lines and the only feasible method is to get opinions from riders only in the downtown

area. Therefore, a threat to our internal validity may be due to "selection," which might cause our dependent variable (reduction in travel time) to not truly and accurately reflect the outcome of our independent variable (bus-only lanes). Another internal validity threat may be due to design contamination because some survey participants may alter their true opinions in the survey if they feel that their response might serve their own best interests. One's experience or history with the transportation system may cause them to bias in their responses to my survey. People who have had bad experiences with the public transit system may be more inclined to do the survey and have strong negative views towards bus-only lanes.

In addition, external validity is threatened due to our selection and causes a sample bias because our sample may not representative of the target population, which is all riders of San Francisco public transit. Thus, we are hoping that by having a bigger sample our results would be less biased. We strive for a sample size of 400, and are expecting a 35% response rate. We believe a 35% response rate is sufficient to our research question. In addition, since my sample is composed of riders in the downtown area, I hope this sample can be somewhat representative because a majority of riders in downtown area do live and come to work from other parts of San Francisco. I hope analysis collected from riders of downtown San Francisco can be generalized to other crowded urban cities.

Unfortunately an experimental design would be extremely difficult to administer in this research because it requires my research team to find two streets with identical features to be my control and experimental groups. Conducting such experiment is almost possible in downtown San Francisco as it requires me to time the speed of buses

in two parallel streets, with the same traffic conditions, one with and one without bus-only lanes. Due to this limitation, a cross-sectional design simply allows me to use surveys to see riders' opinions about the effectiveness of the bus-only lanes.

Lastly, issues worth mentioning are that even if we implement the bus-only lane to its fullest potential as intended and having enforcement enhanced, there will always be violators on the road who just would not obey traffic regulations and continue to ride in bus-only lanes. Driver's riding behavior is an uncontrolled factor that is simply beyond our control. Therefore, time savings in the bus-only lanes will not be reduced if others do not cooperate with traffic regulations. Also, if bus schedules are not improved, buses will bunch up and block other buses that follow.

Schedule

I will conduct my in-person surveys between January 7th to February 8th and I will conduct my focus group interview at the end of January. Then beginning on February 11th, I will begin my data analysis. I believe the data analysis would take about two to three weeks and when this is done, I will begin to write my report on the findings.

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Appendices

Please red the following questions and check the appropriate answer.

1. How do you get to work? Do you take the public transportation or do you drive to work?
   - I take the public transportation_____
   - I drive to work_____
   - I walk to work_____
   - I ride a bike to work_____
2. What do you think about the transportation system in San Francisco?
   - It is a great system_____
   - It is a good system_____
   - It is alright _____
   - I don't like it_____
   - Not applicable_____
3. Do you know notice bus-only lanes in the city? And do you know what they are?
   - Yes____
   - No_____ (If no, bus-only lanes are lanes that eliminate private cars from riding in them as a way to allow buses run more smoothly)
4. Do you own a vehicle?
   - Yes (if yes, go to the next question)_____
   - No (if no, skip the next two questions)_____
5. Do you drive often in San Francisco?
   - Yes _____
   - No_____
6. As a driver in the city, how do you feel about bus-only lanes?
   - I think it is a great system_____
   - I like it is a good system_____
   - It is alright_____
   - I don't like it_____
   - Not applicable_____
7. Have you ever seen private vehicles riding in the bus-only lanes?
   - Yes_____
   - No_____
8. Do you see patrols and police watching these bus-only lanes often?
   - Yes____
   - No_____
9. Since there are always so many private vehicles on the roads, how do you think this might affect the bus-only lanes?
   - Private vehicles affect bus-only lanes greatly____
   - Private vehicles affect bus-only lanes to some degree____
   - Private vehicles do not affect bus-only lanes at all_____
10. When you ride the bus to work, how effective is bus-only lanes in terms of reducing your travel time?
    - It reduce travel time a lot_____

It reduce travel time to some degree____
It reduce travel time a little bit_____
It does not reduce my travel time at all_____

11. Approximately how many minutes do bus-only lanes save you when you ride buses in the downtown area?
    1 to 3 minutes_____
    5-8 minutes_____
    8-10 minutes_____
    More than 10 minutes_____
12. Do you think bus-only lanes are effective in reducing traffic congestions in the city?
    Yes, it helps reduce traffic congestion problems____
    No, I don't think they help reduce traffic problems_____
13. If you answered yes to the above question, why and how does it affect you personally? (briefly describe your experience in the space below).

14. If you answered "no" to question # 12, do you have any suggestions on how to improve the transit system so traffic problems can be reduced? (briefly provide your suggestion in the space below).

15. Do you live in San Francisco?
    Yes_____
    No_____
16. Are you currently employed? Or are you a student?
    Employed_____
    Student_____
17. Do you work in San Francisco?
    Yes_____
    No_____

You have just completed the survey. Thank you for your time and participation.