Making America more Bicycle Friendly.

American cities lag behind many developed cities of the world in safe bicycle travel. There are many benefits to commuting by bicycle including health, cost, and environmental impact. Yet even our most bike friendly cities fall far short of their potential. Portland Oregon is reported to have only 5.8\% of its commuters commute by bicycle but Copenhagen boosts an impressive 36\% and in Amsterdam 60\% of inner city trips are by bicycle. While there are many difficult-to-overcome reasons for this divide, we propose the development of new tools for city planners to boost their effectiveness in providing bicycle-friendly infrastructure. First is an opt-in program to track the commuting behavior of people in the city via GPS-enabled smart phones. Second is the integration of this data with traffic infrastructure planning, giving city planners the necessary details to make decisions that will have the most impact on improving bicycle commuting. Third we incentivize the tracking program with personalized feedback on the benefits gained or missed due to commuting habits.

Bicycle commuting has an unfortunate bootstrapping problem: commuting is much safer when the traffic patterns are dominated by bicycles. Bicycle travel is also higher density and lower maintenance than car travel, leading to the conclusion that if a critical mass of bicycle commuters could be achieved it could be done while decreasing road infrastructure. Most cities have taken a conservative approach to bike friendliness by adding single bike lanes to selected roads or adding isolated bike paths connecting a few points in the city. In order to reach a critical mass where bike commuting starts to have a significant impact on the total traffic in the city, we propose taking a more drastic approach of turning whole lanes and whole roads into bike-only roads. The question then remains, which roads to convert and when? We propose new traffic flow analysis that takes into account existing traffic, car commuter traffic, and bicycle commuter traffic and aids in planning optimal traffic reflows. Another somewhat drastic change would be to encourage housing development around endpoints of isolated bike paths. The benefit of this would be weighed against likely commuters, likely destinations, and expected housing costs.

Rich data sampling would be imperative to improved analysis that can go beyond what simple traffic flow rates can provide. Knowing the entire trip for a commuter provides for richer optimization opportunities. For projecting actual sampled routes to the larger population, other factors like social demographics collected in the sampling could help extrapolate to a more accurate picture of the routes of likely commuters. An additional factor to include in the analysis would be parking space and bicycle storage space. Even high quality bicycle storage is much denser than car parking and potentially would require much less enforcement.

The third part of this proposal is the educational and motivational feedback given to those that opt-in to the sampling program. We believe this will help the data collection grow through social sharing and aid in building the needed critical mass for safe bicycle commuting. This feedback could come in the form of safest route planning that specifies not just what route to take, but why the route was picked, educating cyclists about common safety issues they may not have been aware of. On the other side we can analyze routes taken and give feedback on issues like traffic laws broken. General statistics about the amount of money


saved by not car commuting, time saved (accounting for factors like parking and exercise), calories burned, and city wide traffic reductions as the number of bicycle commuters grow would all be positive motivational feedback.

Potential Benefits

While we feel that the benefits of increased bicycle commuting are clear, the benefits of the needed analysis framework may not be clear. To generalize the problem, we are proposing researching targeted disruptive network changes for reaching critical mass benefits. These changes are targeted by analysis of rich sampling of under-performing traffic. These techniques will likely be beneficial in a wide area of network and data flow analysis including Internet traffic routing, parallel computing (especially in large heterogeneous networks), ecological systems that deal with invasive species, and large scale knowledge representation systems. In short, systems with well defined networks that are resistant to incremental changes but susceptible to new modes of operation given a change to a critical mass would be under the purview of this study.

To give a more in depth example we can look at program interfaces in large software ecosystems. It has become quite clear that shortcomings in programming language design that fail to properly check for buffer overflows is a large security problem. These problems, though existing for some time, have only fairly recently become an issue do to the prevalence of networked computing. The question in this instance is, how do we depreciate API’s that are inherently susceptible to buffer overflows? While there may be some direct ways to address the problem in this specific case, in general we hope to apply the techniques that we develop to isolate the best “low hanging fruit” to address and maximize the impact of the changes. In this instances there is also a clear feedback mechanism back to programs that use API’s in the form of automated code reviews. While there may be many issues that can be detected with static code analysis, we want to avoid the overwhelming nature of such tools by targeting the most effective solutions to gain broader adherence to change.

It is our hope that our research would help discover critical mass changes that could lead to ecosystems where incremental changes would be possible. In the case of bicycle commuting (as well as mass transit) a city’s structure is the dominant factor in enabling broad buy-in. Having a significant community that supports and depends on bicycle commuting puts pressure on the city structure so that when decisions are made, they are made with bicycles in mind. When there is this critical mass of community a city could experience more incremental changes. We cannot, for instance, expect something like rising gas prices alone to lead to cities that are more bicycle friendly. Even though gas prices are motivating factors and could lead to decreased traffic on roads, decreased traffic alone does not lead to safer cycling. Indeed, decreased traffic might lead to higher speed which is directly related to the severity of cyclist injuries. This leads to another potential disruptive change of decreasing speed limits and increasing enforcement and penalties that could be incorporated in our cost model.

Research Plan

- Develop and deploy tracking software for surveying commuters through GPS-enabled smart phones. This software should offer back to the users beneficial information about their commuting habits.
- Survey cities for good candidates for more drastic traffic pattern changes to incorporate bicycle commuting. Specifically, medium sized cities with established bicycle culture but poor commuter rates, would be good candidates to search.
- Develop new traffic flow analysis methods that can incorporate bicycle traffic. This must look beyond just the roads to the paths and sidewalks. Though sidewalks are no place for bicycle traffic due to decreased visibility relative to the speeds involved, these aspects of cycling would need to be incorporated if only to find ways to help cyclists avoid riding on sidewalks.

3Calm down: With a very few exceptions, America is no place for cyclists. http://www.economist.com/node/21528302
• Develop a traffic cost model for drastic traffic reflowing that includes the benefits of increased bicycle travel.

• Deploy recommendations in target cities and work with collaborative studies on the efficacy of the proposed cost model. We want to ensure that any developed systems are flexible enough to interoperate with related studies.

• Share information with other incentive programs to better their targeting of potential bicycle commuters. For example a city might want to provide economic incentives to businesses in targeted areas that increase their bicycle commuter specific offerings.