

Who, Rides, Where, and When?:

Examining connectivity and weather on bike share use

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INTRODUCTION

In many cities and towns throughout the United States, municipalities are planning for the inevitability of climate change. Climate change threatens to disrupt transit systems in a myriad of ways - from higher temperatures warping train tracks to extreme storm events freezing other available routes. Building a diverse system is key to providing a resilient suite of transportation options for residents. However, if bike sharing is to be part of this system, it is important for planners to understand how climate change may impact users' willingness to ride.

The literature shows that bike sharing usage is highly susceptible to weather, especially for casual riders. In addition to the barriers posed by snow piles and the discomfort caused by rain, humidity

and heat can both be factors in users' usage patterns. In cities with temperate climates, like Minneapolis, this can lead to significant changes in ridership. As these cities prepare for the impacts climate change will have on summer temperatures, examining current heat events is critical to understanding future rider behavior.

In this study, we will examine Minneapolis bike sharing data to understand how extreme heat conditions affect bike sharing usage patterns. We will focus on impacts of extreme heat events (which we will define as over 90 degrees Fahrenheit), and parse the differences between "members" and "casual" users of the Nice Ride program. We will also look at connectivity of stations, to better understand where users are riding bikes.

CONCLUSIONS

Understanding how different user types interact with a bike share system can help policy makers and the administrators of bike share organizations leverage resources more efficiently. Bikeshare is an important part of a resilient public transportation system, making it vital to resiliency planning as climates change.

As we can see with the Nice Ride system, the areas of the city with the most environmental resources and are the most attractive on exceptionally hot days are also the least connected to the rest of the Nice Ride system. Improving the bike

network to connect these stations is vital to ensuring everyone can access these areas.

For future analysis, I would recommend examining the connectivity of bike stations in particular neighborhoods. Minneapolis is highly segregated, with neighborhoods separated by socio-economic status, education, and race. The city is also rapidly gentrifying and many current residents are disappointed in the emphasis being placed on amenities for "creative class" residents. If bike share is to be an equitable system, it must ensure that all users are served equally.

METHODS

- Data:**
- Nice Ride trip history data, joined to station location data
 - National Oceanic and Atmospheric Administration (NOAA) daily weather summaries
 - Hennepin County bike and road network shapefiles

Analysis:

I built a **network dataset** from the bike network and road layer using, intersecting the two and merging non-road bike paths and trails.

To perform the **Origin Destination Cost Matrix**, I determined the three most common destinations for casual and member account types. I used these as the destinations for my OD Cost Matrix. While it is possible to bike on many Minneapolis streets, even those without bike lanes, I wanted to

see what the impedance was if users were to only take designated bikeways.

Using **Tracking Analyst**, I visualized how start times change depending on account type and weather. I split the data into "member" and "casual" users, then into days where the maximum temperature met or exceeded 90F.

Sources of error:

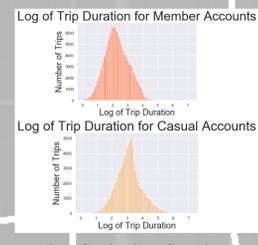
Unfortunately, the station location data for 2017 is incomplete - it only includes 200 of the stations, not all 400+. Some of the trip history is left out. The trip history table does not include x,y data so I had to join the station location data to it. In addition, the bike network layer provided by Hennepin County is incomplete and poorly drawn, hence intersecting it with the road network.

RESULTS

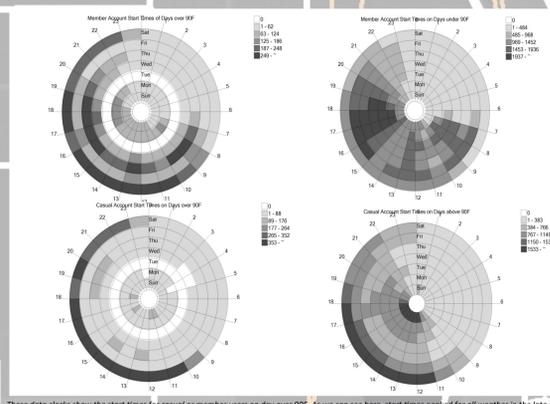
Casual users accounted for a larger number of rides, and their destinations were highly clustered in the three stations around Bde Maka Ska and Lake Harriet. Historically, the Chain of Lakes has been attractive to wealthier residents, with parks and large homes throughout the area. This neighborhood also attracts many tourists, and easily connects to the wealthy southwestern suburbs.

However, these stations are not as well connected to the rest of the city's bike network. As we can see in the large map, trips between these stations and others in the Nice Ride station are far apart. There are fewer connections between stations if one is to just use the bike network. However, the roads in this area are wide and easily bikeable even on streets without bike lanes. Connectivity also does not reach areas further north than downtown.

Member accounts had high numbers of rides across more stations, but the most-used stops were all on the Minneapolis campus of the University of Minnesota (that is a bike/busway that connects the St. Paul campus, but that is outside the scope of this research). The University provides discounted memberships for students and faculty, which could account for the high numbers of registered users. Connectivity in this area was also significantly higher. There are many bike lanes and



The transformed trip duration for casual accounts are slightly longer, which may be a result of the decreased connectivity between the stations casual users chose to visit.



These data clocks show the start times for casual or member users on day over 90F. As we can see here, start times peaked for all weather in the late afternoon.

bikable paths through campus. I also wanted to examine the impact of weather on trip behavior between casual and member accounts. To do this, I separated the data into days where the average temperature exceeded 90F and days where it was below 90F. In most of the bikeshare literature, start times peak during the morning and evening commute. In the Twin Cities, however, start times peak in the mid to late afternoon. This may be because people chose alternate methods of transportation in the morning (maybe taking the bus or light rail) and then bike home when the weather is better.

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Projection: NAD 1983 StatePlane Minnesota South FIPS 2203 Feet
Data Sources: Hennepin County Open GIS, Nice Ride, NOAA Daily Summaries

Nice Ride stations

- Most common destinations for casual riders
- Most common destinations for member riders

Distance on bikeway network

- 0 - 1
- 2 - 3
- 4 - 6
- 7 - 8
- 9 - 10

Bike Network

