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Introduction to GIS Methods

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Revealing Transportation (In)equity in Brooklyn: An Analysis of Bike Lane Placement,

Commuting Characteristics, and Income

One Sentence Project Summary

This project examines whether the placement of bicycle lanes in Brooklyn, NY is equitable in that lanes are located where people bike to work and in lower income areas; it contributes to a larger discussion about transportation equity, the importance of green infrastructure, and neighborhood investment.

Purpose and Background

Bike equity has become a popular topic, as planners and scholars have begun to examine the installation of bike lanes through a more critical eye. Most people can agree that cities should invest in bike lanes in order to alleviate automobile dependency and carbon emissions, traffic congestion, and overcrowded public transportation. However, debates have emerged over whether cities are placing bike lanes in places that are accessible to low-income commuters, and if so, whether these bike lanes are safe, in that they are separated from traffic rather than sharing the lanes with traffic. Bicycle lanes, often used less than other forms of public transportation like subways and buses, are an important aspect of the larger conversation of transportation equity. Some of the issues in New York City regarding transportation equity include rising Metrocard

fares, lack of accessibility to stations, and delays and partial shutdowns that cause certain areas to be cut off from efficient sources of public transportation.

There are a lot of critiques about how cities like New York are not making their transportation equitable, as well as theories about how to achieve equity, and my findings with this project quantitatively identify demographic and infrastructural trends to show how bike equity is improving or not improving.

Literature Review

Research regarding transportation/bike equity speaks to the importance of green infrastructure in a city and takes this idea further by interrogating whether bike lanes, and by extension bike shares, are equitable. Equitable distribution means that the lanes are serving the people that are biking the most and that the city is catering to a larger demographic than simply young, white, middle-to-upper-class, eco-conscious cyclists. Research finds that as cities are turning to green infrastructure like bike lanes in order to reduce carbon emissions and automobile dependence and congestion, these projects are often tailored to these more privileged cyclists. However, low-income, people of color are often the ones using bike lanes the most, and have different needs and opinions of bike lanes than these more privileged cyclists. One limitation of some of the research I've discovered is that a narrative of "economic necessity" is used to explain why low-income people bike to work, while the narrative of "choice" and "eco-consciousness" is used for wealthy cyclists. Part of investigating bike infrastructure and riding habits in Brooklyn is to evaluate how these factors operate in a city such as New York, which has far-reaching subway and bus networks, and has people of different socioeconomic statuses living side by side in neighborhoods currently undergoing gentrification.

In CityLab article titled "You Can't Design Bike-Friendly Cities Without Considering Race and Class", author Anne Lusk states that while many U.S. cities have invested in grocery stores, community centers, and schools in marginalized neighborhoods, they rarely give bike lanes any attention; many of the bikes lanes created are less safe in that they have "sharrows", symbols of a cyclist below two arrows that are painted in a lane of the street to denote that this lane is meant to be shared by bikes and cars. Bike lanes that are safer, in that they are protected from traffic, are more often found in affluent neighborhoods. Lusk found that unsafe bike routes could deter cyclists who fear being injured by passing traffic. In a 2017 report titled "Safer Cycling: Bicycle Ridership and Safety in New York City" published by the NYC Department of Transportation, the city reported that New Yorkers are biking 150% more than they were a decade ago. Furthermore, within this past decade, New York has increased its efforts to make cycling safer and more convenient. Since 2006, the city has added 308 miles of conventional bike lanes and 74 miles of protected ones. In the future, the city hopes to expand the bike share system Citi Bike, continue to install 50 miles of bicycle facilities per year, and increase the percentage of New Yorkers living near a bicycle facility from 80% to 90% by 2022.

Data

Bicycle Routes of New York City (NYC Open Data, 2017)

- I used this shapefile to map Brooklyn's bicycle lanes as of 2017 in all of my maps. I used the corresponding .csv file, which indicated the date of installation and the class (protected/marked/shared) of each bike lane to run SQL statements in ArcMap in order to map certain bike lanes.

Census Tract Boundaries in Brooklyn (American FactFinder, 2017)

- I used this shapefile in place of the TIGER/Line shapefile from the 2010 Census so that the boundaries of the tracts were sure to match up with my 2017 data.

Income in the Past 12 Months (American Community Survey, 2010 + 2017)

- I used the 2017 data to map median area income for all Brooklyn Census tracts alongside the bike lanes. I used both the 2010 and 2017 data to show the percent change in median area income for all Brooklyn Census in relation to the bike lanes that had been constructed in or after 2010.

Means of Transportation to Work: Workers 16 and Over (American Community Survey, 2017)

- I used this data to map the percentage of workers in each Brooklyn Census tract who biked to work to present in relation to the locations of bicycle lanes.

Methodology

After downloading the data listed above, used Excel to clean up the data and perform calculations. I deleted many columns which were not relevant and in the Means of Transportation to work spreadsheet, I created a separate column where I calculated the percentage of people who biked to work for each Census tract.

The first map that I made was a choropleth map showing the percentage of people who biked to work, broken down by Census tract, with a layer of the bike lanes. To start, I added a shapefile of the Census tract boundaries which I had downloaded from the U.S. Census Bureau and imported the Means of Transportation to Work spreadsheet which I had edited in Excel. I encountered a problem, however, when I attempted to join these two data sources and found that there was not a matching field. So, I downloaded a shapefile from American FactFinder by selecting 2017 data for Brooklyn and clicking the option to create a map. Then, I was able to join

the two shapefiles. I used Symbology to create a choropleth map with a monochromatic color scheme and no outlines around the tracts; I divided the data into 5 manual classifications. Next, I added the shapefile of New York City bike lanes and used the SQL statement 'boro'= '3' to only select the bike lanes within the borough of Brooklyn. I then clipped these selected features to the Brooklyn boundary shapefile in order to get rid of any bike lanes that extended towards the water and the beaches. I exported these selected features so I would have the shapefile for the rest of my maps.

For my second map, I followed a similar process. I created a choropleth map of the median income for each Brooklyn Census tract. I used the same graduated color scheme as in the first map and 5 classifications with manual breaks as I saw fit. Then, I added the shapefile of the Brooklyn bike lanes I had created in the previous map. For my third map, I showed the quality of the bike lanes in comparison to the median income of each Census tract. Whereas I used 5 classifications in the second map, I used 3 classifications in this one, which I broke up manually. I only used three classifications because I wanted the focus of the map to be on the bike lanes. For this map, I wanted to show the quality of the bike lanes and grouped the lanes into two categories: protected and conventional lanes, and signed/marked lanes. Protected and conventional lanes are safer than signed/marked ones. The attribute table for the bike lane shapefile has a field called 'facilitycl', where 'I' indicated protected, 'II' indicated conventional, and 'III' indicated signed/marked. Therefore I was able to run an SQL statement of 'facilitycl' = 'I' or 'II' and exported these selected features to a separate shapefile layer. I ran a second SQL statement of 'facilitycl'= 'III' to select the signed/marked bike lanes and exported these features as another separate layer. In Symbology, I mapped the protected and conventional bike lanes in

green and the signed/marked ones in red, colors that contrasted against the purple graduated

color scheme and connoted good and bad, respectively.

The final map I created displayed a choropleth map of the percent change in median

income between 2010 and 2017 and the bike lanes that were built in or after 2010. To only select

the lanes that had been created in or after 2010 I ran the following SQL statement: 'date_instd'

>= date '2010-01-01 00:00:00'. Then, I joined the 2010 Median Income spreadsheet to the 2017

income shapefile and used the Field Calculator to calculate the percent change in income

between 2010 and 2017. The equation I used was: [(2017 income-2010 income)/2010 income].

Then in Symbology I used the same graduated color scheme as I used for all my maps and

mapped the percent increase in income, changing the decimal number to a percent. For all of my

four maps, I added a light grey base map for context, a title, legend, scale bar, North arrow, and

source.

Findings

Percent of Workers 16 and Over Who Biked to Work in 2017 Broken Down By Census Tract in Brooklyn, NY
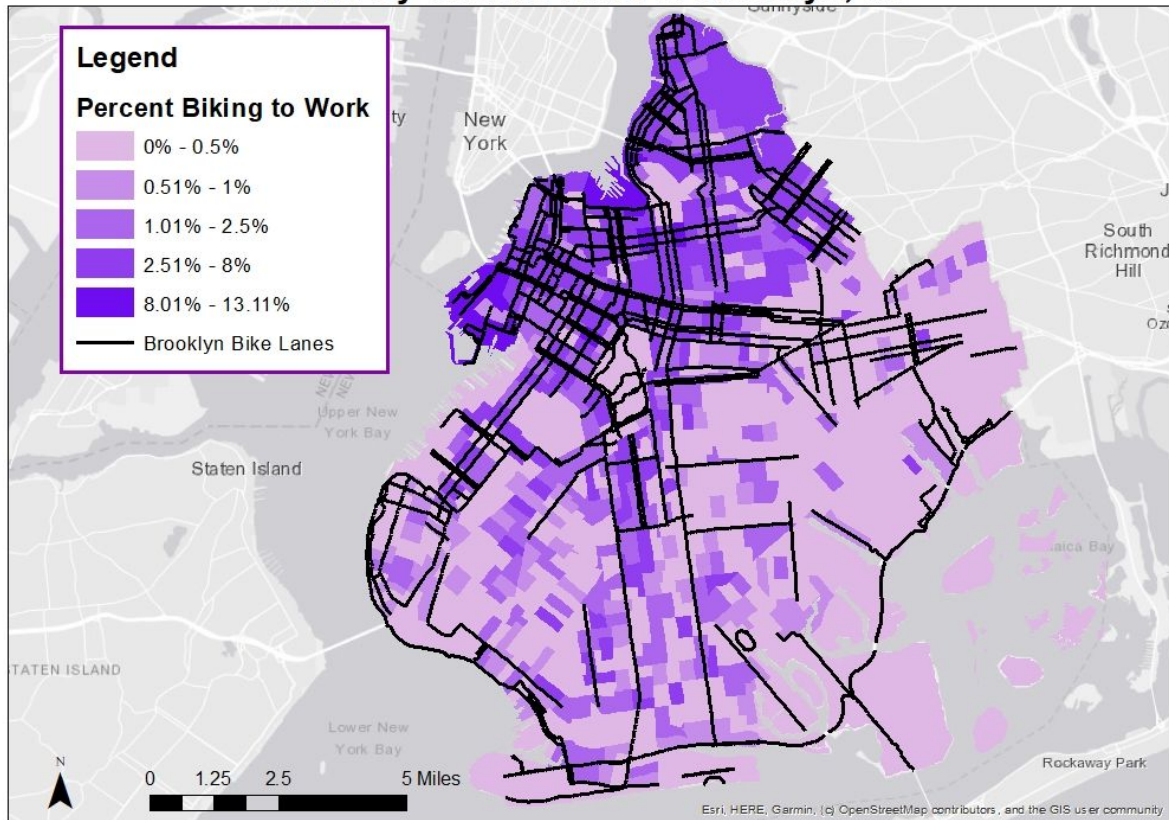
Source: NYC Open Data Bicycle Routes of NYC 2017, ACS 2017 Estimates. Author: Jennifer Congdon. Date: April 25, 2019.
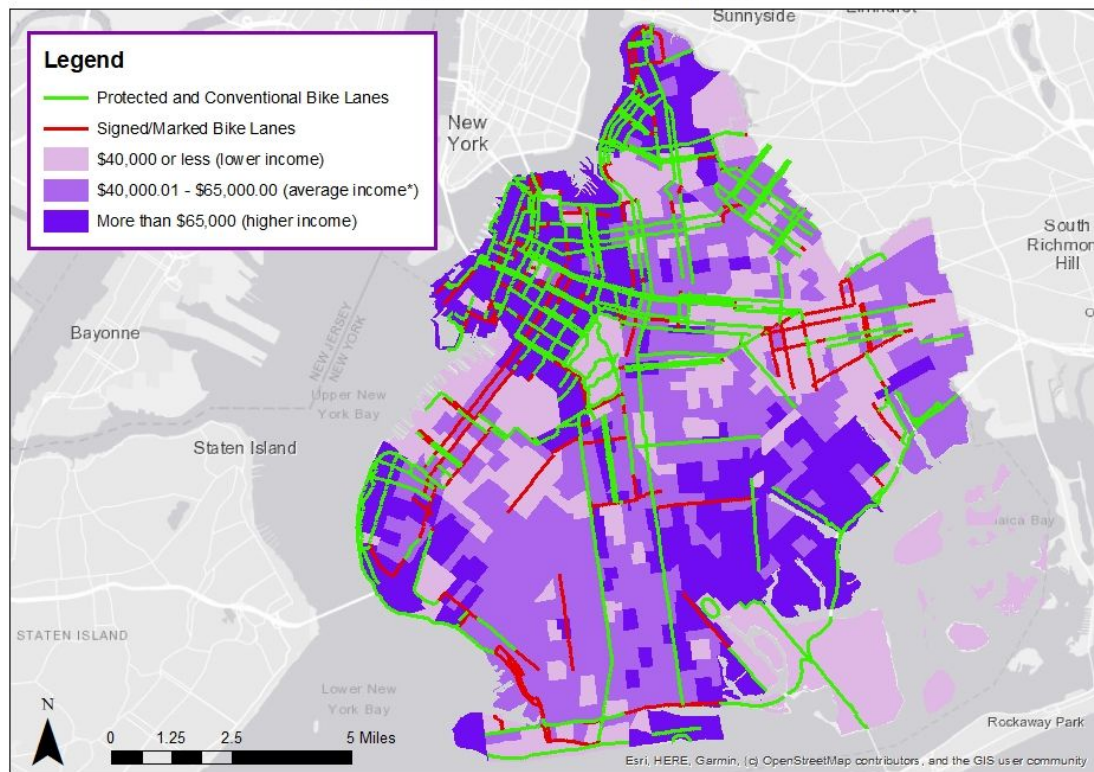
This map displays the percentage of people who commute to work by bicycle and all the bike lanes in Brooklyn. This map shows a strong positive correlation between the presence of bike lanes and the percentage of people who commute to work. For instance, the northern portion of the borough has the densest concentration of bike lanes and the greatest percentages of people who bike to work. Moreover, in the southern half of the borough, where there are fewer bike lanes, the percentage of bike commuters are higher in the tracts that surround these lanes.

2017 Median Income by Census Tract and the Placement of Bicycle Lanes in Brooklyn, NY

Source: NYC Open Data Bicyle Routes 2017, ACS 2017 Estimates. Author: Jennifer Congdon. Date: April 25, 2019.
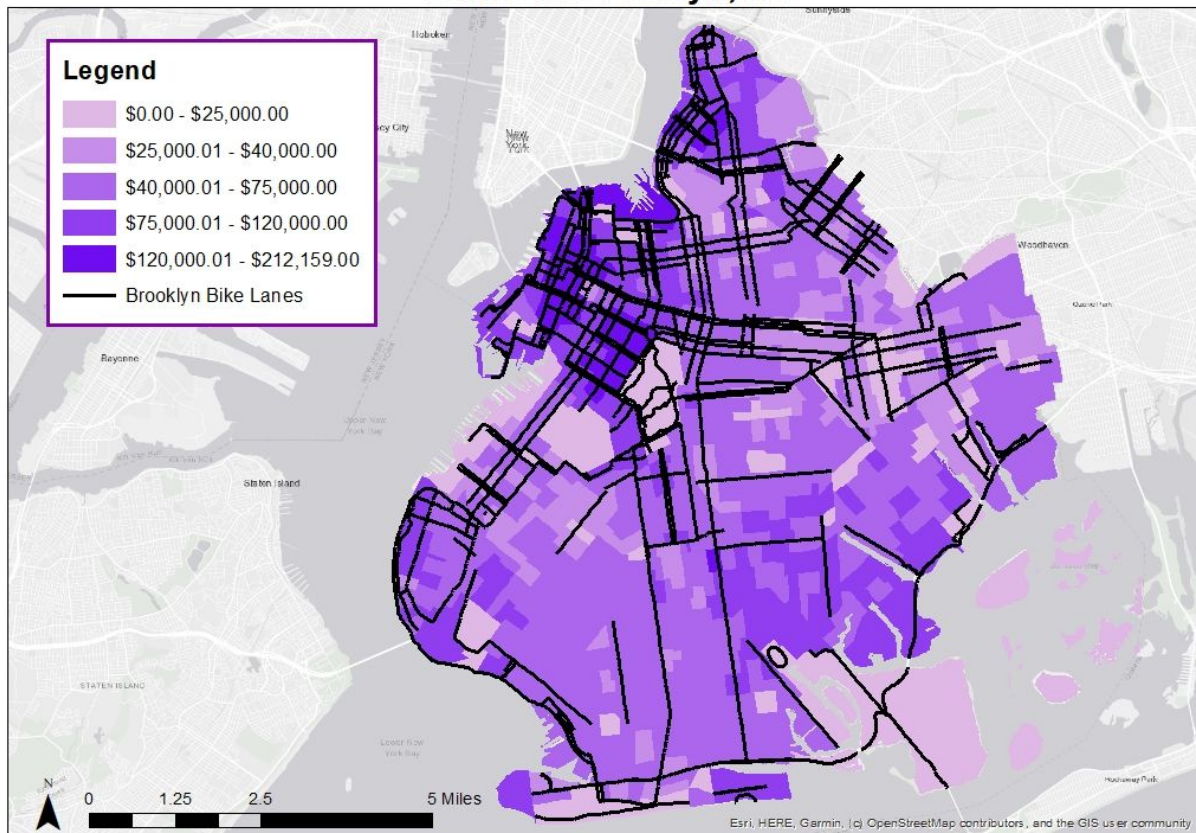
This map shows the 2017 median income in each Brooklyn Census tract, as well as all the bike lanes in the borough. There is a positive correlation, although not as strong as in the previous map, between the presence of bike lanes and the median income. Specifically, the areas with the highest income are in downtown/Northern Brooklyn, which has the greatest density of bike lanes.

Relationship Between Quality of Bike Lanes and 2017 Median Area Income in Brooklyn, NY

Legend
— Protected and Conventional Bike Lanes
— Signed/Marked Bike Lanes
$40,000 or less (lower income)
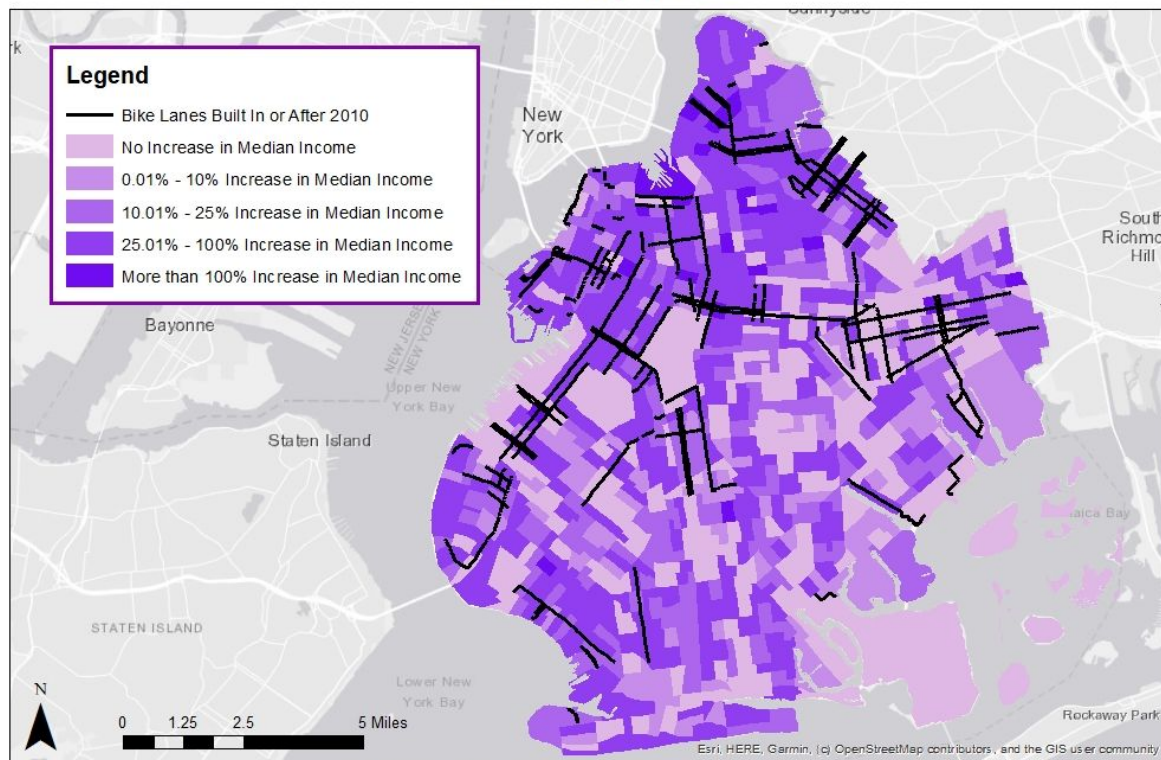$40,000.01 - $65,000.00 (average income*)
More than $65,000 (higher income)

*Range based on Brooklyn median income of $52,782
Source: NYC Open Data Bicycle Routes 2017, ACS 2017 Estimates. Author: Jennifer Congdon. Date: April 29, 2019.

This map shows the quality of Brooklyn bike lanes according to two categories: protected and conventional (which are the safer types of lanes) and signed/marked (which are the least safe type since in this type of lane, automobiles and cyclists share the same lane). The map displays the different categories of lanes with a choropleth map of median income underneath. There is a somewhat positive correlation between income and better quality bike lanes; the northern/western parts of the borough have high median income and better bike lanes, while the cluster of lanes in the northeast of the borough are less safe and are located in lower income areas. However there are some safer lanes located in lower income areas, and vice versa.

Relationship Between Construction of Bike Lanes In or After 2010 and Percent Change in Median Area Income between 2010 and 2017 by Census Tract in Brooklyn, NY

Source: NYC Open Data Bicycle Routes 2017, ACS Estimates 2010 +2017. Author: Jennifer Congdon. Date: April 29, 2019.

This map displays only the bike lanes that were built in or after 2010 with a choropleth map underneath of the percent change in median income by Census tract between 2010 and 2017. There is a fairly significant correlation where the newest bike lanes have seen the highest increases in median income in the area around them.

Limitations

The main limitation of this study is that the Census/American Community Survey only provides data on the mode of transportation people use to commute to work, but not the mode of transportation they use most often in their lives. After all, commutes make up only a fraction of the trips that people take, and may not be representative of their most used form of

transportation. Moreover, while there is limited data on the usage of Citi Bike, the city's bike share program, there is not data on how much each bike lane is used. However, as mentioned in the literature review section of this report, the NYC DOT reports that bike ridership has increased 150% in the past decade. Another limitation of this study is that there wasn't available data that gave demographic factors like income and race of the group of people who did bike to work. In the data on means of transportation to work based on factors like income and race, bicycles are grouped in the same category as taxis and motorcycles, which makes it impossible to know the demographics of only the people who bike to work.

Recommendations and Conclusions

My findings imply that significant efforts have been made on behalf of New York City to install additional and more equitable bike lanes, and that these efforts have produced mostly positive results. The map of the bike lanes built in or after 2010 show how the city has expanded lanes to the southern and eastern portions of the borough and developed more in the downtown area. These areas, especially downtown, have significant proportions of bike commuters, implying that where bike lanes are, people are biking. While expanding bike lanes into the eastern part of the borough, which is lower income, is a good step, these lanes are only signed/marked and therefore less safe. Moreover, areas where new bike lanes have been built have seen the highest increases in median income. This phenomenon can be problematic if these income increases are in fact correlated with increased transportation access, since income increases could lead to displacement. Expanding transportation options into low income areas wouldn't be equitable if it caused displacement. However, further research needs to be done to investigate these correlations. For instance, are new bike lanes causing median income to

increase, or is the city building new bike lanes because the area is becoming more wealthy? Or are the two variables correlated without one actually causing the other?

Nevertheless, installing new bike lanes deserves to be on the city's agenda. For one, bikes don't rely on fossil fuels and cause pollution, which cannot be said for automobiles, buses, and trains. And second, the city's transportation system is struggling, to put it mildly. The MTA's state of disrepair has become a contested political topic, as there appears to be no easy solution for repairing, or even getting the funds to repair, the ancient subway system. Bike lanes, while not used nearly as much as subways, are incredibly inexpensive to install and maintain compared to subways and buses. Constructing more bike lanes can be a fairly efficient way to provide people with a suitable mode of commuting. Finally, with the possibility to greatly expand biking, the city needs to look towards other aspects of bike infrastructure; namely, installing more bike parking and expanding Citi Bike beyond a short radius of midtown Manhattan.

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