People-Mapping Through Google Street View: A New Orleans Experiment

Richard Campanella   November 2017

Google Street View is the most comprehensive visual record of the built environment in history — a detailed photo-atlas with millions of miles of streetscapes worldwide. [1] It's a distorted view, to be sure. Most affluent countries are well scanned, but some have opted out, others have spotty coverage, and more than half of the world's countries have not been visited at all. Big cities like New York and San Francisco have been photographed as many as a dozen times, while the likes of Chugwater, Wyoming, have seen the Google camera car exactly once.

Yet even in that tiny prairie town, the orange icon affectionately known as Pegman can give me, sitting at my desk in New Orleans, a decent sense of the community's housing stock, infrastructure, environs — its human geography, *tout ensemble*. I can even find a few Chugwaterians at work or play, on that sunny day in 2011 when the camera car rolled through town. Their unaffected poses convey a disconcerting intimacy even as their blurred faces remind me not to get too familiar.

Fisheye view of Decatur Street at Frenchman, New Orleans. [Google Street View/Places Journal]

The camera also registers absence. Of the 2.7 million miles of paved roads in the United States, most are hardly ever walked. [2] Even in major cities, many streets are empty at any given time. The rhythms of our lives — home, work, school, socializing, recreating, running errands — constitute six overlapping but distinct diurnal geographies, and while we can map some of these domains, using census data on residences, for example, or Bureau of Labor statistics on job sites, we lack comprehensive information about where and when people take to public space.

The author (in white hat) photographed by the Google camera tricycle, 2012. [Google Street View]

But what if Street View can fill in the gaps? If only we could plot those pixelated pedestrians, we would have a spectral Census Bureau of urban space, a remote apparatus through which humanity and its public expressions can be enumerated and mapped.

Measuring Aggregate Humanity

As a geographer who studies New Orleans, I consider mapping aggregate humanity — i.e., everyone — to be the Holy Grail of urban metrics. This is a challenging city for such an inquiry, given the tumult that followed Hurricane Katrina in 2005 and the years-long recovery. Yet there are many initiatives whose success entails an understanding of where people are and where they are not. The map of my dreams

would show how the city's 400,000 residents and 10 million annual visitors typically distribute themselves in public spaces like streets, sidewalks, parks, and porches. Think of it as foot-traffic mapping, similar to putting a GPS tracker on every person's head and aggregating their movements over time.

A metric of aggregate humanity would help spatially characterize key urban phenomenon, including livability, business activity, civic engagement, social capital, gentrification, and "eyes on the street," and could point to opportunities for improvements. Moreover, it would aid the evaluation of policy and design interventions such as upzoning, street diets, bike lanes, greenspacing, and overlay districts. Finally, it could be used as a denominator in normalizing socio-spatial phenomena such as crime and traffic collisions.

Allow me to explain with a local example. Having written a book about Bourbon Street, I often get press inquiries when violence breaks out on the rollicking strip. There have been a dozen shootings since 2010, killing six and wounding 35. Each tragic incident makes national news and elicits calls for stricter policing, to which authorities have responded with proposals for street checkpoints, metal detectors, and traffic reconfigurations — this in a city with limited means, overstretched police, and one of the highest crime rates in the nation.

But while the absolute number of shootings on Bourbon is all too high, it is not evidence of exceptional danger in need of extraordinary resources. Why? Because the underlying denominator — that is, the total aggregate humanity occupying this space — is enormous. My live pedestrian surveys show that over 100 people per minute stroll Bourbon's busiest blocks on weekend evenings, with over 200 per minute during special events and rarely under 40 per minute on quiet weeknights. Millions of people set foot on Bourbon Street annually, in regular wave-like patterns, and all the good and bad of humanity travels with them. [3] So when we normalize the dozen shootings by the roughly 50 million pedestrian trips since 2010, Bourbon Street goes from being an absolutely dangerous space to a relatively safe one — among the safest in town. Conversely, it's the little-known backstreets with occasional shootings but hardly any pedestrians that should be flagged as relatively dangerous.

Similarly, the intersection of Canal and Bourbon Streets has been identified among the "most dangerous" for pedestrians, with ten crashes in 2014 and eighteen in 2017. [4] But normalized by the millions who cross paths here, these are relatively low rates. That's not to say the problem goes away; it's to recast what we mean by "most dangerous."

We readily differentiate between absolute and relative statistics at the city, county, and state level, because the total population is easily available. Yet we consistently neglect this fundamental arithmetic when it comes to streets and public spaces, because their denominators are tough to measure.

While Google Street View images are not regularly used in scholarly research, they can be a cost-effective alternative to traditional social-surveying methods, under the right conditions. Public health experts have used Street View as a neighborhood auditing tool, and have found it to be a reliable indicator of broader trends and patterns, if not fine targeted phenomena. [5] And researchers at the MIT Media Lab used pairs of geo-tagged street images to "map the inequality of urban perception" by soliciting online input about which scene looked "safer," "more upper class," and "more unique." [6] Urban planners Reid Ewing and Otto Clemente assessed the viability of Google Street View and its competitors Bing Streetside and Everyscape for counting pedestrians, compared with live street surveys. They found that human raters were reliable in online counting, and that Google Street View had the strongest correlation with live counts (Cronbach's alpha = 0.864 on a scale of zero to one). [7] Other researchers have proposed methods to remove people from images automatically, which would enable more systematic studies. [8] Until such tools are widely available, researchers will have to devise sampling strategies, set up protocols, and manually deploy that invaluable remote assistant, Pegman.

Google Street View was not, of course, designed for the collection of research data. It doesn't control for season, weather, special events, or the time of day or week. Yet to the extent that such moments of non-representativeness are evenly spread across the study area, they are no more problematic than the anomalies plaguing other survey methodologies. Off-street spaces are a notable limitation, but Google now deploys camera-equipped tricycles in parks and on campuses, and even pokes its periscope into stores and restaurants. And these constraints are offset by the strengths we all know well: Street View is free, convenient, quick, data-rich, spatially integrated, temporally deep, regularly updated, and constantly expanding. Try budgeting for all that in your next research proposal.
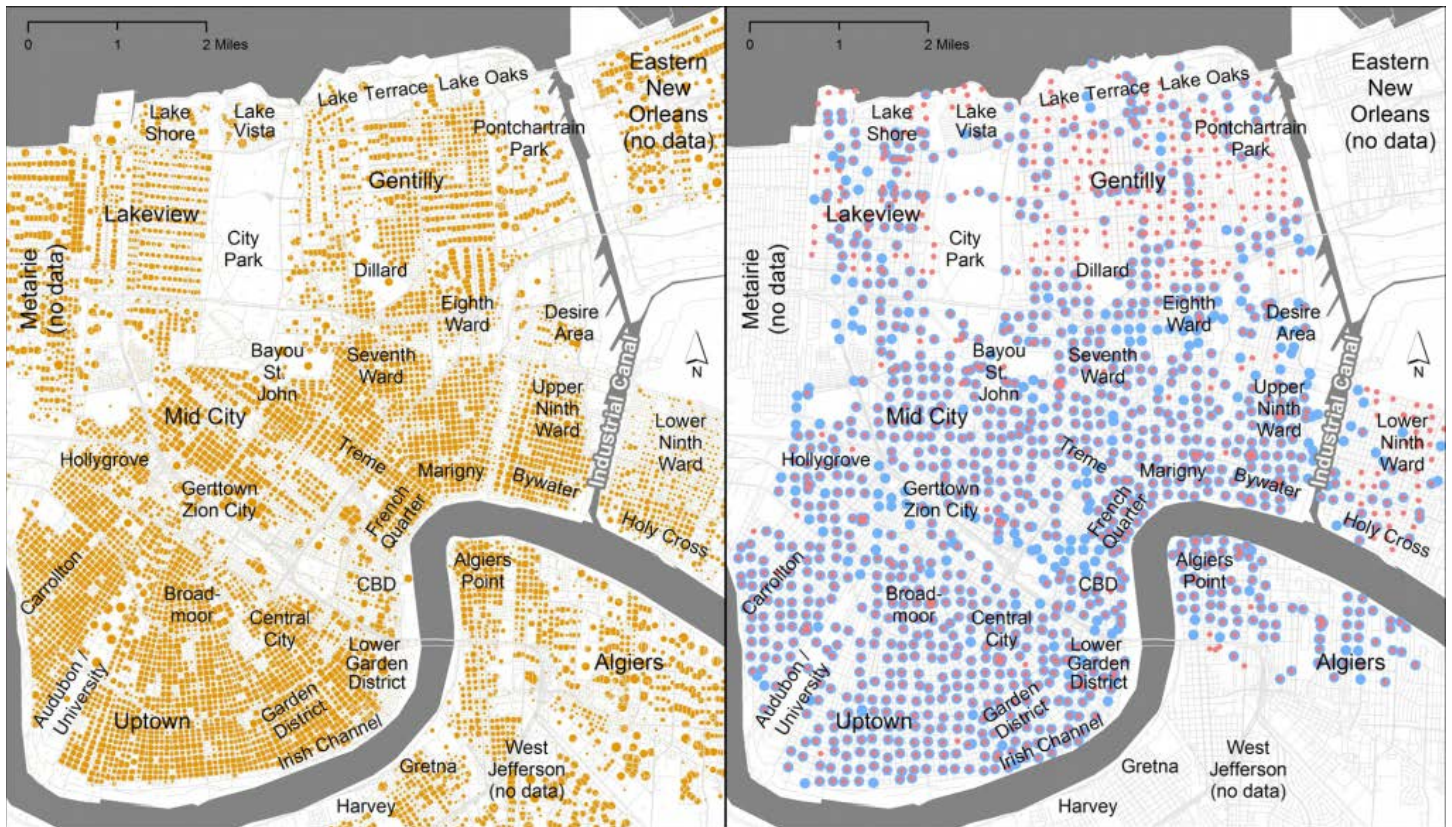
Left: Distribution of New Orleans residents, according to the 2010 census. Right: Coordinates of Google Street View images analyzed for this study; n = 1,381 sampling points in 2007 (red) and 1,305 in 2016 (blue). [Richard Campanella for *Places Journal*]

Methods

For this study, I used GIS to create a grid of 1,500 points throughout the heart of New Orleans and intersected them with a street layer. Addresses closest to each point were dumped into a spreadsheet and scrubbed for aberrations, then passed on to a perseverant graduate assistant, Elliott Petterson, with the following instructions:

- Position Pegman at the given address in Google Maps and invoke the latest Street View imagery (in this case, from spring 2016).
- Rotate Pegman 360 degrees and count all discernable people, be they standing, walking, seated, queued at bus stops, playing in schoolyards, perched on porches and balconies, etc. Exclude those in vehicles or entirely indoors.
- Using the same process, count all bicycles.
- Rate the level of visible graffiti, on a scale from 0=none; 1=tiny/possible; 2=a little; 3=some; 4=ample; to 5=dominant; excluding street artworks that appear to be sanctioned murals.
- Finally, repeat all steps using the earliest available imagery (from 2007).

Like all seemingly straightforward protocols, this one soon generated questions. How to handle blocked views? Partially visible bodies? Big crowds? Infants? Should we include industrial areas, cemeteries, and closed streets? And what about that bane of all GIS analysts, the null sample, where no Street View imagery was recorded? We laid down rules for these and other quirks and ended up with 1,381 points for 2007 and 1,305 for 2016. Each point required one to four minutes of rating time, depending on street activity, and the whole process took about 100 hours. The results were plotted in GIS and spatially analyzed.

Comparison of views from 2007 (left) and 2016 (right). Top to bottom: Camp Street, Decatur Street, St. Claude Avenue, Freret Street, all in New Orleans. [Google Street View]

Results

These maps depict the number of people visible in Street View images at those 1,300-plus points in 2007 and in 2016, which were then interpolated into a heat map. Before we decipher the patterns, let's put some numbers on them. In 2007, each omnidirectional image had an average of 1.1 visible persons, with a maximum of 42 people (on Decatur Street in the French Quarter), and a standard deviation of 2.6. Fully 59 percent of the images had no people at all, and in many cases the only people visible on otherwise vacant streets were workers repairing damaged homes. Nearly a decade later, the average surged to 3.5 people per location, and the maximum was 219 (on Bourbon Street), with a standard deviation of 10.1. Only 37 percent of the sampled streets were empty. What's going on here?
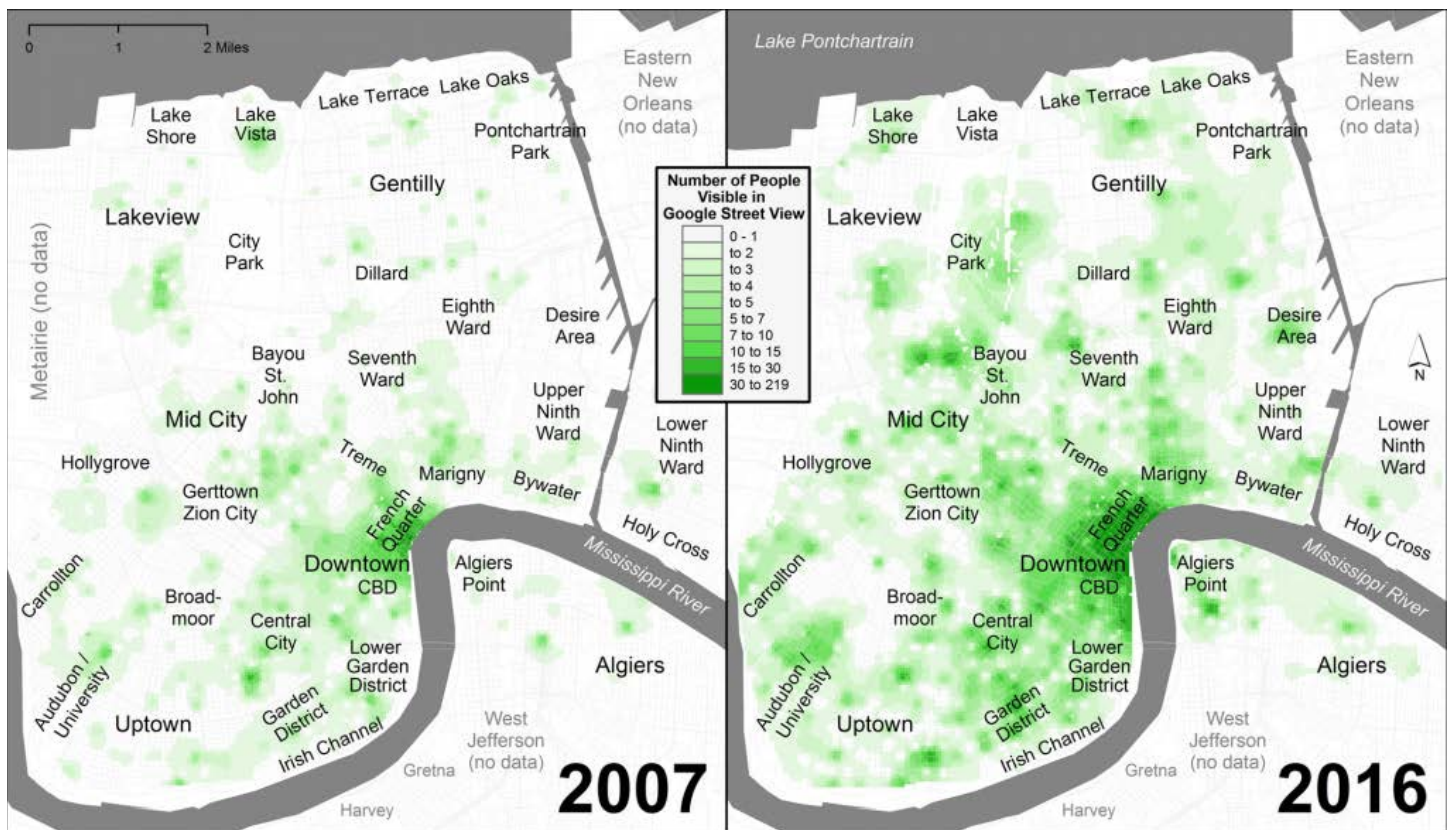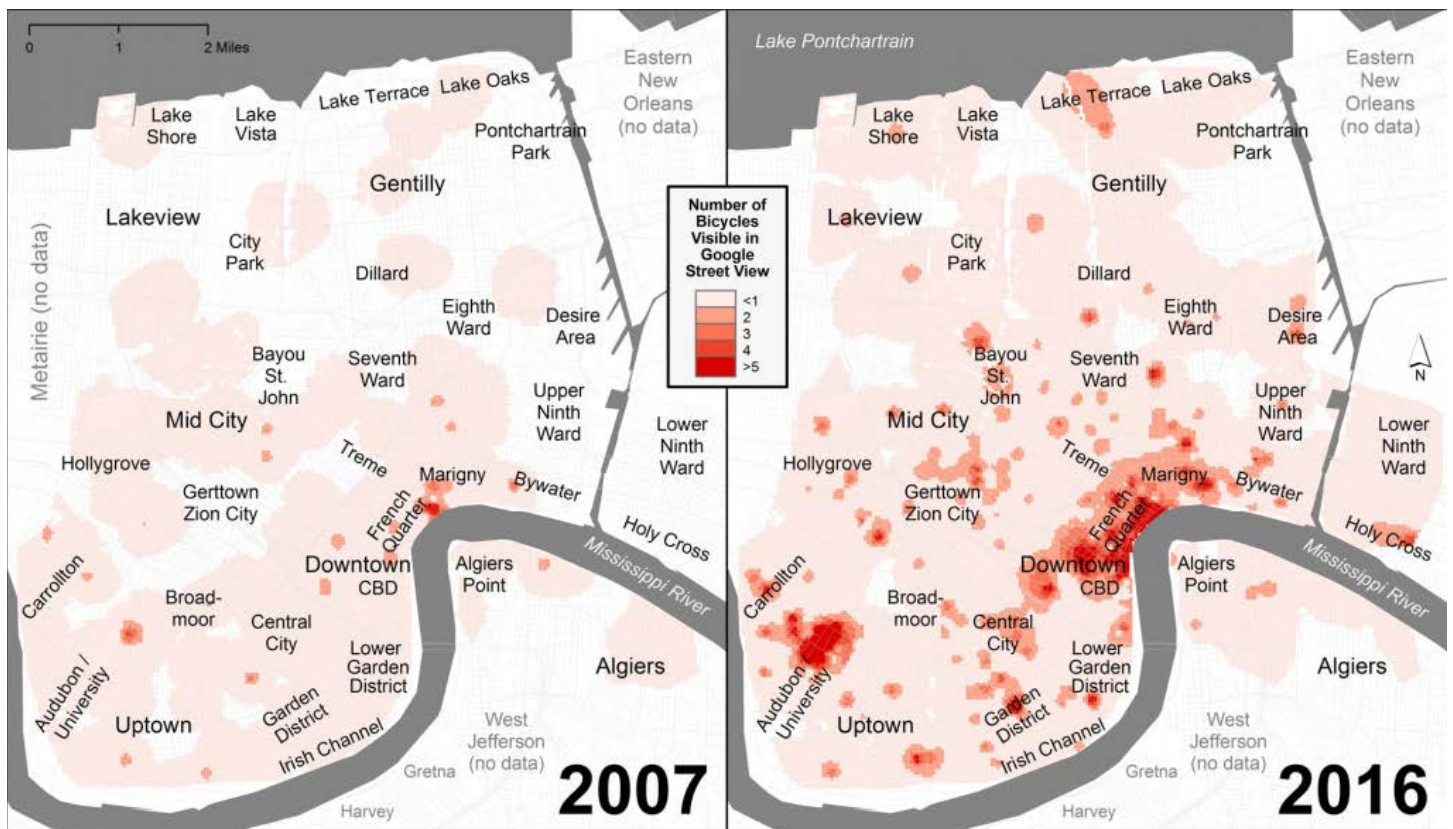

People Visible in Google Street View, New Orleans, 2007 and 2016. [Richard Campanella for Places Journal*]*

One major explanation for this rise in public space occupancy is the Katrina recovery. When the Google car first roamed New Orleans in the summer of 2007, two years after the hurricane and floods, wrecked houses prevailed in two-thirds of the study area, and the city's total population and visitation were both down markedly. Recovery efforts got off to a rocky start, and debates about issues such as crime, the future of public housing, and the replacement of Charity Hospital grew to a contentious crescendo. The recovery finally gained momentum around 2010, and within a year or two, New Orleans — at least the historic district — became economically hot, culturally cool, and socially transformed. Newcomers moved in, restaurants opened, and tourists ventured further. (The New Orleans Tourism Marketing Corporation runs a campaign called "Follow Your NOLA," explicitly encouraging visitors to explore citywide.) Between 2007 and 2016, the city's population increased by 36 percent, from about 288,000 to 391,000, and its total visitation grew by 47 percent, from 7.1 million to a record-breaking 10.45 million.[9] Thus, the post-Katrina "renaissance" accounts for some of the increased streetscape occupancy, particularly downtown.

But note that our average Street View counts rose from 1.1 to 3.5 over nine years. That's a 218 percent jump, much larger than the corresponding increases in residents and tourists. So something else is going on here: people are going out *in* New Orleans at a pace far greater than they've returned *to* New Orleans.

That "something else" may be the much-ballyhooed nationwide trend of young professionals rediscovering urban centers. (A trend that now appears to have peaked, according to its most famous propagator, Richard Florida, who has declared that "The Urban Revival is Over." [10]) But even here, there is a Katrina tinge: many newcomers who have arrived since the flood are self-selected for traits of civic engagement and meliorism. They tend to be smitten with urbanism in general and New Orleans in particular. Many work for nonprofits or schools; others are entrepreneurs and activists; and they speak the language of sustainability, resilience, and place-making. All this *esprit* tends to express itself in the public space, as this is a sociable and outdoorsy bunch. They congregate. They walk. They go out to eat and enjoy live music. They relax at parks, revel at festivals, and dance at second-lines. They also fix up historic houses, which gives old neighborhoods new cachet (and new AirBnB spaces) and draws more people to a wider area.

Perhaps most conspicuously, they bike. Several new bike-rental and bike-tour businesses have opened in and around the downtown faubourgs, while the Bywater streets in which I was one of very few bikers 15 years ago are now full of retro cruisers. How many more? Here's evidence from Street View, showing all visible bicycles, either rolling or parked, in 2007 and 2016.
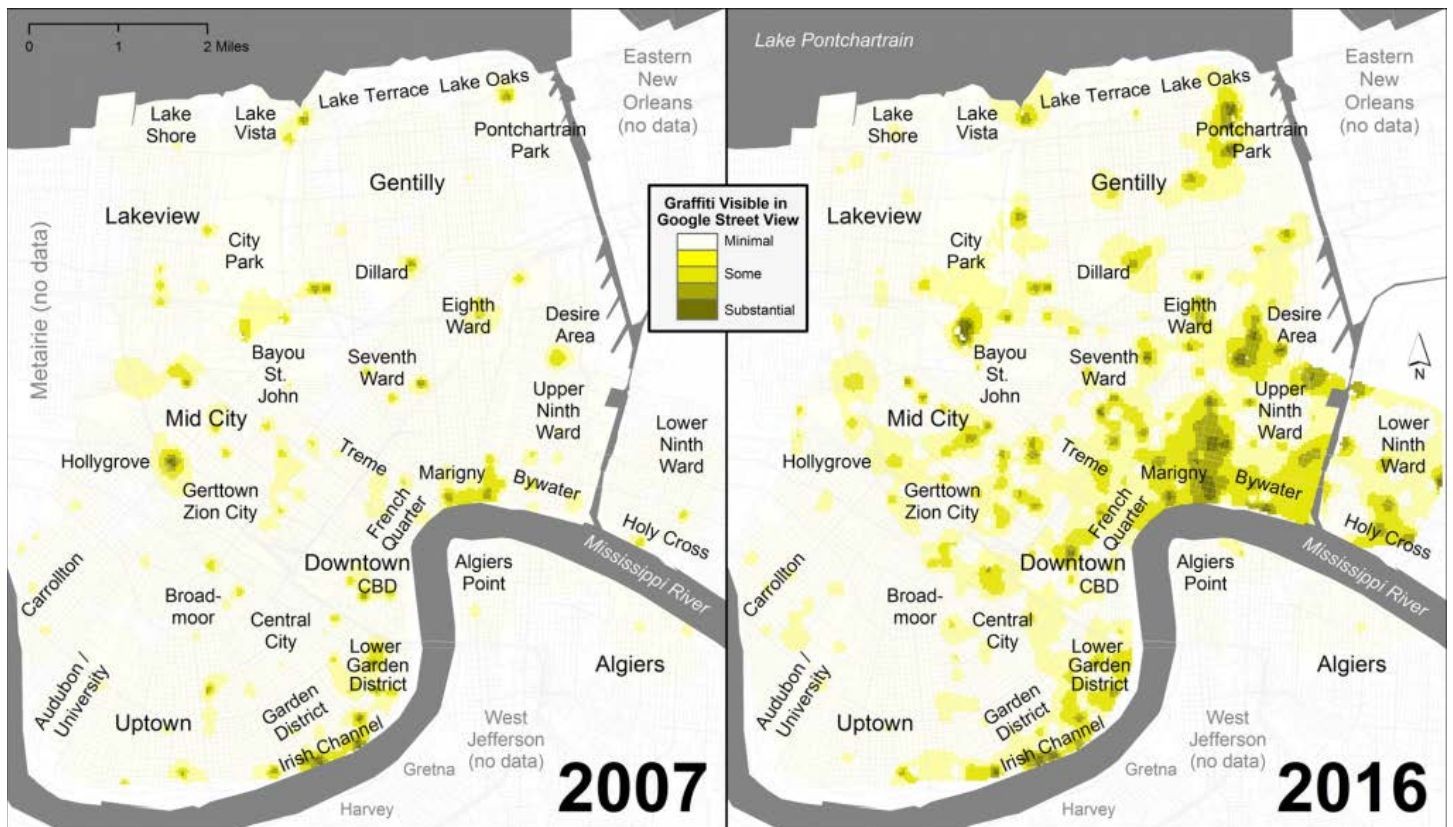

Bicycles Visible in Google Street View, New Orleans, 2007 and 2016. [Richard Campanella for Places Journal*]*

In 2007, each viewpoint had an average of 0.12 bikes, and there were no bikes at all in 91 percent of the images. The maximum was 9 bikes, on hipster-friendly Decatur. In 2016, there were five times as many bikes, an average of 0.59, and the streets with zero bikes dropped to 72 percent. The maximum was 47 bikes, uptown on Freret Street, where an overlay-district rezoning triggered a dramatic boutique-ification of local businesses. In a distant second, there were 14 bikes on Baronne Street, where an unusually wide bike lane opened in 2014. [11] The explosion of cycling in New Orleans, again paralleling national trends, has been abetted by a nearly tenfold increase in bike-lane mileage since Katrina. [12]

And that leads to the big X factor: government investment and intervention in the city's public spaces. In the past decade, New Orleans has received billions of dollars in federal funding, much of it Katrina-related, for urban infrastructure improvements. Streetcar expansions, community amenities and facilities, street enhancements, parks, walking and biking paths — all draw people into public space, at least in theory. They also pave the way, sometimes literally, to higher real estate values and gentrification. Further, the city has seen effects from the

highly controversial demolition of public housing complexes and their eventual replacement with a smaller number of New Urbanist mixed-income units; the equally controversial bulldozing of an entire neighborhood for the University Medical Center and Veterans Hospital; and the creation of thousands of new residential units with the aid of federal Historic Tax Credits or Low-Income Housing Tax Credits. These and other transformations have put feet on streets in new spaces, and they're showing up in our maps.

I imagine most readers would agree that having more people in public space and more bodies on bikes is healthy for cities. Most readers would also agree that some of the forces driving these trends are problematic, from the government's role in up-valuing real estate, to iniquitous disaster recovery, to the displacement of lower-income residents — who, we should remember, occupied streetscapes in their own way, with elders on stoops and children playing in the streets. (Rare is the sight of either in the French Quarter today.) It's also important to note that some of the patterns in these maps do not represent people *contentedly* occupying the public space, but rather relegated there.

Graffiti Visible in Google Street View, New Orleans, 2007 and 2016. [Richard Campanella for Places Journal*]*

Despair shows its face to Google's cameras, too. Homeless camps, blighted structures, and weedy lots can all be identified and mapped. Our study of graffiti confirmed what many residents have observed, that New Orleans, which previously had only casual tagging (and untagging, by a counterinsurgent known as the Gray Ghost, for his cans of gray paint) is now home to some rather talented and prolific graffiti artists whose work is concentrated in certain areas. We found that graffiti in New Orleans more than doubled in both intensity and spread from 2007 to 2016. (Average tagging went from 0.38 to 0.84 on our 0-to-5 scale, and the percent of sampled streets with visible graffiti rose from 21 to 44 percent.) Much has been written about the tortured relationship between gentrification and graffiti, with fury on all sides, from the artists who decry "revitalization" even as developers appropriate their work, to the locals who cast artists as vandals — or worse, gentrifiers themselves. What our data show is an alignment between new graffiti and the Ground Zero of the gentrification wars, the area around Marigny, Bywater, St. Roch, and along St. Claude Avenue.

Just as positive social and economic interactions can increase when people amass in public space, so can conflict — which brings us back to that other use of people-mapping data, as a spatial denominator. On a heat map of 911 calls in a recent year, there is a striking concentration in the French Quarter and on Bourbon Street.

In abstract, it might seem that these areas are the most dangerous in the city. But when we compare the 911 patterns to our people-mapping of public space, which also shows intense concentrations in the French Quarter, we can see the district is relatively safe. There are all too many fights and muggings, but they are proportionally low given the millions of people who walk these streets in the course of a year.

Conclusion, and *Lagniappe*

Google Street View offers vast amounts of qualitative urban information that is both spatially referenced and temporally revisited, and I hope this investigation shows that it can be mined for creative place-based metrics. I encourage computational researchers, particularly those who work at Google, to devise automated methods to enumerate and display distributions of phenomena such as pedestrians, bikes, and cars — sufficiently filtered and anonymized, of course, to respect privacy and ethical concerns. Though they contain artifacts and imprecisions, such data can help us understand everything from street design to street crime in new ways. Where people occupy the public realm is one of the most important dimensions of urban life, and it should inform the plans we make and the landscapes we design.

This project also yielded an interesting *lagniappe* (that's an old Louisiana word meaning "a little something extra") in the impact it had on Elliott Petterson, the Tulane architecture student who assisted me in the research. A newcomer to New Orleans, Elliott got to know the city virtually before experiencing it in person. "I will frequently walk down a street for the first time," he told me, "and encounter a block I am completely familiar with from Street View. It's a strange sensation." A Texas schoolboy at the time of Katrina, Elliott got to see what disaster recovery looks like at street level by time-traveling through the 2007 imagery. "Dumpsters … seemed to be on every other block," he said. "Sometimes the only people I counted [were] handymen and construction workers. I was witnessing the city rebuilding itself." Amid the ruins he found hope, in the form of people interacting and enjoying public space in the manner every urbanist dreams of. "I always felt a flare of excitement," he observed, "when I zoomed in on what I assumed would be a barren street, only to find a colorful party, or a family gathered on the stoop."

Notes

1. In a recent post commemorating Street View's 10th anniversary, Google reported that its camera cars had "traveled about 10 million miles," although that figure is presumably higher than the number of unique miles of imagery. See Arjun Raman, "Cheers to Street View's 10th Birthday!," *The Keyword*, May 30, 2017. ↵
2. S. Bureau of Transportation Statistics, "Table 1-4: Public Road and Street Mileage in the United States by Type of Surface," 2015. ↵
3. Richard Campanella, "Tracking Bourbon Street's Pedestrian Parade: How Do You Fence a Cloud?," *The Times-Picayune*, December 20, 2016. ↵
4. City of New Orleans, in collaboration with the Regional Planning Commission, "Pedestrian Safety Action Plan Part 1: Engineering Strategies" [PDF], July 2014; and "The 20 Most Dangerous New Orleans Intersections for Pedestrians," *The Times-Picayune*, July 18, 2017. ↵
5. Andrew G. Rundle, Michael D. M. Bader, Catherine A. Richards, Kathryn M. Neckerman, and Julien O. Teitler, "Using Google Street View to Audit Neighborhood Environments," *American Journal of Preventive Medicine* 40(1), January 2011, 94-100, http://doi.org/bnwh65; J. S. Wilson, C. M. Kelly, M. Schootman, E. A. Baker, A. Banerjee, M. Clennin, and D.K. Miller, "Assessing the Built Environment Using Omnidirectional Imagery," *American Journal of Preventive Medicine* 42(2), February 2012, 193-99, http://doi.org/fxt7kp. ↵
6. Philip Salesses, Katja Schechtner, and César A. Hidalgo, "The Collaborative Image of The City: Mapping the Inequality of Urban Perception," *PLOS ONE* 10(3), July 24, 2013, http://doi.org/f5bs55. ↵
7. Ried Ewing and Otto Clemente, *Measuring Urban Design: Metrics for Livable Places* (Washington, DC: Island Press, 2013), 83-98. ↵
8. Arturo Flores and Serge Belongie, "Removing Pedestrians from Google Street View Images," *Computer Vision and Pattern Recognition Workshops* (CVPRW), IEEE Computer Society Conference on Computer Vision and Pattern Recognition, June 2010, http://doi.org/fvrhv3; Li Yin, Qimin Cheng, Zhenxin Wang, Zhenfeng Shao, "'Big Data' for Pedestrian Volume: Exploring the Use of Google Street View Images for Pedestrian Counts," *Applied Geography* 63, September 2015, 337-345, http://doi.org/f7tb4p. ↵
9. Gordon Russell, "New Orleans, St. Bernard and Jefferson Parish 2007 Census Figures Revised Upward," *The Times-Picayune*, January 14, 2009; New Orleans Metropolitan Convention and Visitors Bureau, press release, "Tourism, Hospitality and Cultural

Economy Fact Sheet: Five-Year Anniversary of Hurricane Katrina" [PDF], August 2010; French Quarter Business Association, press release, "New Orleans Breaks Tourism Records for Visitation and Visitor Spending in 2016," March 23, 2017. ↩

10. Richard Florida, "The Urban Revival Is Over," September 1, 2017, *The New York Times.* ↩
11. New Orleans Comprehensive Zoning Ordinance, Article 18: Overlay Zoning Districts. See 18.2.H for the Freret Overlay District. ↩
12. Allison Plyer, Nihal Shrinath, and Vicki Mack, "The New Orleans Index at Ten: Measuring Greater New Orleans' Progress toward Prosperity," July 31, 2015. ↩

Citation*: Richard Campanella, "People-Mapping Through Google Street View," *Places Journal*, November 2017. Accessed [date]. https://placesjournal.org/article/people-mapping-through-google-street-view/

About the Author

Geographer Richard Campanella is Senior Professor of Practice at Tulane University and author of several books. Full Bio More by Richard Campanella:

- 14 to 1: Post-Katrina Architecture by the Numbers
- Backwater: Landscapes of the Mississippi Delta
- A Katrina Lexicon