
PARIS
2020
WITHOUT
CARS

Abstract

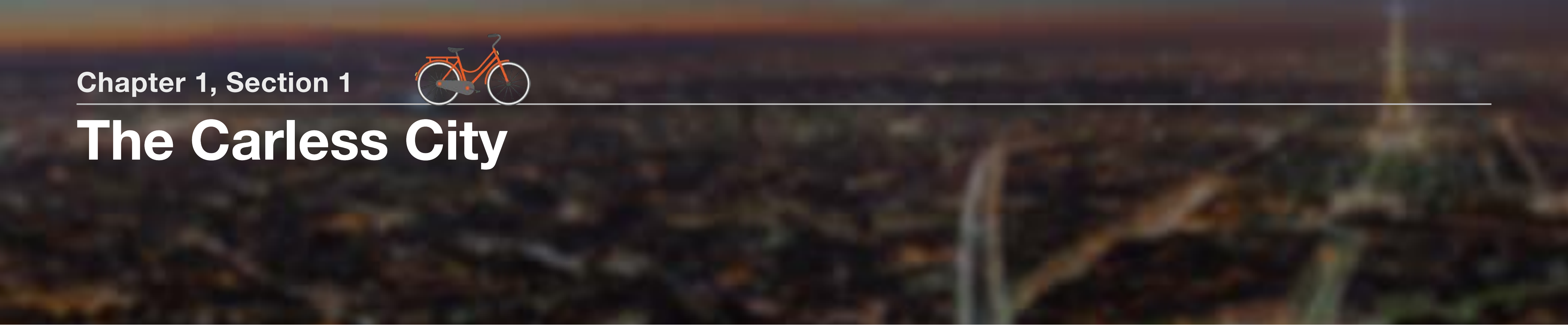
Our mission is to bring the roads of Paris to life by creating a more dynamic, efficient, adaptive, and responsive method of transportation for Parisians. Inspired by the idea of a carless city and the virtues of bicycling, we have used the basis of the intricate and effective biological processes involved in the circulatory system to propose dynamic bicycle lanes that adapt to traffic conditions throughout Paris. These dynamic lanes, implemented with lights installed in the road pavement or movable bollards, will make bicycle transportation more convenient, effective, and safe for cyclists and drivers.

In this way, the impending shift away from car transportation will less of an inconvenience for Parisians and more of a natural evolutionary process. The implications of increased bicycling traffic extend far beyond decreasing congestion: Paris will become not just more environmentally healthy, due to decreased carbon emissions, but also more socially connected, enriching the social capital of the city.

Chapter 1

Introduction: A Carless City

An overview of the current state of transportation in Paris, as well as an introduction to the ideal of a carless city and the degree to which it can and should be implemented in the city of Paris.



Chapter 1, Section 1

The Carless City

> **PARIS BY 2020**
>
> Anne Hidalgo, the mayor of Paris, has proposed these modifications by 2020:
>
> 1. Doubling of cycling lanes (700 to 1,400 km)
> 2. Triple proportion of bicycle journeys (5 to 15 percent)
> 3. Modifications to smaller roads: two-way cycling lanes and 30 km/h speed limit for drivers
> 4. Banning of all diesel fuel vehicles in Paris
> 5. Pedestrianization of downtown areas
> 6. Limiting of especially polluted roads, such as Rue de Rivoli, to electric and low-emission vehicles

Decreasing car transportation has the potential to impact Paris as a city in numerous positive ways, improving the social and environmental atmosphere as well as the efficiency of transportation. The space that is currently monopolized by excessive parking demands could be opened up for pedestrians, creating more opportunities for interaction and tactical urbanist transformations of space. The emissions that are ravaging our environment—56% of which (in Paris) come from car transportation (more than 11 times the amount resulting from the historically huge manufacturing industry)—could be cut in half, creating a cleaner and more responsible society. With a maximally efficient transportation system that doesn't depend on cars, we can make transportation faster and more effective for all passengers while transitioning towards this carless vision.

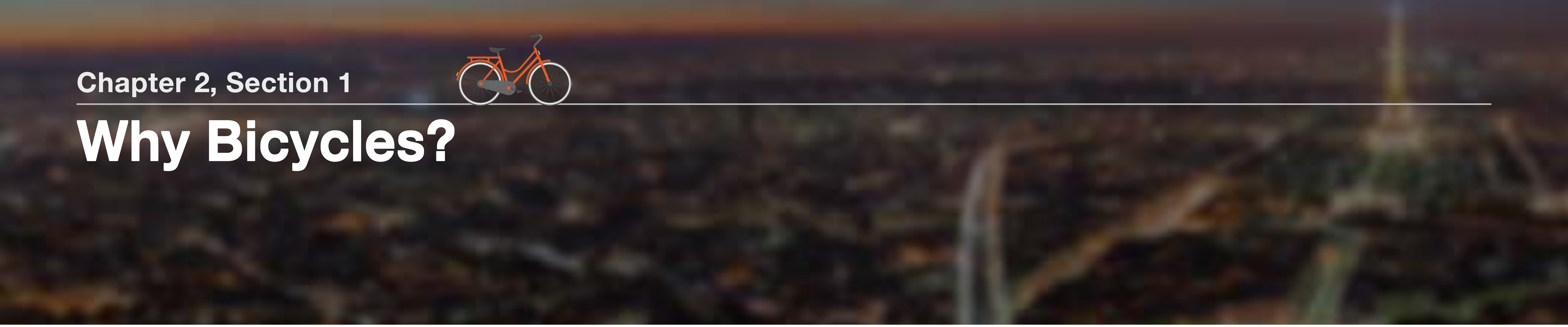
Anne Hidalgo, the mayor of Paris, has envisioned a future for Paris in five years that involves banning diesel fuels and expanding bike lane infrastructure. This goal is highly aligned with our vision for our project. In fact, this proposal is meant to go hand in hand with the existing efforts to make Paris a carless city.

Bicycling on Boulevard Champs-Elysees

Chapter 2

The (Second) Rise of the Bicycle

Despite the proliferation of cars in the 20th century, bicycles have an increasingly important role in modern transportation. The 1890s were the first golden age of bicycling—will the 2020s become the next?



Chapter 2, Section 1

Why Bicycles?

WHY BICYCLES?

1. Environmental responsibility: fewer carbon emissions
2. Reclaiming valuable space: free areas claimed by cars
3. Increased social connectedness and mindfulness: more interaction with others
4. Exercise and health benefits
5. Size and convenience: helps people travel nearer their destinations

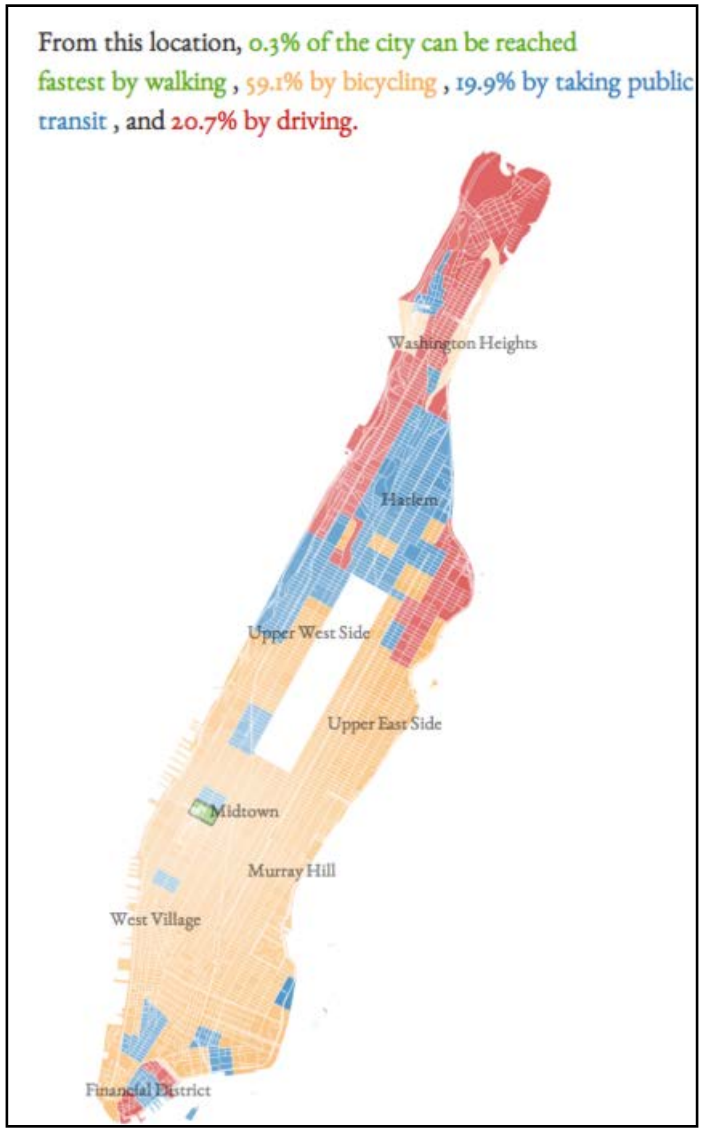
The goal of decreasing the number of cars in Paris should not be implemented solely through pure restrictions on car usage. Instead, we aim for a more natural and comfortable shift to other modes of transportation, shaped by evolution of infrastructure over time and incentivization of cleaner and more space-effective transportation. Rather than suddenly and arbitrarily ban or highly limit car traffic, the key for a carless Paris is to make other modes of transportation—smarter, more efficient modes of transport—more convenient, quick, and usable for citizens and tourists alike.

If our goal is to decrease the usage of private cars in Paris, we must provide a mode of somewhat private transportation that is significantly more convenient than cars. We believe that the solution is bicycles. Although bicycles seem to some like a thing of the past, with the correct infrastructure, they have many advantages over cars. This is especially in a dense city like Paris, where maneuvering a large vehicle through congested or narrow streets is difficult.

A fundamental shift needs to occur, and that shift requires flexible infrastructure that can adapt to the increasingly carless demands of the city, accommodating more bikes and making it more possible to travel longer distances (from the suburbs to the heart of Paris, for instance) via public and bike transportation.

Our project focuses on improvements in the current system of bike infrastructure. Paris today is one of the world's most bike-friendly cities, but it still has a long way to go before biking is viewed as the most convenient mode of transport. With improved infrastructure and policies, biking has the potential to surpass car transport when it comes to speed and efficiency.

Consider the map of Manhattan (an area similarly sized to Paris) on the top right, which displays the fastest mode of transportation to any location given a starting point. From Midtown, the vast majority of Manhattan is most quickly reached by bicycling. We look to make bicycling prevail in Paris as it does in Manhattan, as well as improve its safety and general convenience.



59% of Manhattan is accessible most quickly by bicycling from the green area near Midtown.

We are introducing a plan of infrastructural and political evolution that can ease the transition and counterbalance the future restrictions that will be placed on cars. Our plan is to make bike transportation adaptable according to the flow of traffic and the evolving demands placed on each mode of transportation.

30 minutes biking decreases risk of **breast cancer**

20x greater **health benefits** from biking than safety risks

40% decreased **mortality** rate in bicyclists over 15 years

2 year **longer life** expectancy in bicyclists than average

Health benefits of bicycle transportation

Bicycling in Paris

VELIB BY THE NUMBERS

- 283,000 new subscribers in 2014
- 20,000+ bicycles
- 1,800 stations
- 1 rental per second
  86,400 rentals per day
- €30 per year
  27 times cheaper than Pass Navigo

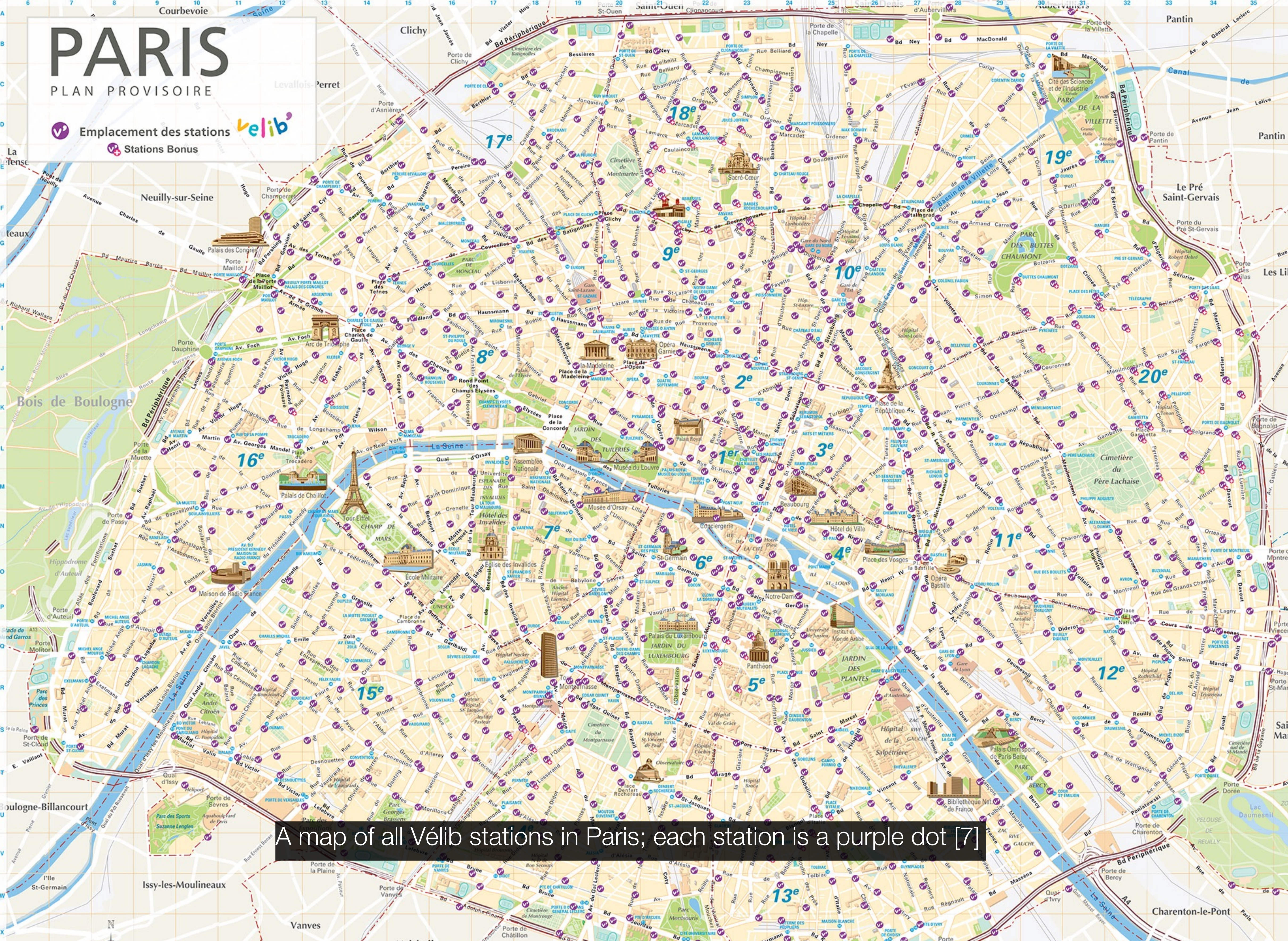
Bike transportation in Paris today consists of both public and private sectors. The Vélib system is a central mode of transportation. For a €30 yearly subscription, citizens have the opportunity to use bicycles for up to thirty minutes at a time with no additional charge, paying €2 for each half hour afterwards. There are about 18,000 bicycles and 1,230 bicycle stations in Paris.

The Vélib system has been growing; reaching a new record of 283,000 subscribers in 2014 and continuing to see increases, the new system must meet the increased demands of the citizens, and hopefully, the imminent even greater increase in usership.

Vélib has the opportunity to undergo significant changes in 2017 when the Paris' contract with JCDécaux, the sponsor of Vélib, ends. The city of Paris has a vision for the future of bike transportation, and the future of Vélib is highly promising. The hope is to implement a system with more electric bikes, more bike lanes, and more metro stations in the Greater Paris area, making transportation (bike and metro) more accessible to everyone.

This impending shift in Vélib infrastructure provides an opportunity to implement productive changes. According to Patricia Pelloux [6], an urban planner who has worked extensively with the Vélib system, bike storage is an issue that has yet to be resolved when it comes to increased bicycle transportation, both private and public.

Another issue with the current Vélib system, one that Pelloux is very aware of, is the lack of Vélib accessibility to all ages and physical ability. Because of liability issues, Vélib is forbidden to those under 14, limiting transportation opportunities for families and children. Pelloux said that, in her personal life, she tends to use Vélib on weekdays when she needs to get from one place to another, and her personal bikes on the weekends with her children, who are too young to use Vélib. Similarly, Vélib is inaccessible to those many of those with physical disabilities.



A map of all Vélib stations in Paris; each station is a purple dot [7]

Chapter 2, Section 3

Social Implications and Mental Health

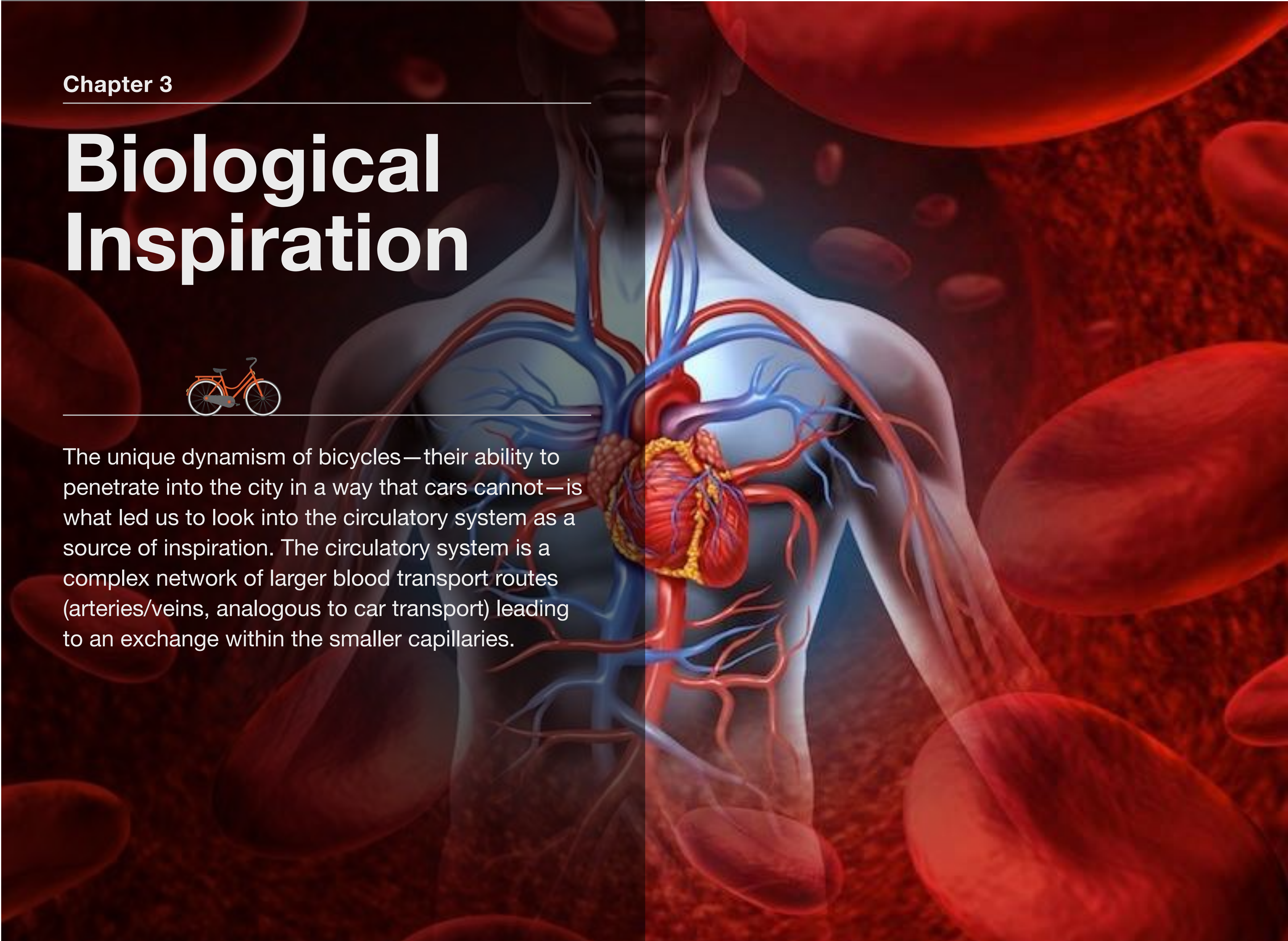
> "Why, if one wants to compare life to anything, one must liken it to being blown through the Tube at fifty miles an hour—landing at the other end without a single hairpin in one's hair! Shot out at the feet of God entirely naked! Tumbling head over heels in the asphodel meadows like brown paper parcels pitched down a shoot in the post office! With one's hair flying back like the tail of a race-horse. Yes, that seems to express the rapidity of life, the perpetual waste and repair; all so casual, all so haphazard...."
>
> —Virginia Woolf, "The Mark On The Wall" (1921)

Bicycles promote a culture of interaction and personal responsibility. Car transportation has an isolating effect; there is a general sense of disconnectedness that comes with car transportation. There aren't any opportunities to interact with the people just feet away, to take a quick stop somewhere beautiful or interesting seen along the way, to explore the smaller roads where car transportation is limited. Biking gives riders this flexibility to interact with others and become more of a part of their community, taking part in cultural events.

Bicycling also gives riders a sense of direct responsibility for their own transportation and for the environment they live in. When taking the metro or riding in a car, the work required to get from one place to another seems less direct, less immediately visible. Riders are more removed from the world around us and how things work.

Bicycles not only promote a sense of cultural engagement and environmental responsibility, but they promote awareness of the user's surroundings and general mindfulness, facilitating time for the user to be "unplugged" from technology. We're victims to constant notifications and the stresses of needing to be "plugged in" (to a social platform or other network) at all times. Riding a bike creates a peaceful break from that attention, forcing the rider to appreciate and focus on what's around them without this sense of social disconnectedness. Mindfulness is difficult to come by, and many people regret not living in the moment and being attentive to what's around them. For this reason, apps and technologies have been developed to bring back the mindfulness we've lost through this constant connection-- however, forcing "mindfulness" in this way, through another electronic platform, seems counterproductive when it's so accessible in other ways.

In addition, current society is marked by a divide in the use of bicycle transportation—the purpose of bike transport tends to vary depending on socioeconomic status. Improving bike infrastructure to converge these two purposes, to encourage bike transportation for utilitarian purposes (which is currently more often used by the less wealthy) while allowing a concurrent cultural experience can help erase these lines between socioeconomic groups.



Chapter 3

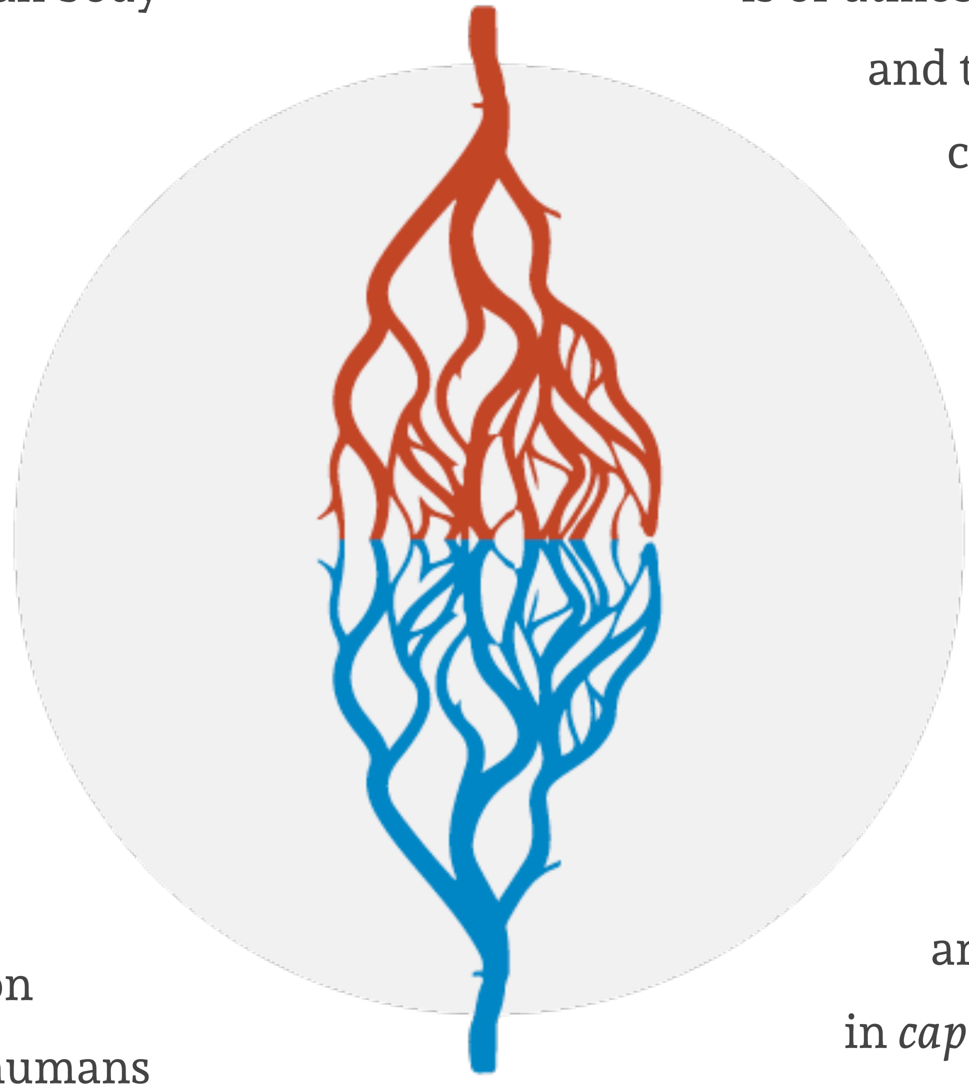
Biological Inspiration

The unique dynamism of bicycles—their ability to penetrate into the city in a way that cars cannot—is what led us to look into the circulatory system as a source of inspiration. The circulatory system is a complex network of larger blood transport routes (arteries/veins, analogous to car transport) leading to an exchange within the smaller capillaries.

Chapter 3, Section 1

Capillaries

The circulatory system of the human body consists of a vast network of blood vessels that transport blood to all the tissues of the human body and back to the heart and lungs, where the red blood cells are reoxygenated. Similarly, the transportation network of the city consists of a vast network of roads and various modes of transportation that transport humans to their daily activities and back to their homes. Circulation of red blood cells and of traveling humans is of utmost importance to the human body and to the city, respectively; problems in circulation completely cripple the body and city.



When we closely examine the behavior of red blood cells when they actually supply cells with oxygen and other nutrients, we find that this exchange occurs not in the large arteries and veins with which we are familiar. Rather, these they occur in *capillaries*, which are the thinnest blood vessels in the body. Capillaries form spidery networks within tissues in order to reach every single cell and supply it with what it needs for life. Red blood cells arrive at their destination by hurtling through arteries, but do not actually interact with other cells until they have reached the capillary beds.

Similarly, when humans travel in the current car-based mode of transportation, they do not interact at all with their surroundings until they reach their final destination and exit their car. In a city such as Paris, where parking is scarce, often people must navigate streets by foot in order to reach their destination or perform the activities they wish. This is analogous to a red blood cell (human) traveling through the body (the city) at a high speed in an artery (in a car) but only actually *interacting* in a capillary (while on foot). The implications, as discussed under "Cultural Implications and Mental Health," are that car transportation leads to increased social isolation.

Bicycling through the city, as opposed to traveling by car, is similar to always being in a capillary. Bicyclists are always ready to take a stop and interact with people, shops, parks, the city as a whole, exhibiting capillary-like behavior while still traveling at a high speed. Thus, the circulatory system has inspired us to believe in bicycle transportation as a way to promote interaction of people with their communities and surroundings, allowing them to truly penetrate deeply into every nook and cranny of the city while still traveling at a high speed feasible for a commute.

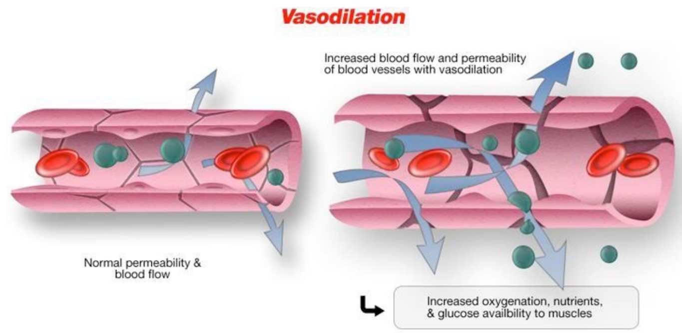
To extend the analogy of arteries to car transportation and capillaries to bicycle transportation, arteries almost always have a corresponding vein going in the opposite direction returning to the heart, while capillaries are purely unidirectional. Similarly, many car roads have bidirectional traffic while smaller roads —the ones that bicycles really make accessible—are one-way.

A conception of the city as a network of arteries, veins, and capillaries.

Blood Vessel Dilation and Pressure

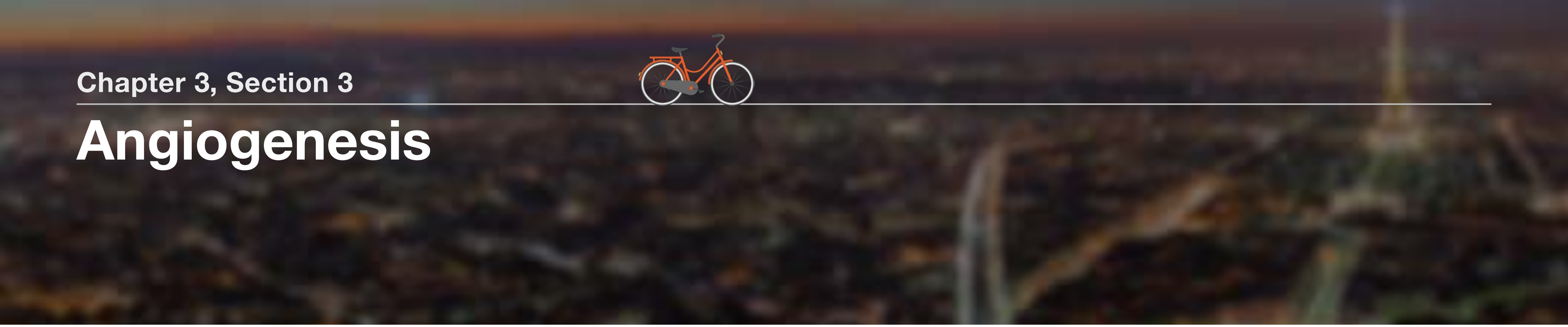
Human blood vessels are able to constantly adapt to the flow requirements of the tissues they serve by expanding and contracting (vasodilation and vasocontraction). This behavior can occur due to factors ranging from muscular exertion to temperature changes to hormonal regulation. Most impressively, vasodilation and vasoconstriction can occur on both global and local scales, regulating and targeting the flow of red blood cells to specific tissues, like a sprinter's calves, based on immediate need.

City roads are not living and dynamic: maximum throughput is constant day or night, weekday or weekend, rush hour or holiday. But by changing the



functions of lanes in the roads—for example, by increasing the number of bike lanes on the road, we dilate a vessel that transports bicycles while contracting a vessel that transports cars.

Additionally, blood pressure varies over a daily cycle corresponding to the daily circadian rhythms of the human body. This causes vasodilation at night corresponding to a 10-15% drop in blood pressure. Similarly, when the city sleeps at night, traffic in roads is sharply decreased.



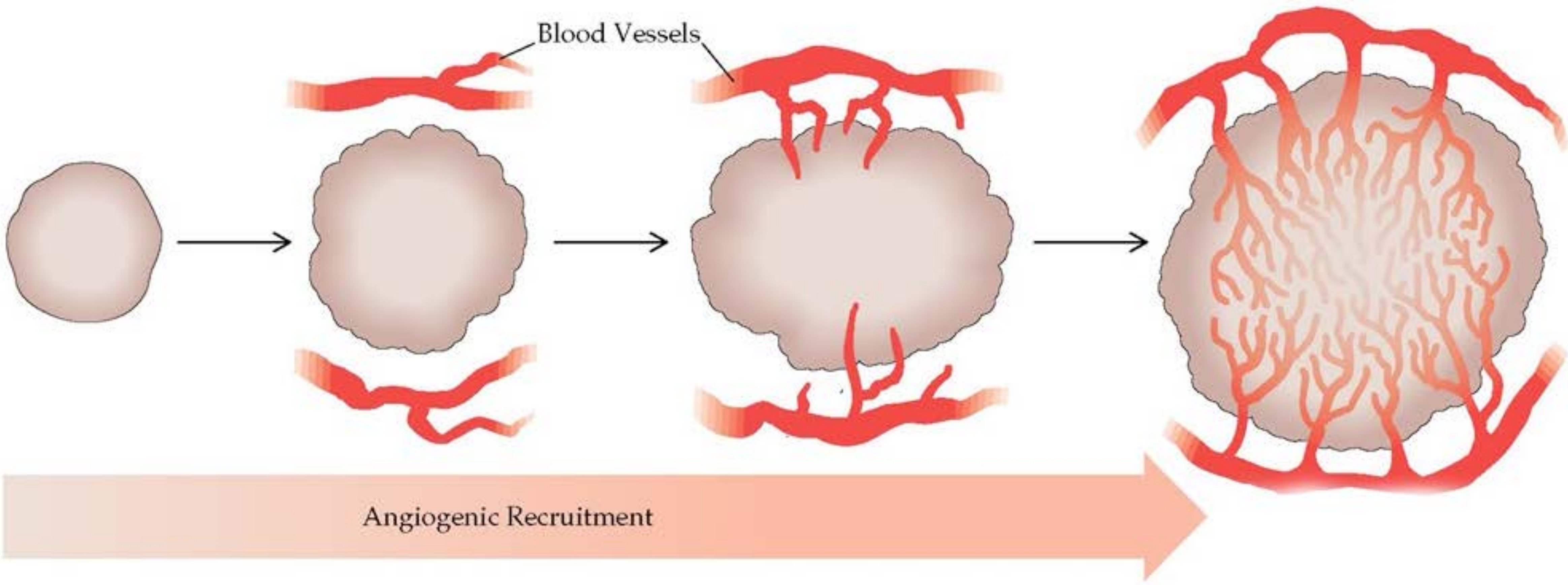
Angiogenesis

To further extend the analogy of capillaries, we can consider the *process* by which capillaries are formed. Unlike how the structures of large organs of the body are prescribed genetically, capillaries are formed over time based on the needs of the tissues they serve. This process is called angiogenesis, in which large arteries split into a network of many smaller vessels—often at the capillary level—in response to growth factors. Notably, angiogenesis is triggered strongly at wounds to bring blood flow to the site of injury and hasten the healing process.

We compare angiogenesis to the process by which Paris' bicycle lanes develop and increase over time.

Increasing bicycle lanes, as detailed earlier, is similar to the formation of capillaries due to the greater penetration of cyclists into the city. To make the development of bicycle lanes responsive to the needs of the city just like angiogenesis, development of bicycle lanes should be targeted to areas that need them the most. And the development of bicycle lanes in areas inconvenient or dangerous for bicyclists is analogous to the healing of a "wound" in a the city.

It is absolutely critical that we create bicycle lanes highly intelligently and deliberately where they are most helpful and necessary. A solution inspired by angiogenesis will be efficient and optimal.



Angiogenesis

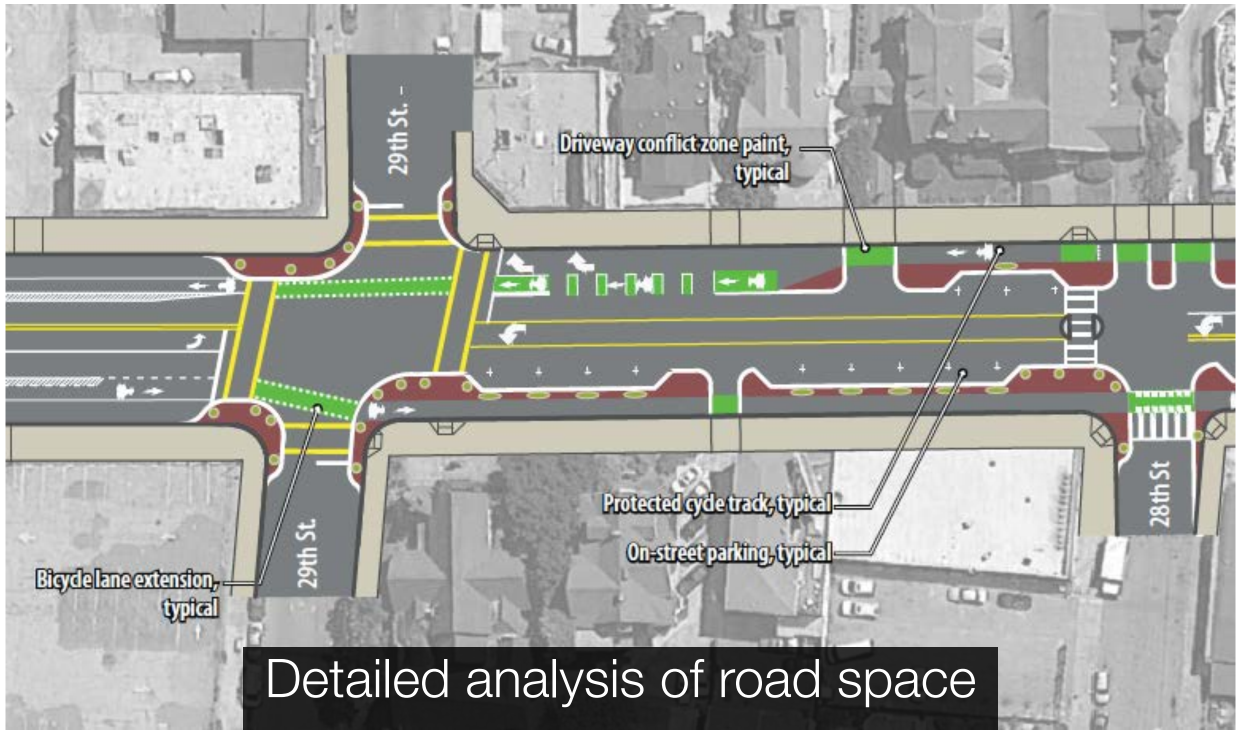
Chapter 4

Rethinking Roads

Though roads are often viewed as a place of transition, solely a way to get from point A to point B, in a dense city like Paris is imperative that we think about them in a way that harnesses their full potential. Roads aren't just a space for cars or buses: they are a space that can be used for a variety of purposes depending on the needs of the community. Not only are roads a place for cars—they can also be a place for people.

Fixing The Static Nature of Roads

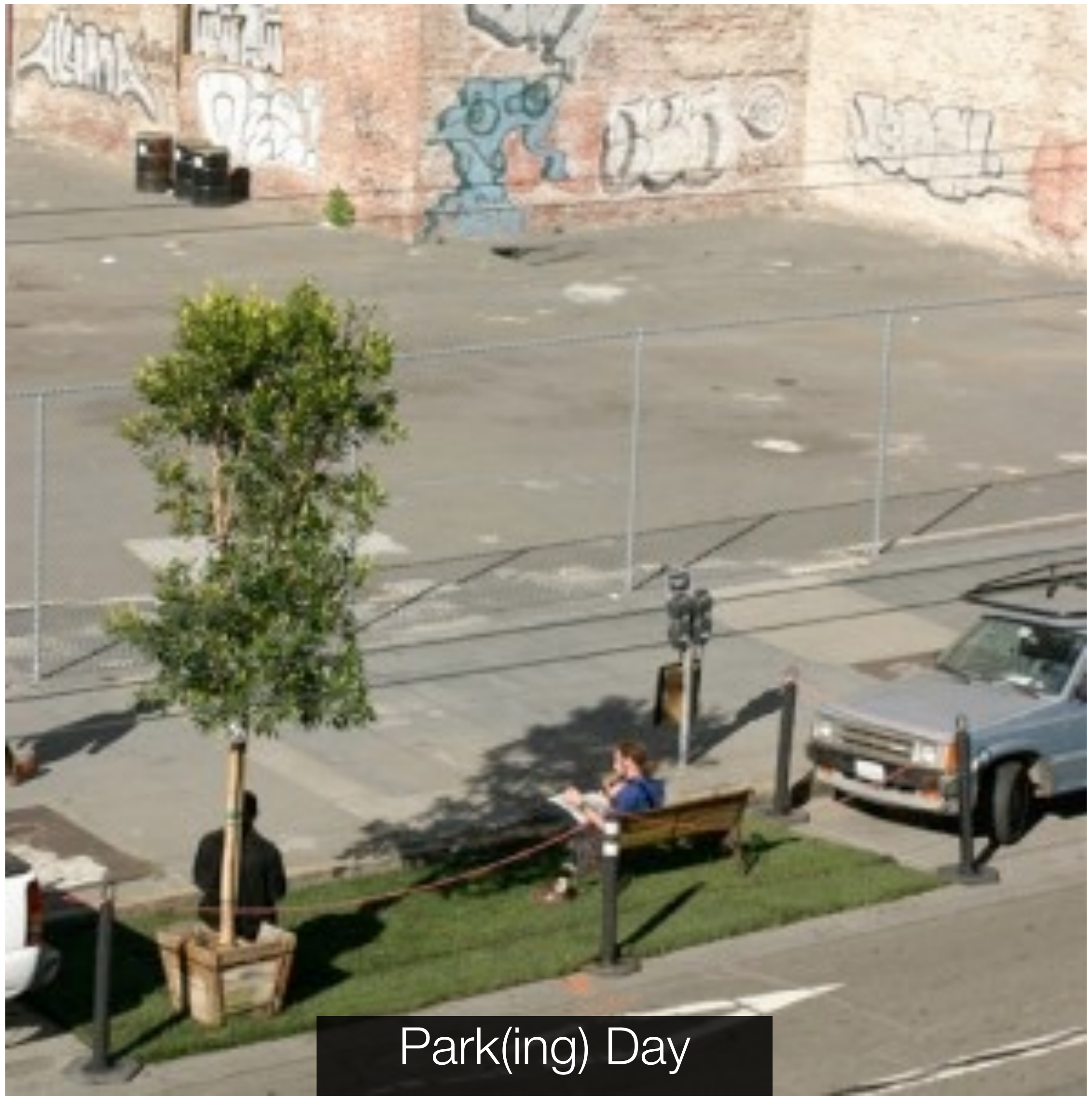
Most modern roads are completely static. They are designed and optimized for cars at the cost of the convenience and safety of bicyclists and pedestrians. In our vision of a carless city, roads can be made more flexible and utilized for a variety of purposes, transportation and otherwise. Every building between the roads of the city is scrutinized so its every square meter can be intelligently utilized (often to maximize profit). In a city as compact as Paris, why aren't roads treated with the same care and reverence?



Detailed analysis of road space

Our conception of a road flexibility exists on two levels. The first is flexibility between modes of transportation. Currently, each lane of the road has a fixed, defined purpose. Bicycle lanes in Paris and around the world have been created by effectively permanent modifications, such as road paint or raised surfaces. These permanent changes often incite opposition, especially by drivers concerned about their infrastructure. In fact, in New York, miles-long bicycle lanes have been constructed and then painted over due to opposition[10]. And then, on the other hand, the opposite problem is that as Paris hopefully becomes less and less car-dependent, roads will require further modification over time to increase the amount of bike lanes relative to car lanes.

The deeper level of road flexibility redefines the purpose of the roads, which should be able to be used for purposes other than pure locomotion. The simplest and most obvious use of roads for a non-locomotive purpose is car parking, which, in Paris, is already done under a variety of circumstances with regard to regulation and infrastructure such as marked parking spaces, meters, delivery zones, and regulations of times when parking is allowed. Similarly, Vélib stations often use space on or near the road to store their



Park(ing) Day

bicycles.There are many uses for road spaces other than parking. Road space, especially along the curb, can be temporarily converted into a pop-up installation, such as a public mixed-use space or a shop. One of the most popular non-transportation uses of road space is backed by the tactical urbanist initiative Park(ing) Day (see below), whose aim is a day-long event across the world where metered parking spaces are transformed into miniature public parks.

On a greater scale, large roads or areas are often closed to car traffic entirely for the purpose of increasing pedestrian, bicycle, and other activities. Notable examples include areas of Paris' Le Marais district and Boston's Memorial Drive, both of which are closed to cars on Sundays—Le Marais as a rich cultural center and shopping area, and Memorial Drive as a park space.

Similarly, during festivals such as Bastille Day, street vendors often spill from occupying sidewalks into the side of the street itself. These uses of the street as more than a venue for transportation but rather a general-use space for pop-up events allow Parisians to help adapt the city to the needs and demands of its citizens without requiring the construction of a large community center or even the occupation of a large area.

In short, we propose a new way of considering road space that considers each square meter of the road as a possibility for transportation—car, bike, or transportation—as well as for a public space. This perspective should function in tandem with a system that allows dynamically changing the purpose of the road.

Carless roads in (clockwise from top left) Paris, Houston, Portland, Beijing

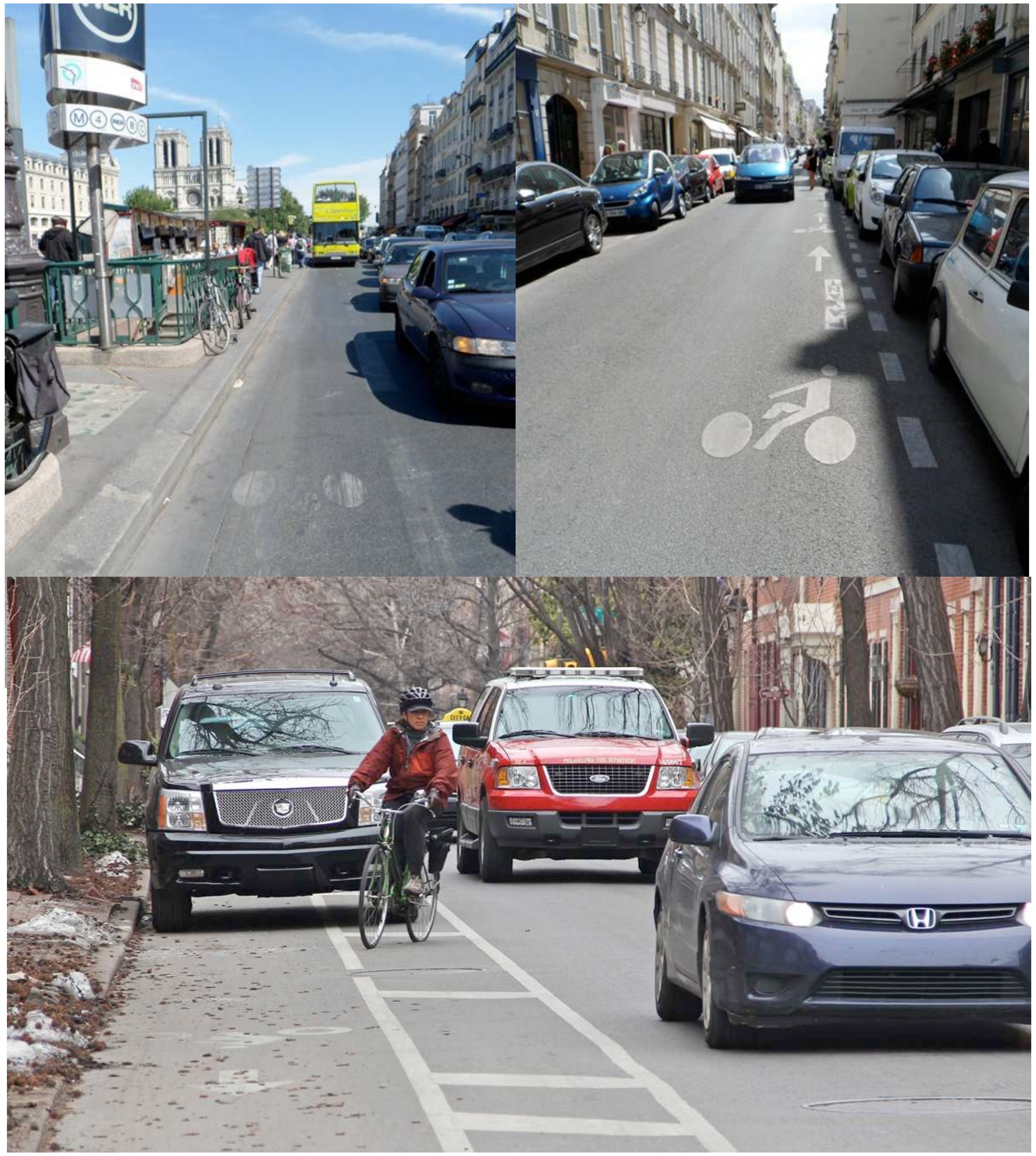
Chapter 4, Section 2

Effective Multi-Mode Roads

A dynamic and flexible road would be able to accommodate varying amounts of car and bicycle traffic depending on both short-term and long-term trends, and even facilitate special cultural or commercial events, all in real time. For example, to encourage bicycle transportation in general while allowing crucial rush hour traffic, a lane management system might keep limit bicycle lanes to one lane from 8:00 to 9:30 and 17:00 to 18:30 while expanding bike lanes to two or three lanes between 9:30 and 17:00 and between 18:30 to 8:00. On weekends or holidays, lanes might be adapted to purely bicycle traffic with one lane dedicated to special stands or festivities. In the exceptional case of extreme car gridlock, all bicycle lanes could be temporarily removed to help cars escape the traffic.

The simplest method to allow the dynamic repurposing of traffic lanes is by installing lights in the road to signify the designated purpose of the lane. In this system, lights would be installed at possible lane boundaries similarly to road reflectors with different colors signifying the various usages of the lanes. To drivers, these lights would be function similarly to traffic lights—a red light is highly visible and would signify not to enter a specific lane. Lights would allow for spontaneous creation of bicycle lanes as well as of public parks or stands for businesses.

However, we can do better: safer and more effective solutions designated especially for bicycles can be created. In Paris, bicycle lanes have been installed in many roads in an effort to improve the Parisian bicycling experience. Usually, these bicycle lanes take the form of either a narrow painted lane on a road adjacent to the sidewalk curb or a raised path on the sidewalk itself. While these lanes provide basic rights for bicyclists, studies have shown that painted lanes on the road are extremely dangerous and are far less effective than bicycle lanes with a physically raised separator between car and bicycle traffic. Safety is a main factor in promoting bicycling as a mode of transportation, as shown by a negative correlation between kilometers biked per capita and number bicycle accidents per year in many large European cities.



One of the most cost-effective implementations of a physically divided bicycle lane is the installation of thin delineator posts between bicycle lanes and car lanes, which cost €10000 per kilometer. However, these divider posts are fixed: they cannot adapt to traffic at all. Another implementation of a divided lane uses car parking spots to divide moving cars and bicycles. This is extremely safe, due to a large, visible, and solid barrier between cars and bicyclists, but requires a massive change to the structure of roads. Meanwhile, both of these methods are totally unadaptable to traffic needs.

A conception of movable bollards

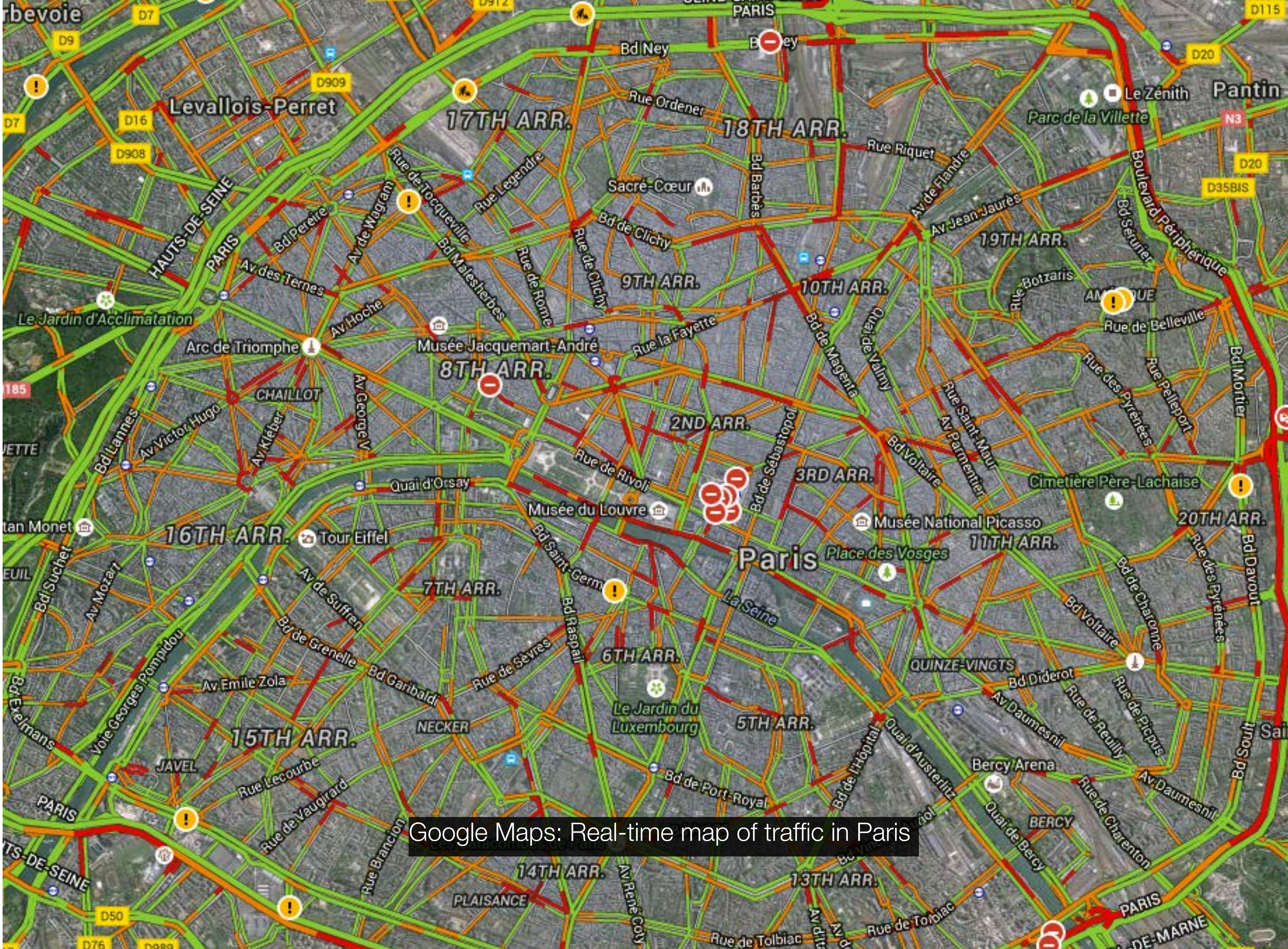
To create a safer bicycle lane with a physical barrier between cars and bicycles, we propose the creation of a collapsible delineator post system between lanes that can vanish to remove bicycle lanes and reappear to create more. This allows the adaptability of a light-based system with increased safety. In addition, the bollards could be used as bicycle parking while the posts are expanded (during the day) and then retracted outside of those hours. Flow manipulation on a daily cycle is biologically analogous to regulation of blood pressure due to circadian rhythms and sleep.

Chapter 4, Section 3

Real-Time Adaptivity

The system of lights and bollards for adaptive bicycle lanes is only effective if it correctly reflects the needs of the traffic system of the city they serve. At present and in the near future, the most important factor in determining the proper bicycle-car lane balance is the amount of car traffic in the road: increasing bicycle traffic is important for the environment and long-term improvement of the traffic of Paris, but creating too many bicycle lanes at the cost of car lanes could impede traffic in the short-term. Similarly, in the body, regulation of vasodilation and vasoconstriction is crucial to providing ample amounts of red blood cells to all parts of the body despite environmental conditions or activities.

In order to determine the amount of car traffic in any road and thus the proper bicycle-car lane balance, we can use any number of existing methods for monitoring traffic. One method is traffic cameras installed throughout the city. This is feasible for installation on large roads, such as Rue de Rivoli, but it is probably impractical to also install cameras on all minor roads throughout Paris. An alternative method is to use the method employed by Google Maps, which utilizes big data of phone users' location and velocity in order to approximate the existence of traffic jams. Over time, these trends can even be generalized into traffic patterns, which can form routine (but still flexible) bicycle-car lane adaptations.



Google Maps: Real-time map of traffic in Paris

Chapter 4, Section 4

Beyond Transportation

The gradual disappearance of cars will free road space for pop-up installations on a regular basis. This will allow diverse cultural initiatives to open for special times days—or even hours—at a time, in line with the principles of tactical urbanism. Tactical urbanism, a movement based on cheap, small-scale, and nonpermanent improvements, is most effective for improving localized areas, which is especially important for a socioeconomically and culturally diverse city such as Paris.

Removing cars from the street will thus improve the environment of the city in three ways. The obvious improvement of Paris' environment is ecological, due to the decreased amount of emissions from cars. Next, decreased traffic will help people circulate about the city more efficiently, improving the productivity and effective social capital of the city. Finally—and most important to tactical urbanism—the freed space further increases the interactions of people with their fellow citizens and increasing the sense of community within Paris and its areas.

To formalize the use of road space for these projects, we would create a reservation system for plots of space around the size of a parking space, a size which the Parking Day initiative has shown to have high potential for meaningful installations. These spaces could thus be used for a variety of initiatives, including many of the other proposals in our program—for example, a parking space could host an exhibit by the 1968 pop-up museum.

A similar program has been initiated in Manhattan in Times Square, where traffic has been rerouted out of the area in order to create sitting areas for visitors and a generally more pleasant experience. The transformation of the area from an overwhelming center of traffic into a much more relaxed and enjoyable area is depicted below.

Chapter 4, Section 5

Previous Efforts

There are other cities around Europe that have taken the lead when it comes to bike-friendly infrastructure and culture. In creating our plan to implement this bicycle infrastructure and policy, we can look to Amsterdam (one of many bike-friendly Dutch cities) as an example.

In Amsterdam, bikes outnumber citizens. Extensive networks of bike lanes exist, making bike transportation safe and convenient for people of all ages and purposes. "Amsterdam has approximately 280 miles of cycling lanes, and close to 58% of its residents use bicycles on a daily basis, 43% of them are commuting to work by bicycle." People use bike transportation for practical purposes—getting to and from work, for instance—and leisure alike. Cars pose little threat to bikers, but instead play a more secondary role in everyday transportation. Though Amsterdam has the advantage of being flat and of moderate climate patterns, its friendliness to bike transportation

Bicycle racks at a train station in Amsterdam is the result of a deliberate cultural and infrastructural shift. “At the same time the use of cars in city center was discouraged by limiting car speeds and car parking. To park a car in city center now costs approximately $7 to $8 an hour, and due to low-speed limits it takes longer to drive than bike.” Gradually shifting policies to favor bike transportation could make the transition more natural, and encourage people to give up unnecessary car usage.

Bicycling in Amsterdam

Dynamic bus lanes according to traffic flow exist in Caluire and Barcelona. Caluire, a city located next to Lyon, has a bus line that runs one way during some times of day and another during other times, in order to match traffic flow. From 5:00 to 13:00, lanes are shifted to allow bus traffic towards Lyon; from 14:00 to 24:00, the lanes are reversed to allow traffic back to Cailure. However, these dynamic lanes are for singular modes of transportation.

Chapter 5

Execution

The implementation of the system of dynamic bike lanes requires planning to determine the optimal location of lanes. Implementation in limited tests will take place over the course of the next two years and implementation will be initially combined with Vélib by 2017.

The following timeline outlines our plan of action in conjunction with the city's goals and plans, showing how our project could work with the future that has already been projected by Mayor Hidalgo and other city officials.

Car-free day in Paris, implemented by Anne Hidalgo.

Vélib system changes in 2017, ideally including electric bikes.Expansion of

Diesel fuel vehicles banned.
Bike lanes expand around Paris.

Metro lines and Vélib stations expand around the greater Paris region, making it possible for anyone in Paris or its suburbs to reach a metro stop within a short bike ride.

Sept 27

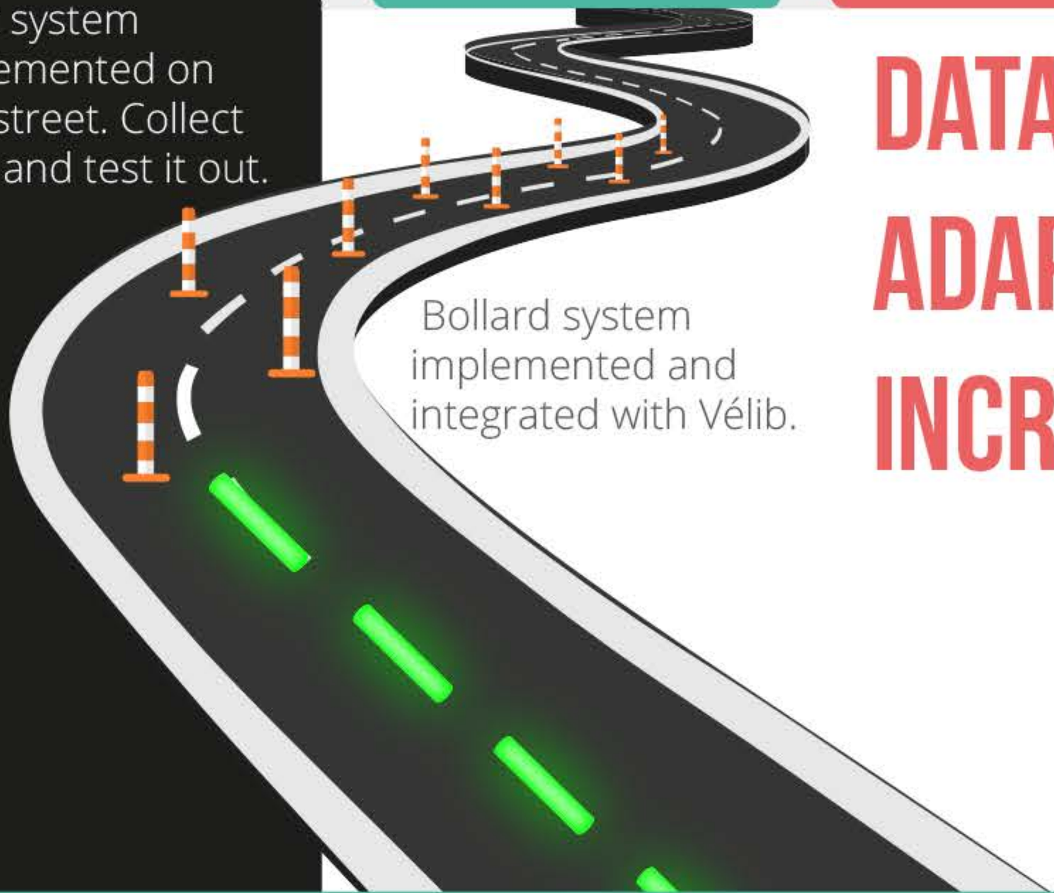
Use car free day to implement tactical urbanist initiatives to see the possibilities of what could be. Use it to collect data on bike usage in certain areas and compare it to normal.

2016

light system implemented on first street. Collect data and test it out.

2017

Bollard system implemented and integrated with Vélib.



2020

2030

DATA COLLECTION

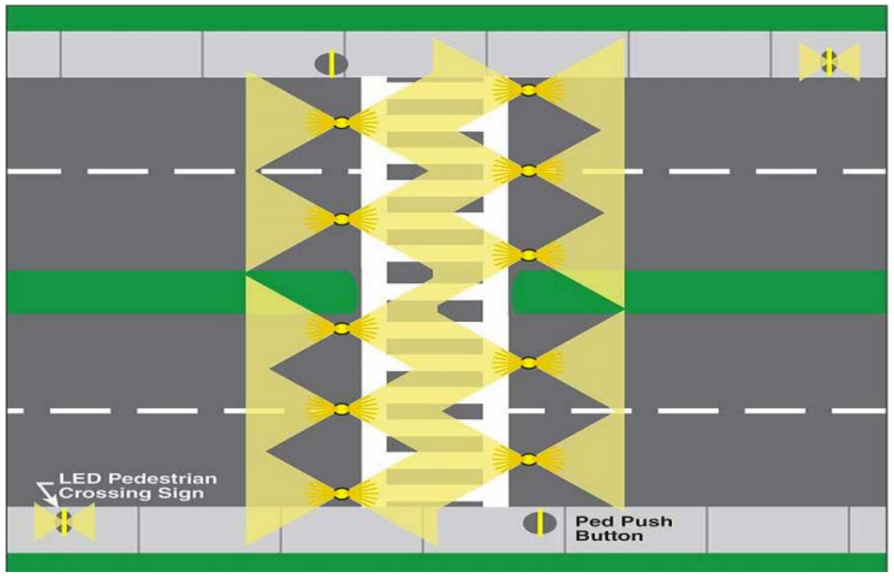
ADAPTATION of car lane to bike lane ratio depending on flow.

INCREASE tactical urbanist initiatives

Lights

The first stage of our plan focuses on installation of lights to mark the use of each lane. These lights would be installed in the road bed at the boundaries of the lanes, able to display any color, and be highly visible day and night. Lights would function for bikers and drivers alike, signifying the lane purpose to both groups. Where no bicycle lanes exist, lights would help create them; where lanes already exist, lights would extend them into existing car lanes. They would act to extend already existing bike lanes, or in some cases to create them where there are none currently. Our time frame is to implement the lights for an initial limited run (2-3 medium-large streets) in one year and test their effectiveness.

In terms of hardware, many existing models of lights exist that have a flush profile on the road (do not disrupt traffic) and are bright enough to be visible in the day. Many models exist and similar lights have actually been used for pedestrian crosswalks (sample installation plan below).

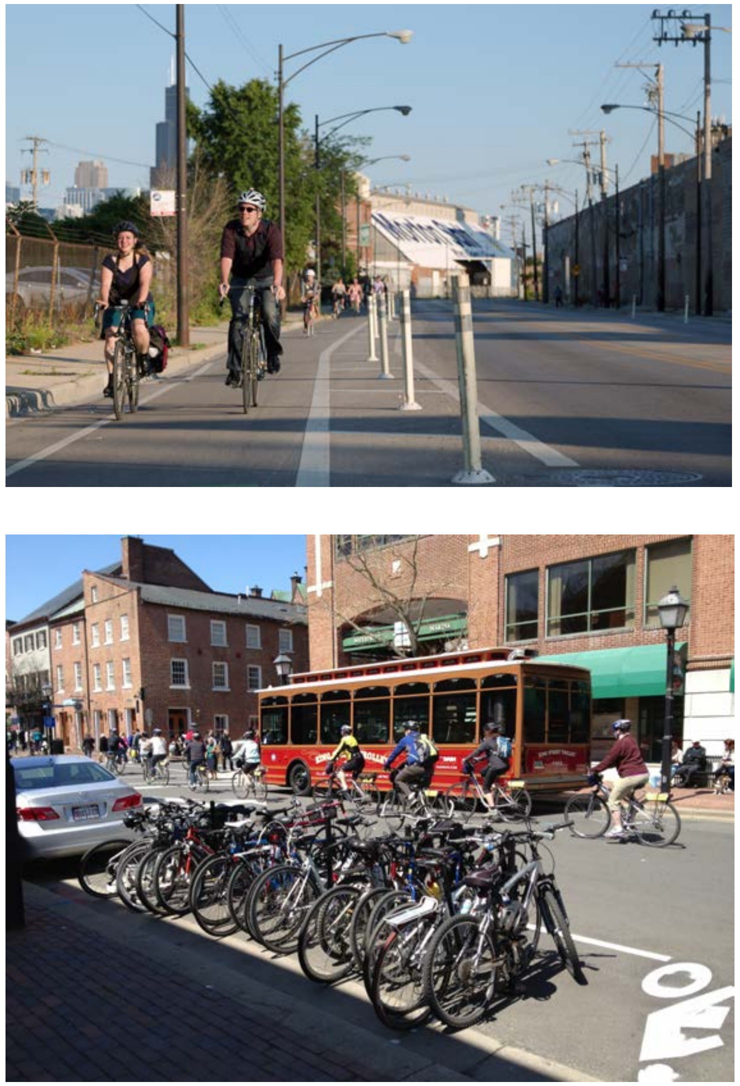


Chapter 5, Section 2

Bollards

The second stage of our plan involves the installation of collapsible hybrid bollard-bike posts between car and bike lanes as well as permanent ones along the curb. These bollards would serve to increase bike safety and provide more space for temporary bike parking (while bollards were scheduled to remain up) to accommodate the constantly increasing demand for bicycle parking. Just as the lights we propose to install are completely dynamic, so are the bollards—they collapse to the ground and reappear vertically in order to recreate these lanes.

Assuming the effectiveness of the lights, we plan to install the bollards one year after that. Installation will be more complex—bollards will not have a flush profile with the road—and require significant road closures in order to be implemented. Therefore, we propose that the bollards be first implemented on medium-sized streets before committing to installation on a major road for testing.



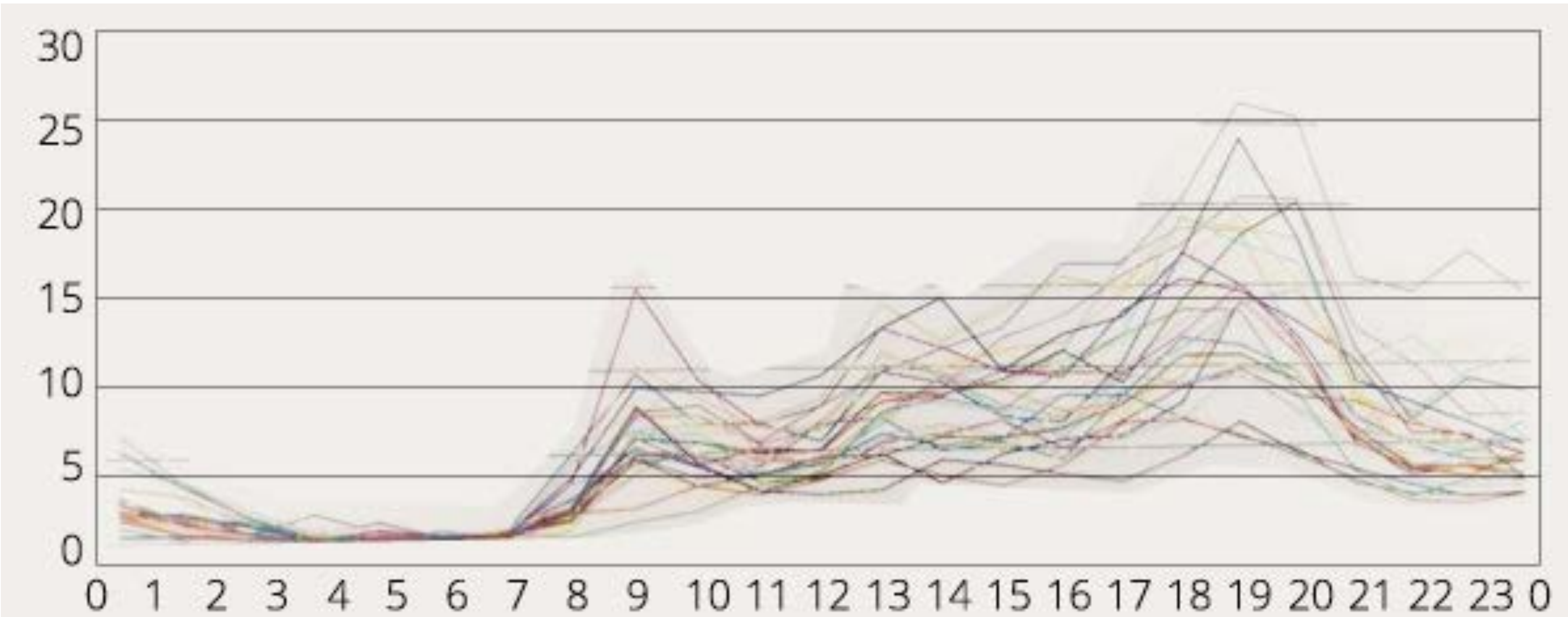
Bollards and bicycle parking

Targeting Roads for Improvements

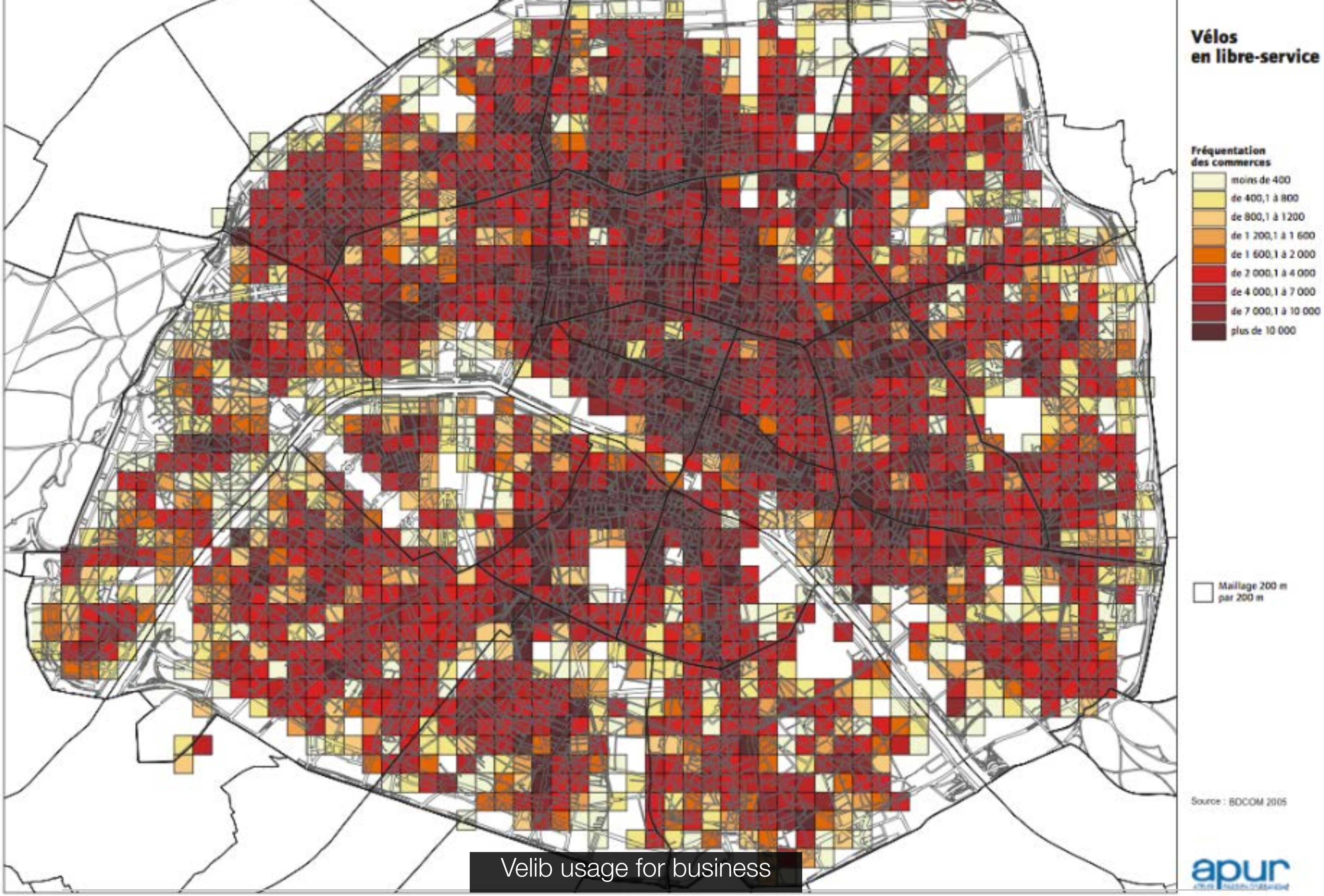
It is imperative that we select good roads to test the light and bollard systems for effectiveness. Effects will be most noticeable and measurable in areas that improve greatly—in other words, where conditions for cyclists are poor. A secondary factor is the presence of tourists in the area of improvements, which would draw attention to Paris as a cycling-friendly city. One such major road on which we consider to be a good target for initial bollard installation is Quai de les Tuileries, which runs along the right bank of the Seine and the gardens of Tuileries. This road is wide (more than five lanes), has no bicycle lanes at all (bicycles share the sidewalk equally with pedestrians), and is somewhat frequented by tourists. Similarly, Quai de Montebello, along the left bank of the Seine near Saint-Michel–Notre-Dame, possesses four car lanes, one purely painted bicycle lane, and is highly frequented by tourists.

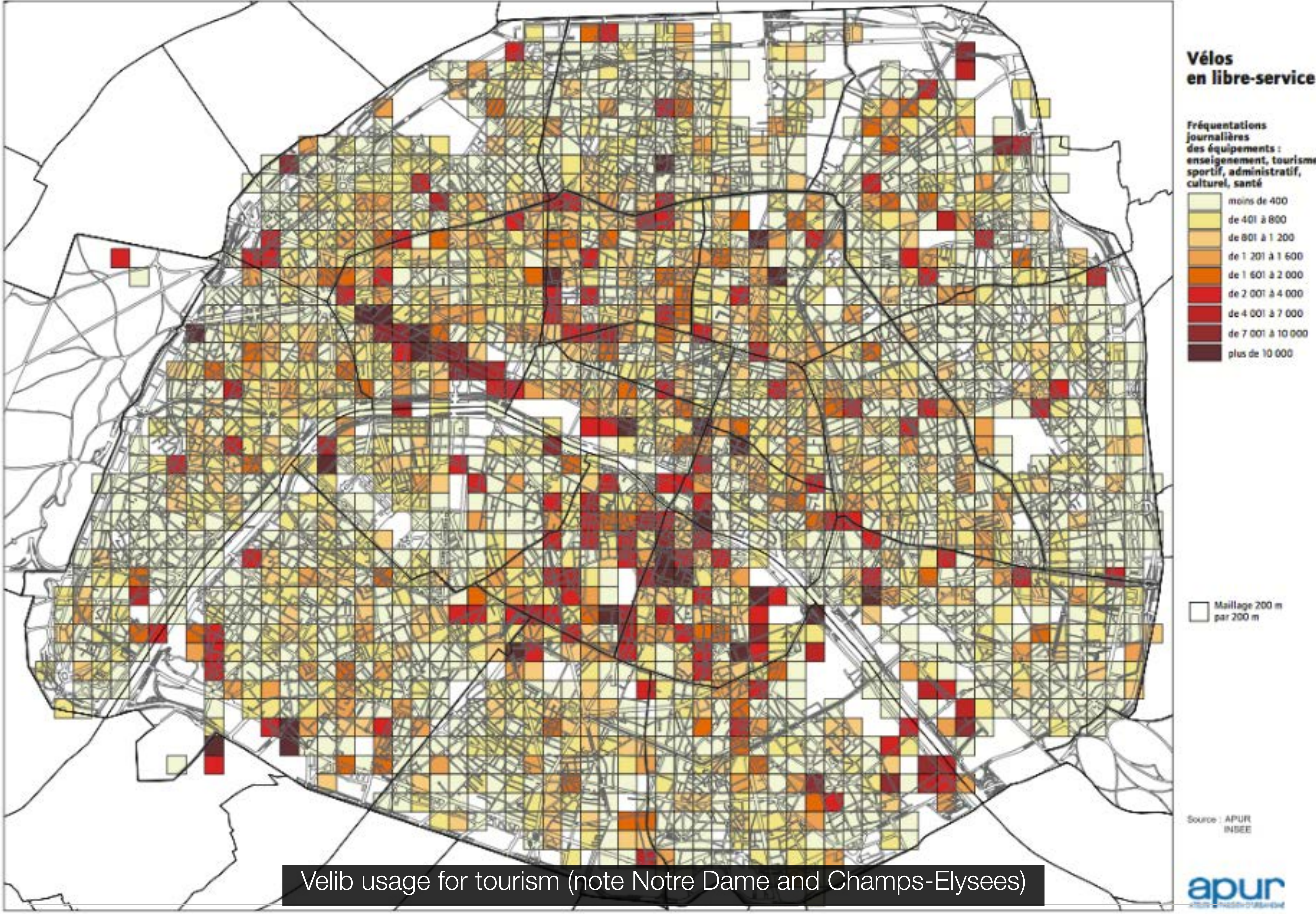
Quai de les Tuileries in Green,
Quai de Montebello in Red

Additionally, the implementation of the Vélib system has involved extensive data collection about the needs of transportation in different regions of Paris. We can use this data to better understand the different needs of transportation in the different regions and decide where to put in new lanes and at what times the demands are highest. Some regions have clearer distinctions between transportation demands during different times of the day; these are the regions where people tend to use transportation mostly to commute to work, as opposed to tourist or shopping regions where there aren't such clear travel times. Looking at these graphs below, we can see the differences between peak travel times in different arrondissements, and see that the contrast is greater in some locations. Subsequently, we can examine Vélib usage maps of these areas by purpose (two following pages) and see where the concentration of travel for different purposes is different.



Velibs in use by hour. Each color is a different station.


Vélos
en libre-service
Fréquentation
des commerces
moins de 400
de 400,1 à 800
de 800,1 à 1200
de 1 200,1 à 1 600
de 1 600,1 à 2 000
de 2 000,1 à 4 000
de 4 000,1 à 7 000
de 7 000,1 à 10 000
plus de 10 000
Maillage 200 m
par 200 m
Source : BDCOM 2005
apur
Velib usage for business



Velib usage for tourism (note Notre Dame and Champs-Elysees)

The preceding two graphs show Vélib traffic for business and tourism, respectively. The contrasting areas of high usage show trends (such as Boulevard Champs-Elysees) that could be used to identify good choices of streets for implementation.

Finally, we can use an already-planned event to further determine the best road for the light/bollard system's first major implementation. 27th September 2015 will be Paris' first planned Car-Free Day. On this Sunday, passenger cars will be banned **entirely** from the city of Paris.

We plan to utilize car-free day to collect data on where people bike compared to where people bike normally, to figure out where exactly to start implementation. By determining the greatest differences in bicycling routes on this day, compared to normal bicycle traffic, we can determine on which roads the citizens and tourists of Paris really wish to bicycle, but are unfortunately prevented from doing so by the cars and car-centric infrastructure present.

Similarly, we anticipate that many pop-up events will be held on the Car-Free day. By mapping the number and popularity of these events, we can determine in which vacated road areas pop-up events can and should be held after the Car-Free day.

However, the actual implementation of these pop-up events is out of the scope of this discussion. Rather than impose limitations on the types of events that might occur within repurposed road space, we encourage those who would propose ideas to push the boundaries of the road space to best help the citizens of Paris, just as we have pushed the definition and purpose of roads.

Chapter 6

Evaluation

We plan to create a system that responds to the needs of the city's traffic and environment. Effective modification and planning of extension of the system to more roads requires examination of initial data according to our plans.

Monitoring Car Traffic and Velib

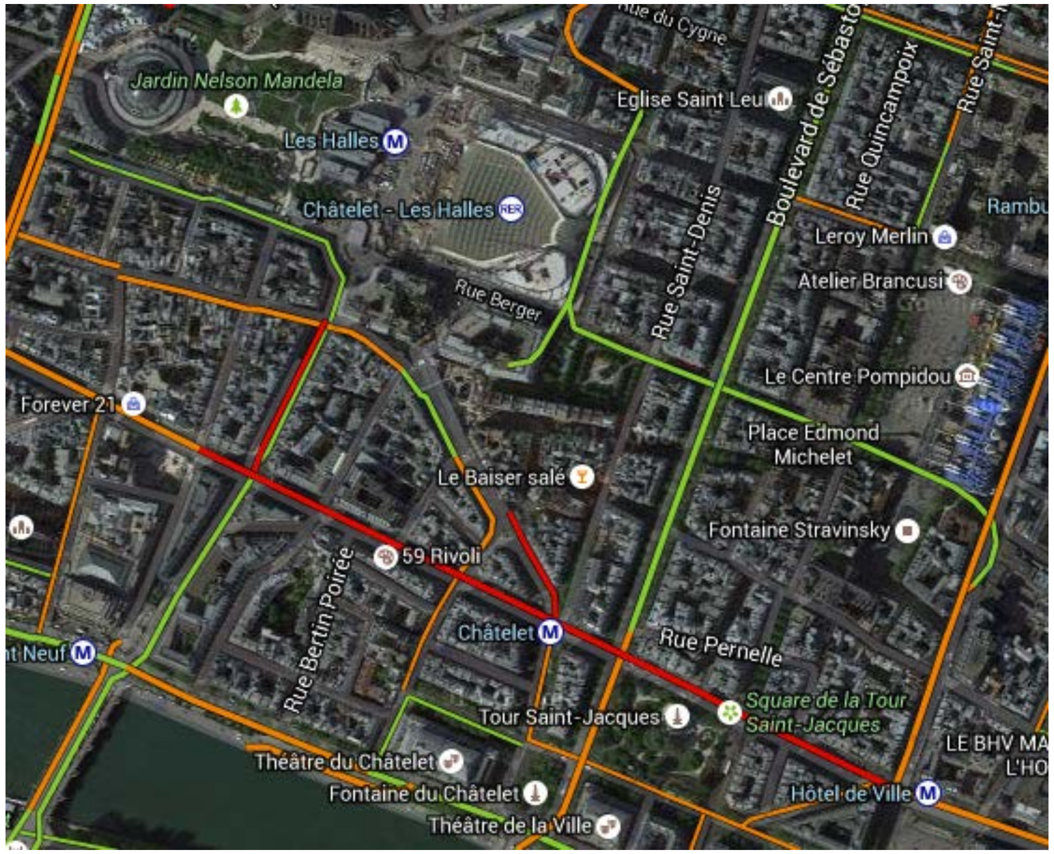
To assess the circulatory system of a patient's body, a medical doctor would both directly measure a patient's blood pressure as well as the interaction between circulation and the rest of the body, such as the consequences of exercise. Similarly, to assess the circulation within a city, we will use both direct measurement of traffic as well as related impact factors. Thus, we plan to evaluate the effectiveness of the light and bollard systems through the continual observation of traffic conditions in Paris depending on the lights/bollards, as well as analysis of other factors such as Vélib usage and air pollution.

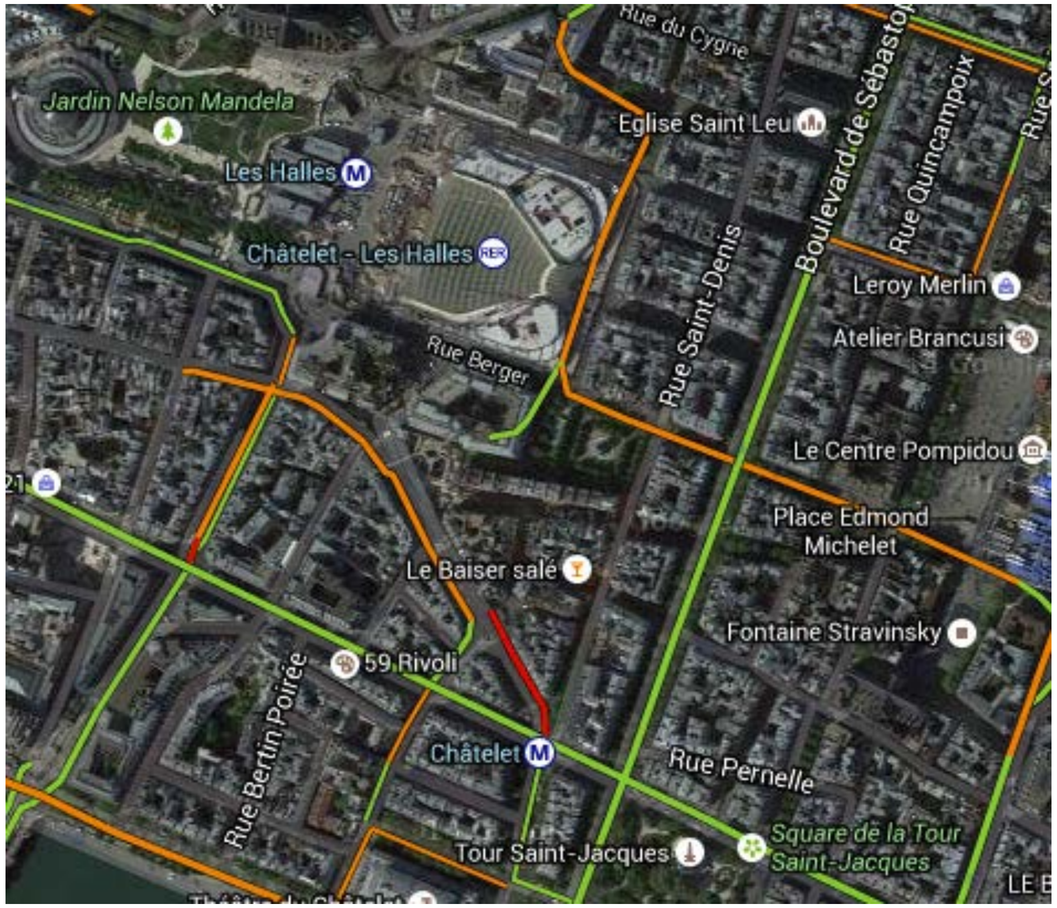
As we have previously acknowledged, there are many ways to evaluate traffic patterns— these include the Google map traffic data that works to determine traffic conditions in real time by collecting information from smart phones, and the installation of traffic cameras throughout the city. Over time, these trends can be generalized into traffic patterns, which can form routine bicycle-car lane adaptations as well as evaluations of how well the lanes are functioning.

Essentially, we could evaluate the effectiveness using the same mechanisms that we can use to adapt the lanes according to demand. In fact, these general trends can already be observed on Google Maps.

Consider the two maps on the right; the top map is of traffic at Wednesday at 08:35 and the bottom one is of traffic at Sunday at 08:35 at the same location. This stark difference would enable scheduled bicycle lane routines.

Collecting more data on the usage of Vélib stations in the areas in which we implement these lanes would also be a good way to evaluate the effectiveness of the systems we have proposed. There is already extensive data on Vélib usage, and based on continued monitoring of Vélib usage throughout the deployment and maturation of the light and bollard systems. If a statistically increase in Vélib demand greater than that of similar regions in Paris is detected in these areas, it can be concluded that this increase is due to the improvement in bike infrastructure, which has made it safer and easier—ultimately more attractive—for people to use bicycles in those areas.

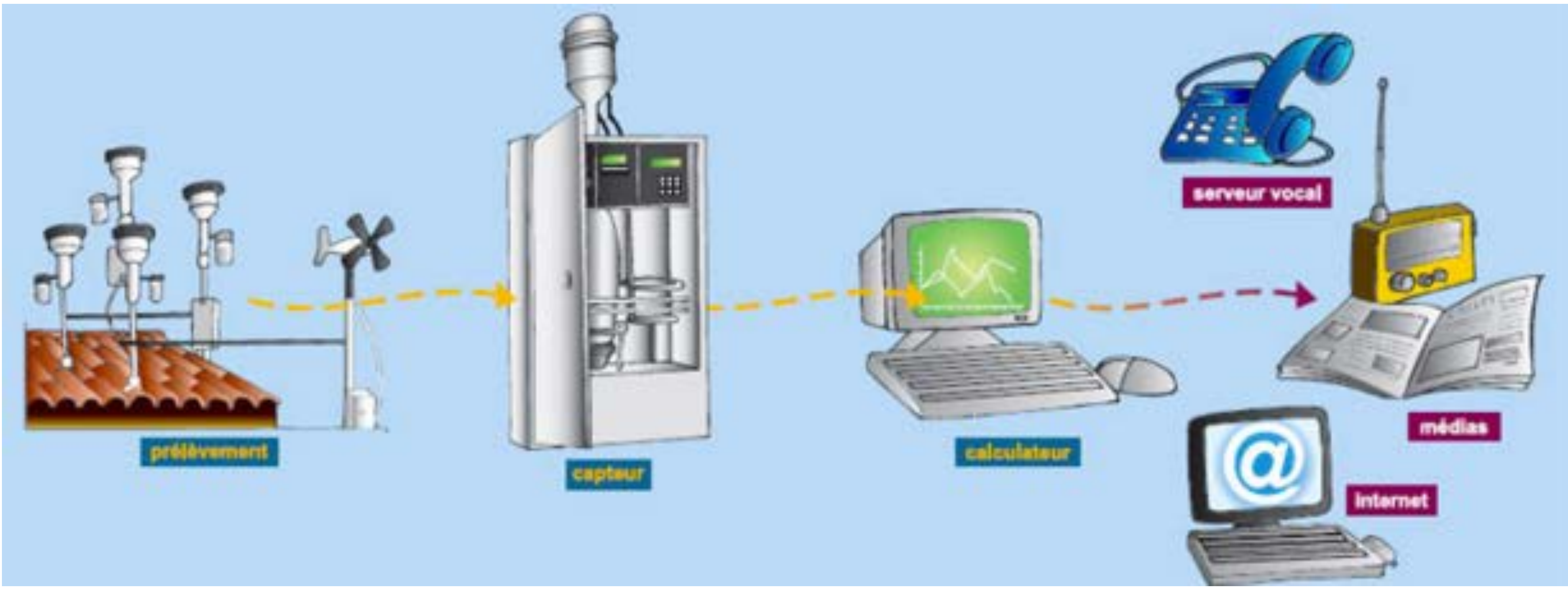


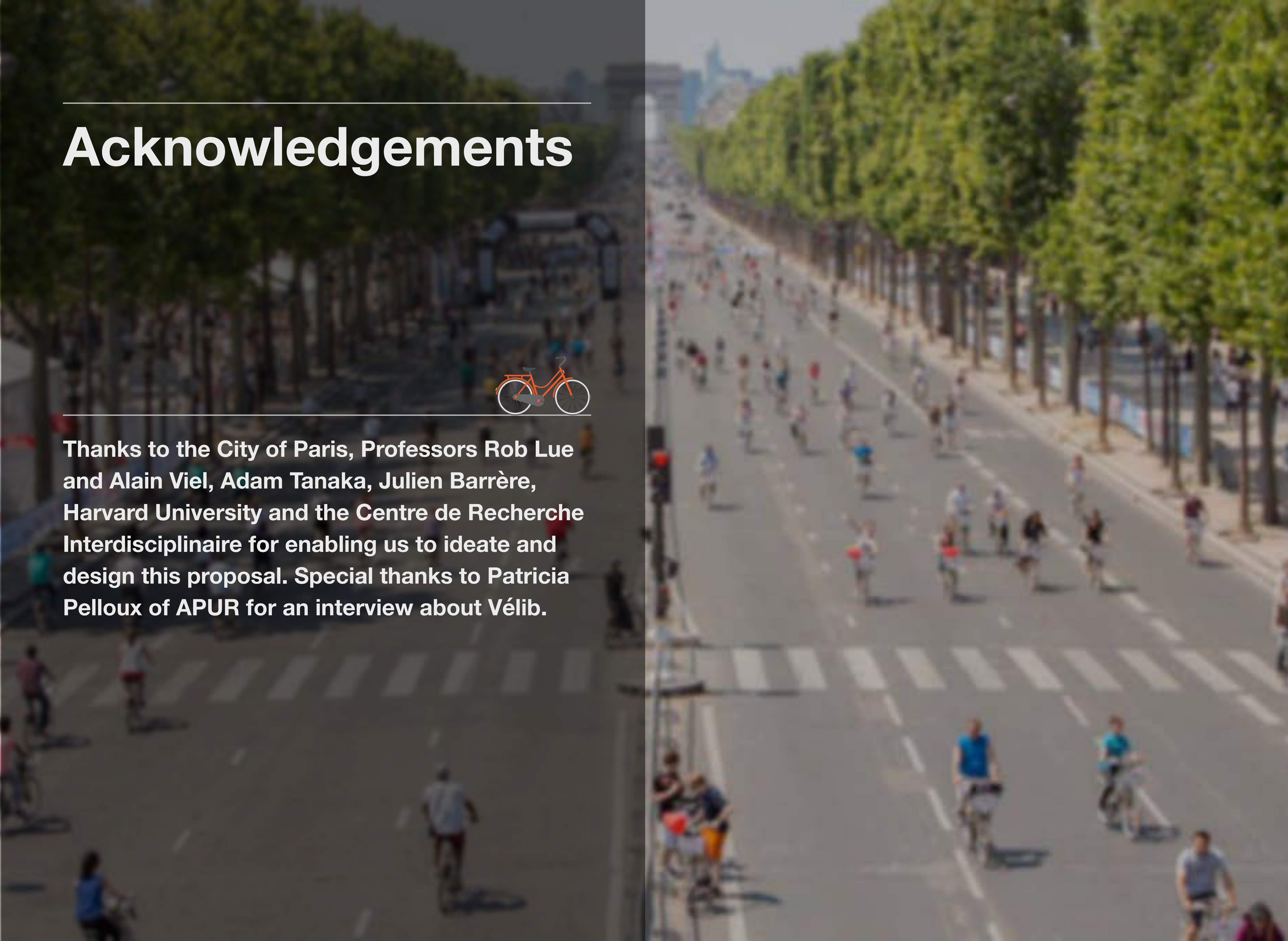


Monitoring Air Pollution

A more creative but big-picture method of evaluating the success of our system is by measuring pollution near our increased bike lane regions and comparing it to regions that have gone without the improvement. Pollution and temperature will be continuously measured through automatic analyzers located next to the lanes. A comparison of pollution and microclimate data after the installation of the light and bollard systems could perhaps indicate that this environmental change is due to the reduced carbon emissions due to fewer cars traveling in this area. In this way, we could estimate just how big of a contribution our lanes have to increased clean transportation and the reduction of emissions.

We propose a pollution-measuring system similar to the one below.





Acknowledgements

Thanks to the City of Paris, Professors Rob Lue and Alain Viel, Adam Tanaka, Julien Barrère, Harvard University and the Centre de Recherche Interdisciplinaire for enabling us to ideate and design this proposal. Special thanks to Patricia Pelloux of APUR for an interview about Vélib.

Bibliography:

1. Steriu, Mircea. "Statistics Brief: World Metro Figures." (2014). UITP. Web. <http://www.uitp.org/sites/default/files/cck-focus-papers-files/Metro%20report%20Stat%20brief-web_oct2014.pdf>

2. "RATP." Ratp.fr. N.p., n.d. Web. 17 July 2015. <http://www.ratp.fr/>

3. Farand, Chloe. "Paris to Double City's Cycling Lanes by 2020 - The Local."Paris to Double City's Cycling Lanes by 2020 - The Local. The Local, 03 Apr. 2015. Web. 17 July 2015. <http://www.thelocal.fr/20150403/paris-to-double-number-of-cycling-lanes>.

4. De Mallevoüe, Delphine. "Le Plan Anti-voitures D'Anne Hidalgo." Le Figaro. N.p., 12 July 2014. Web. 03 July 2015. <http://www.lefigaro.fr/conjoncture/2014/12/07/20002-20141207ARTFIG00066-anne-hildago-ne-veut-plus-du-diesel-a-paris-d-ici-2020.php>.

5. You Are Here. <http://youarehere.cc/#/maps/by-city>.

6. Pelloux, Patricia. "Interview of Patricia Pelloux." Personal interview. 16 July 2015.

7. Atélier Paris D'Urbanisme. "Étude De Localisation Des Stations De Vélos En Libre Service." (2006): n. pag. Print.

8. Atélier Paris D'Urbanisme. "Vélib': Analyse Du Fonctionnement Du Service Sur Le Mois D'octobre 2007; Préconisations Pour L'amélioration Du Service D'ici L'été 2008." (2008): n. pag. Print.

9. "STATISTICS LIBRARY / PARTICIPATION STATISTICS." People For Bikes. N.p., n.d. Web. <http://www.peopleforbikes.org/statistics/category/participation-statistics>.

10. Goodman, J. David. "Expansion of Bike Lanes in City Brings Backlash." The New York Times. The New

York Times, 22 Nov. 2010. Web. 17 July 2015. <http://www.nytimes.com/2010/11/23/nyregion/23bicycle.html>.

11. "In-Roadway Warning Light Systems." Traffic Safety Corp (2010): n. pag. Web. 17 July 2015. <http://www.xwalk.com/images/advocacy/In-Roadway-Warning-Light-Systems_103110B.pdf>.

12. "Park(ing) Day." Parking Day. N.p., n.d. Web. 17 July 2015. <http://parkingday.org/about-parking-day/>.

13. Bracken, Matt. "Ringing in Bastille Day 2015". Photo. The Dark Room. July 14 2015. July 16 2015. <http://darkroom.baltimoresun.com/2015/07/ringing-in-bastille-day-2015/#5>.

14. Reji. "Girl on bike with Arc de Triomphe". Photo. The Local. Apr 3 2015. July 17 2015. <http://www.thelocal.fr/20150403/paris-to-double-number-of-cycling-lanes>.

15. "Molecular Genetics of Cancer Part 4." Whatwhenhow RSS. N.p., n.d. Web. 17 July 2015.

16. Ville de Paris "Vélib, vélos en libre-service à Paris"http://cdn6.feeldesain.com/feel/wp-content/uploads/2013/11/pepsi_circulatory_system_ad_open.jpg>

17. RC. "Bike lane". Photo. <http://www.bricoleurbanism.org/cyclism/bike-lane-ideas-from-paris/>.

18. Joseph Castro "11 Surprising Facts About the Circulatory System" . Photo. <http://www.livescience.com/39925-circulatory-system-facts-surprising.html

19. Photo taken by group member Bree Lalor