POLICIES FOR PEDALING

Managing the Tradeoff between Speed & Safety for Biking in Chicago

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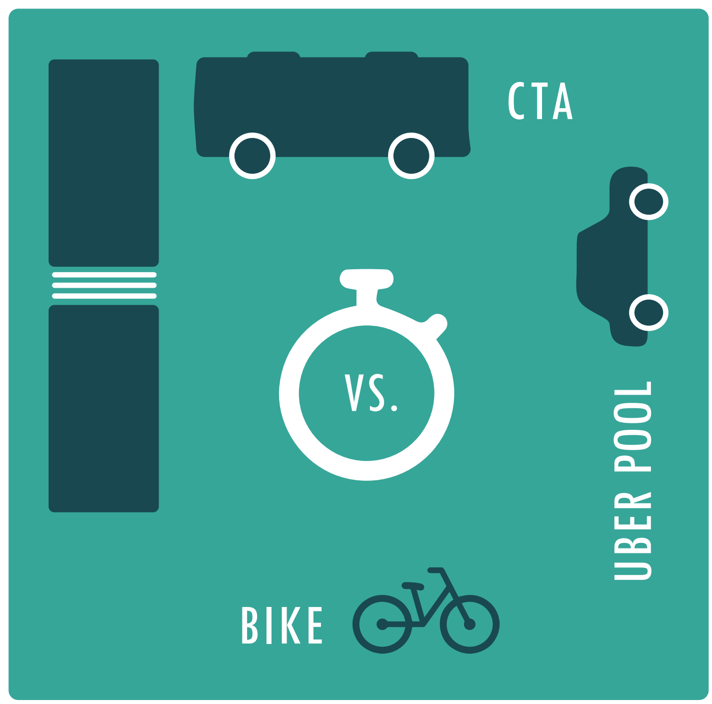

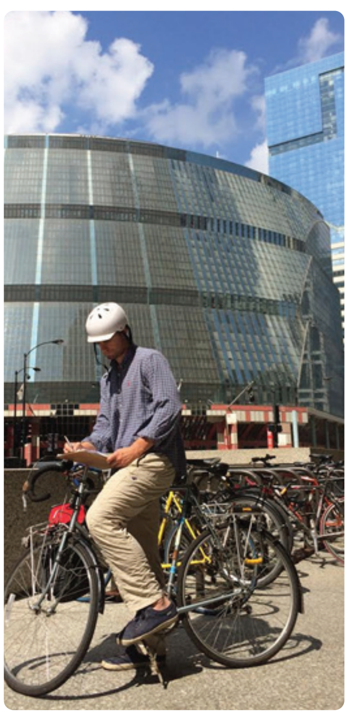

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EXECUTIVE SUMMARY

The City of Chicago's investments in bike infrastructure over the past several years, including designated lanes and other amenities, are allowing cyclists to reach their destination quickly and with a strong perception of personal safety. This study evaluates the speed, convenience, and predictability of bicycle travel in Chicago as well as policy options to help manage the growth of biking as a means of transportation in the city.

A review of municipal ordinances around the state of Illinois and field observations of 875 cyclists at six intersections in Chicago provide valuable details about the behavior of cyclists in the city – particularly in regards to reducing risk. Building on data collected for the Spring 2016 study, *Have App, Will Travel: Comparing the Price and Speed of Fifty CTA and UberPool Trips in Chicago*, the report also explores results from 45 matched trips made between randomly selected points throughout the city. Considering all three modes – public transit, UberPool, and bike – biking proved faster than public transit on 33 of the 45 trips and faster than UberPool on 21 trips. While trips between neighborhoods included the largest percentage of unmarked streets used, more than half of the total bike mileage on all routes could be ridden on dedicated bike lanes and/or trails.

Based on these data, the study makes policy recommendations for municipalities interested in supporting bike travel by encouraging ridership and safety on the road. Recommendations include:

I. *Considering permitting "Idaho Stops" at four-way stop intersections, which would enable cyclists to determine whether to stop or yield based on traffic conditions in order to maintain their momentum. The study shows that only about one cyclist in 25 presently complies with the law to come to a complete stop. A pilot program to allow Idaho Stops at certain traffic signal intersections when traffic volumes are relatively low may also be considered.*

II. *Lowering fines for cyclists who commit minor traffic violations and offering "diversion programs" as an alternative to paying a fine if the cyclist attends an approved traffic safety class. Such programs present a unique opportunity to educate cyclists about traffic laws and how they are enforced.*

III. *Prioritizing incremental, low-cost infrastructure improvements, such as signage, along routes that connect neighborhoods outside of downtown. In the absence of a designated bike lane, these efforts both encourage drivers to share the road and justify cyclists riding in traffic.*

Investments in bike infrastructure throughout Chicago—dedicated lanes on city streets, trails, bikesharing stations and related amenities—are allowing many who travel by bike to reach their destination faster and with a stronger perception of personal safety than just a few years ago. The impressive pace of these enhancements, together with the health benefits, convenience, and low cost of biking, have raised the visibility of a mode once confined to the margins of urban life.

Along with the growth of biking comes a need for new strategies to better integrate this mode into the ebb-and-flow of the city's transportation system. This report offers technical perspectives on three issues that address these concerns:

SECTION I explores the status of regulations governing bicycle travel and enforcement, both in Chicago and elsewhere. This section offers a detailed look at potential implications for adopting the "Idaho Stop Law" to address cyclists' desire to preserve their momentum at intersections and save time.

SECTION II provides new evidence to support the notion that shorter travel times and trip predictability may be drivers in the growth of bike travel. The section compares travel times by bike with public transit and UberPool along 45 different routes.

SECTION III suggests policy options and priorities for policymakers, with particular attention focused on adopting policies that strike a reasonable balance between the desire to encourage the convenience of bike travel, while not overlooking the safety of cyclists and others on the road.

This report does *not* extensively consider the benefits and costs of infrastructure improvements to support bicycle travel. Instead, it offers practical short-term policy options worthy of careful consideration.

I. POLICIES AND REGULATIONS GOVERNING BIKING IN CHICAGO

Although Chicago has received national attention recently for its bike-friendliness, it is often overlooked that the city has embraced and encouraged this mode for many decades. The city has a long tradition of investing in biking infrastructure, starting in earnest with Mayor Carter Harrison, who created a bike path from the Edgewater neighborhood to Evanston and made bicycling a prominent part of the 1897 mayoral campaign. Between the 1960s and early 2000s, both Richard J. Daley and Richard M. Daley also demonstrated a commitment to cycling improvements, including off-street trails and protected bike lanes.[i]

Nevertheless, it was not until after Chicago's current mayor, Rahm Emanuel, took office in 2011 that efforts to make biking more attractive to commuters gained high visibility. Many miles of dedicated bike lanes have been added to city streets under Emanuel. The widely-celebrated 2013 launch of the Divvy bikeshare program further reduced barriers to entry for people to try biking while also increasing awareness that streets are meant to serve modes other than cars and buses. The Bloomingdale Trail, known colloquially as "The 606", as well as the soon-to-be-completed Navy Pier Flyover, "Paseo" in Pilsen, and other dedicated bikeways have become hallmarks of the city's biking agenda.

In response, biking has become more pervasive and the share of all *commuting* trips in the city has risen exponentially. From 1990 to 2000, this share rose from 0.3% to 0.5%. By 2015, commuting by bike made up 1.4% of the total share of commuters—more than four times the rate of 1990. Although the percentage of commuters who travel by bike is less than that in nearby Evanston (3.5%), and Champaign (2.8%), it is far above every other city in Illinois with at least 50,000 residents.[ii]

Interest in promoting cycling is underscored by its myriad of health and environmental benefits. A study by de Hartog, Boogaard, Nijland & Hoek (2010) demonstrates that the reduction in air pollution resulting from a shift from driving to biking can decrease pollution-related mortality rates for communities. Additionally, cities with high biking rates tend to have a lower risk of fatal crashes for all road users (Marshall and Garrick, 2011). This benefit is likely due to the "safety in numbers" phenomenon, the idea that drivers adjust their behavior in accordance with the perceived probability of encountering a bicyclist.

The Active Transportation Alliance, Chicago Metropolitan Agency for Planning, and Chicago Department of Transportation have all been active participants in efforts to promote safe bike travel throughout the region. The CDOT *Streets for Cycling Plan 2020* remains the cornerstone of Mayor Emanuel's vision of a world-class bike network for Chicago, espousing to make it the "best big city for biking in the United States." The 2012 plan ambitiously calls for a 645-mile network of innovative bikeways that positions bicycle accommodations within a half-mile of every Chicago resident. The plan also strives to concentrate the greatest number of bikeways in the most densely populated neighborhoods and identify low-ridership areas where infrastructure could spur greater ridership. In some respects, much of the plan's vision has already been achieved: Chicago this year was named the "Friendliest Bike City in America" by *Bicycling Magazine.*[iii]

REGULATIONS & ENFORCEMENT

Analysis by this report's research team nonetheless paints a mixed picture of existing regulations on bike travel. The study team reviewed the ordinances of each of Illinois' 29 municipalities with populations of 50,000 or more to assess the status of bike laws. The following is a brief summary of results that appear in the 2016 issue of the *Illinois Municipal Policy Journal*.

Bike vs. Motor Travel

In all 29 cities, bicyclists are required to comply with the same laws governing motor travel. This includes speed limits, observance of traffic control devices, passing regulations, and behavior at railroad crossings.

Helmets

None of the 29 municipalities require *all* cyclists to wear helmets, although Cicero, Evanston and Oak Park require children below a certain age to wear them. Chicago does not have a universal helmet law, a policy consistent with the views of most experts, who believe helmet laws can deter people from biking and thus are counterproductive. Further, universal requirements for helmets can create complications for people interested in using Divvy and other bikeshare programs, particularly those who use them only sporadically.

Penalties

The fines charged for bicyclists breaking traffic laws generally range from $10 to $50. Chicago's fines are at the higher end of that range (between $50-$200). Chicago is the only municipality evaluated, however, that outlines fines for motorists endangering cyclists (parking in bike lanes, doorings, etc.), with fines ranging between $150-$1,000[iv]. Enforcement of these types of fines are strongly endorsed by many bicycle advocates.

Sidewalks

In 22 municipalities, language articulates "if and where" it is appropriate to ride on the sidewalk. Chicago is among the 22 cities that bans adults from riding on the sidewalk in business districts, and is one of three cities evaluated that make an exception for downtown sidewalk riding for children under a certain age (which, in Chicago, applies to riders under 12 years old).

Trends in Enforcement

Chicago shares with nearly all of the municipalities evaluated a general leniency toward bicyclists who violate the regulations described above. In Chicago, 13,150 traffic-related tickets were issued to cyclists from 2006 and 2015. The vast majority of these were for sidewalk violations (Knight, 2015). Other analysis indicates that the city issued an average of about nine tickets per day in 2015. Recent media reports, however, suggest that ticketing may be on the rise.[v] Nevertheless, the rate of citations appears to be well below that of New York.[vi]

In short, Chicago stands out for its ambitious efforts to invest in infrastructure, ticket motorists who put cyclists at risk, and promote bikesharing. Like most cities, however, Chicago has not placed a great deal of emphasis on creating bike-specific traffic laws or adopting effective enforcement methods to deal with concerns over safety.

IS THE IDAHO STOP LAW APPROPRIATE FOR ILLINOIS COMMUNITIES?

At present, none of the 29 municipalities have adopted the Idaho Stop Law, which was enacted in 1982 in the state of Idaho. This policy allows cyclists to treat stop signs as yield signs and red traffic signals as stop signs (Pedestrian and Bicycles, 1982). The details of the Idaho Stop Law suggest that it was written to align policy with the fact that many cyclists seek to maintain their energy and momentum at intersections without compromising safety.

While the full language of the Idaho Stop Law can be found in the Appendix, the most noteworthy sections for this study can be found in the gray box below.

Research on the Idaho Stop Law suggests it can be a reasonable accommodation to cyclists and may, in fact, enhance safety. Meggs (2010) found that the year after the law was implemented, cyclist injuries in Idaho declined by 14.5% and fatality rates remained constant. The study also drew attention to the fact that having cyclists follow the same laws as drivers may in fact be more dangerous. Leth, Frey, & Brezina (2014) concluded the Idaho Law reduced the number of intersection accidents between cyclists and motorists in cities where the policy has been adopted. No studies were found that concluded the Idaho Stop Law was unsafe.

A 2007 report by Transport for London's road safety unit found that although women make up roughly a quarter of all cyclists in that city, they are killed by large trucks at three times the rate as men (Tran, 2010). Between June and September of 2016, six cycling deaths occurred in Chicago (the average for a full year), half of which were women struck by commercial sized trucks making turns (Sobol & Wisniewski, 2016). The Transport for London report posits that women are more vulnerable to truck collisions due to their tendency to be less likely to disobey red traffic signals than men. By going through a red traffic signal before it turns green, men are less likely to be caught in a truck driver's blind spot. Instead, they get in front of the truck before it starts to enter the intersection. This research suggests that some cyclists disobey stop signs or red traffic signals in situations where their personal safety might be at risk otherwise.

Other research also points to the dangers that traffic signal intersections pose to cyclists. Chen (2015) analyzed 707 instances of bicycle crashes from 2010 to 2013, taking into account numerous variables, such as the type of intersection and traffic controls. These results shows that signaled intersections were associated with more bicycle crashes. Thus, if cyclists are legally permitted to yield and proceed through an intersection when cross-traffic is not present, they can clear the intersection before more traffic becomes present.

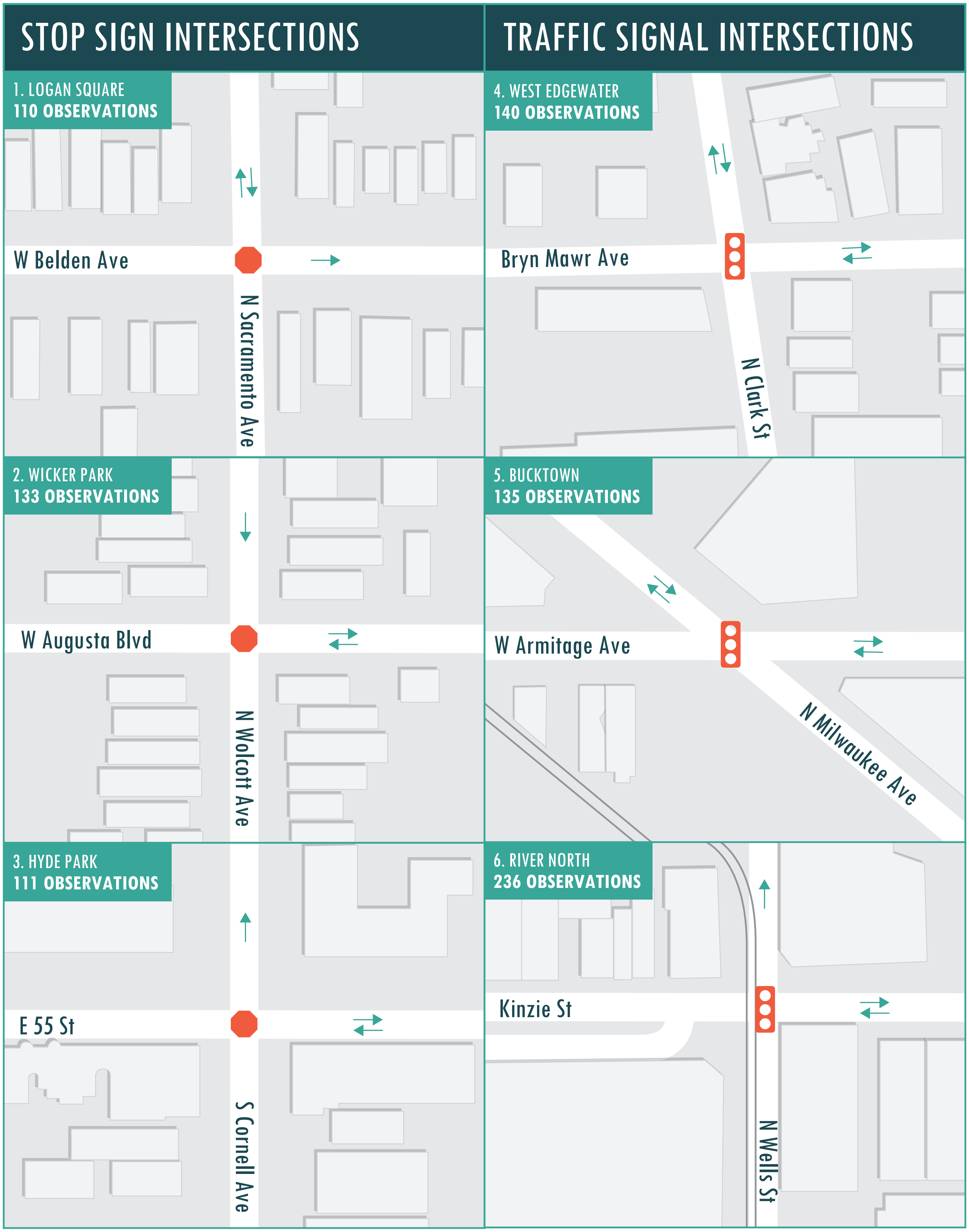
A study by Nixon published in 2011 found that nearly 94% of cyclists interviewed consider it a negative physical experience to have their momentum interrupted by a stop sign or red traffic signal. The majority of bikers surveyed reported that they actually make an Idaho Stop, even when the law forbids this. Fajans and Curry (2001) suggest that this behavior has a rational basis, determining that a 150 pound cyclist producing 100 watts of power, with a stop every 300 feet, incurs a 40% drop in their average speed.

IDAHO STOP LAW | SUMMARY

At *stop signs*, the Idaho Stop Law stipulates that a cyclist: "Shall slow down and, if required for safety, stop before entering the intersection. After slowing to a reasonable speed or stopping, the person shall yield the right-of-way to any vehicle in the intersection or approaching on another highway so closely as to constitute an immediate hazard." The law also specifies that a biker "may cautiously make a turn or proceed through the intersection without stopping."

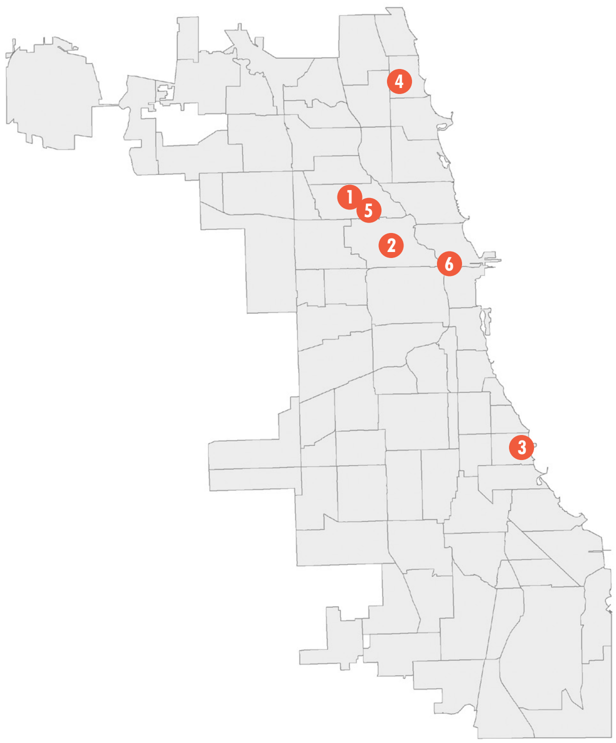
At *traffic signals,* a cyclist: "Shall stop before entering the intersection and shall yield to all other traffic. Once the person has yielded, he may proceed through the steady red light with caution." At signaled intersections, the law specifies "a left-hand turn onto a one-way highway may be made on a red light after stopping and yielding to other traffic."

FIGURE 1: Observations of Bicyclist Behavior at Intersections with Counts



A total of 875 bikers were observed during 14 total hours of observation during Summer 2016

FIGURE 2: Intersection Locations- City of Chicago



CYCLIST BEHAVIOR IN CHICAGO

To gain perspective on the behavior of the typical cyclist, the data team for this report observed bicyclists in Chicago during the summer of 2016 at six intersections outside downtown on the north, northwest, west and south sides (Figure 2). Half of the intersections are equipped with traffic signals and the other half with four-way stop signs. Observers remained largely out of view of cyclists and recorded the number that made legal stops, Idaho Stops, or failed to exercise either level of precaution. Intersections were selected based on high levels of bike traffic. Counts for each intersection can be seen in Figure 1.

Field observations were conducted twice at each location for at least 60 minutes each, once during regular commute times (generally 8 – 9 am or 5 – 6pm) and once during an off-peak time (e.g. weekends). The data offers a reasonable representation of how cyclists behave at intersections, and supports the following findings.

FINDING I:

When cross-traffic is not present, few cyclists comply with existing laws at either stop signs or traffic signals. About half, however, exercise at least the level of caution associated with Idaho Stops.

At *stop signs*, just two percent (about one cyclist out of every 50) came to a full stop when cross-traffic was not present while far more (43%) made Idaho Stops, slowing down enough to yield if necessary (Figure 3). The remaining 55% failed to take either precaution. One can posit that when cyclists sense there are no immediate safety risks, their desire to maintain forward momentum and conserve energy almost always exceeds their desire to strictly adhere to traffic laws.

At *traffic signal* intersections when cross traffic is not present, 30% made full stops and waited until the light turned green, or made a right turn when permitted after stopping. More than twice as many (65%), however, made Idaho Stops, often by proceeding through the intersection before the light changed. Only five percent failed to do either, proceeding through the intersection without stopping or yielding at all.

These results show that in quiet conditions, compliance with traffic laws is far greater at traffic signals than stop signs.

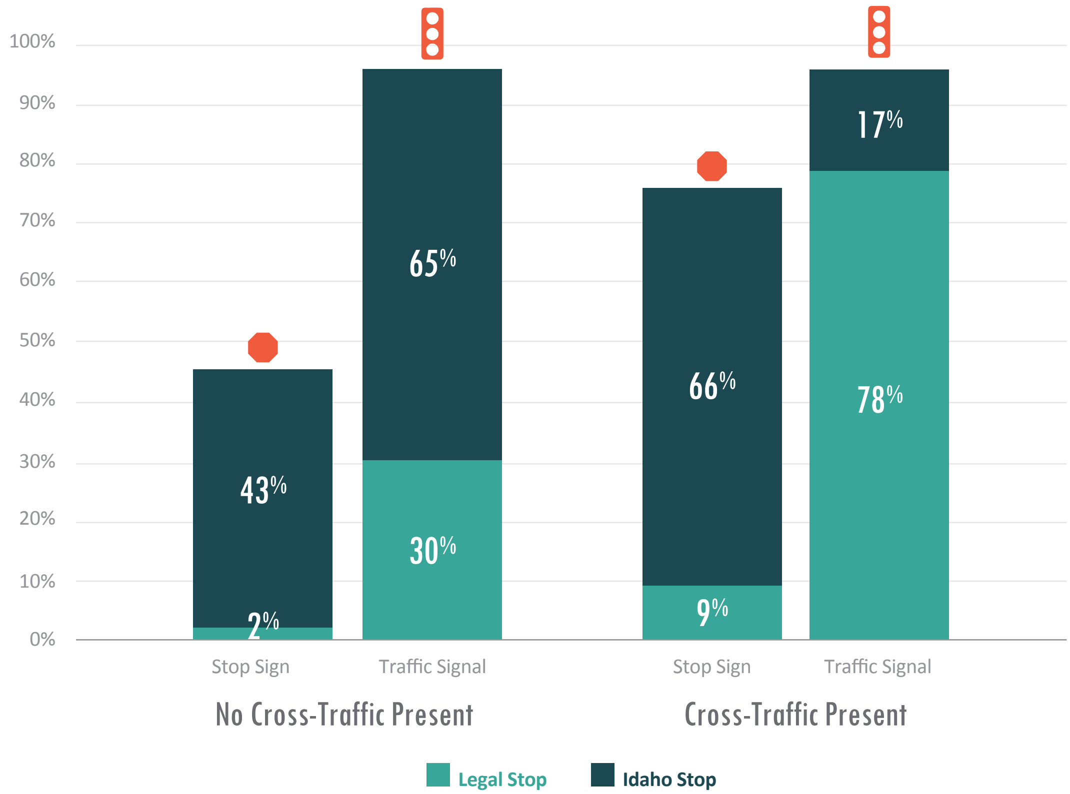
FINDING II:

When cross-traffic is present, compliance with existing laws is much greater, particularly at traffic signals.

At *stop signs*, nine percent of cyclists made full stops when cross-traffic was present, while 65% made Idaho stops; the remaining 26% took neither precaution. At *traffic signals*, 78% followed the law, and only 17% made Idaho Stops (Figure 3). The remaining six percent exercised neither precaution.

The sample is not large enough to make definitive conclusions about differences in travel behavior during peak and off-peak times. However, during morning and evening rush hour (as well as on weekends), it appears that a greater share of cyclists make at least an Idaho Stop compared to off-peak times. Overall, 54% complied with current laws during commuting times compared to 44% at other

FIGURE 3: Legal and Idaho Stops at Chicago Intersections by Traffic Conditions



times. The limited size of the sample makes it difficult to determine exactly why this is the case, but heavier traffic during peak periods is likely a contributing factor. For a summary of some of the notable differences in behavior between intersections as well as cumulative results, please refer to Appendix A.

Overall, these results show that the Idaho Stop is the most prevalent action taken by bikers approaching an intersection except at traffic signals when cross-traffic is present. Given this, it would likely be quite controversial for law enforcement officials to dramatically "step up" enforcement by targeting Idaho Stops at stop sign intersections and at traffic signals where cross-traffic is not present. As noted in Section III, these results suggest that adopting the Idaho Stop in certain circumstances could enable resources to be diverted to dealing with more flagrant violations.

II. MEASURING THE RELATIVE SPEED OF BICYCLE TRAVEL

The popularity of biking in urban areas may be stimulated by its relative speed and predictability. To better understand the importance of these factors, this section offers a systematic analysis of the differences in travel time between biking, Chicago Transit Authority (CTA) services and UberPool trips. Introduced in the city in November 2014, UberPool is a form of ridesourcing (often called "ridesharing") that allows the driver to pick up other passengers on the trip. This specialized service is often referred to as "ridesplitting" and priced around 40% less than conventional UberX service, making it more competitive with traditional transit options.

The analysis builds upon a previous study by the Chaddick Institute, *Have App, Will Travel: Comparing the Price & Speed of Fifty CTA & UberPool Trips in Chicago*, which compares 50 "paired trips" (in which travelers departed simultaneously on one of the two modes) between randomly selected points in the city. The analysis below supplements this study, with data collected from June – December 2016.

The newly collected data includes all routes with distances of at least 3.5 miles—45 of the study's original 50 paired. This minimum mileage threshold was chosen to limit the analysis to bike trips of at least 20 minutes. On shorter trips, one would expect a bicyclist to arrive much faster than public transit—particularly when a transfer is necessary—on an overwhelming share of rides. The longest trip was 15.6 miles.

METHODOLOGY

The data collectors followed a strict set of methodological guidelines, riding the same commuter road bike and beginning each trip by starting a timer at the origin address and walking the bicycle to the street. The rider maintained a moderate pace throughout the entire ride, resulting in speeds slower than the experienced cyclist, but comparable to a casual commuter. Upon approaching the destination address, the rider locked up the bicycle on a rack (if available) or street signpost, walked to the destination address and stopped the timer. The data collector took the necessary time to put on and remove a helmet.

All biking trips were conducted on weekdays between 10 a.m. and 6 p.m. In addition to regular traffic lanes (those with no identifiable markings), two types of bike lanes were utilized during these trips: 1) shared bike lanes, which involve a barrier or painted lane; and 2) off-street lanes, i.e., the North Shore Channel, The 606, and Lake Front Trail. The majority of the routes included riding on some form of bike infrastructure or marked lanes, especially when utilizing "blood line biking streets", such as Milwaukee Avenue and Dearborn Street. Routes were identified using the Google Bike app to avoid subjective judgments.

Each trip is categorized into one of three groups: 1) downtown-to-neighborhood trips; 2) neighborhood-to-neighborhood trips; and 3) outer downtown-to-neighborhood trips, with the "outer downtown" being comprised of locations on the periphery of downtown. Please refer to the *Have App, Will Travel* study for details on how origins and destinations were selected for these trips.

DIFFERENCES IN TRAVEL TIME

The results show that bike travel times differ sharply based on the origin and destination of the trip, as seen in Figure 4.

Downtown – Neighborhood:
On these trips, bicycle travel times averaged 50:52, making this mode slightly slower than the CTA, which averaged 49:15, and significantly slower than UberPool's 43:21. Bicycle travel was faster than public transit on eight of 19 downtown-to-neighborhood trips, and was also faster than UberPool on eight of 19 trips (Table 1).

Outer Downtown – Neighborhood:
Bicycle travel times averaged 43:38, moderately faster than the CTA (52:58) and a few minutes slower than UberPool (40:09). Bicycle travel was faster than transit on eight of the nine trips in this category, and was faster than UberPool on three.

TABLE 1: Results of 45 Paired Trips in Chicago: Bike, CTA & UberPool

	PAIRED TRIPS	AVERAGE BIKE DISTANCE	AVERAGE TRAVEL TIME			# TRIPS FASTER BY BIKE/ SLOWER BY BIKE		AVERAGE COST*		AVERAGE WALK DISTANCE
TRIP TYPE			BIKE	CTA	UBER POOL	VS. CTA	VS. UBERPOOL	CTA	UBER POOL	CTA
DOWNTOWN – NEIGHBORHOOD	19	8.55 MILES	50:52	49:15	43:21	8 FASTER 11 SLOWER	8 FASTER 11 SLOWER	$2.35	$10.11	.55 MILES
OUTER DOWNTOWN – NEIGHBORHOOD	9	7.70 MILES	43:38	52:58	40:09	8 FASTER 1 SLOWER	3 FASTER 6 SLOWER	$2.35	$9.51	.63 MILES
NEIGHBORHOOD – NEIGHBORHOOD	17	5.27 MILES	28:11	52:05	31:37	17 FASTER 0 SLOWER	10 FASTER 7 SLOWER	$2.41	$9.47	.58 MILES
ALL TRIPS	45	7.05 MILES	40:51	51:04	38:16	33 FASTER 12 SLOWER	21 FASTER 24 SLOWER	$2.36	$9.66	.58 MILES

**While commuter cyclists incur regular maintenance costs to keep their bikes running smoothly, they do not pay a cost per-trip.*

Neighborhood – Neighborhood*:*
For these trips, bicycle travel dominated, having an average time of 28:11, which was markedly faster than the CTA (52:05) and moderately faster than UberPool (31:37). Bicycle travel was faster than transit on all 17 neighborhood-to-neighborhood trips, and was faster than UberPool on 10 of 17 trips.

When considering *all* trips, the average bike trip was 40:51 minutes, about ten minutes faster than the 51:04 average CTA trip, and two-and-a-half minutes slower than UberPool (38:16). Biking was faster than public transit on 33 of the 45 trips and faster than UberPool on 21 trips.

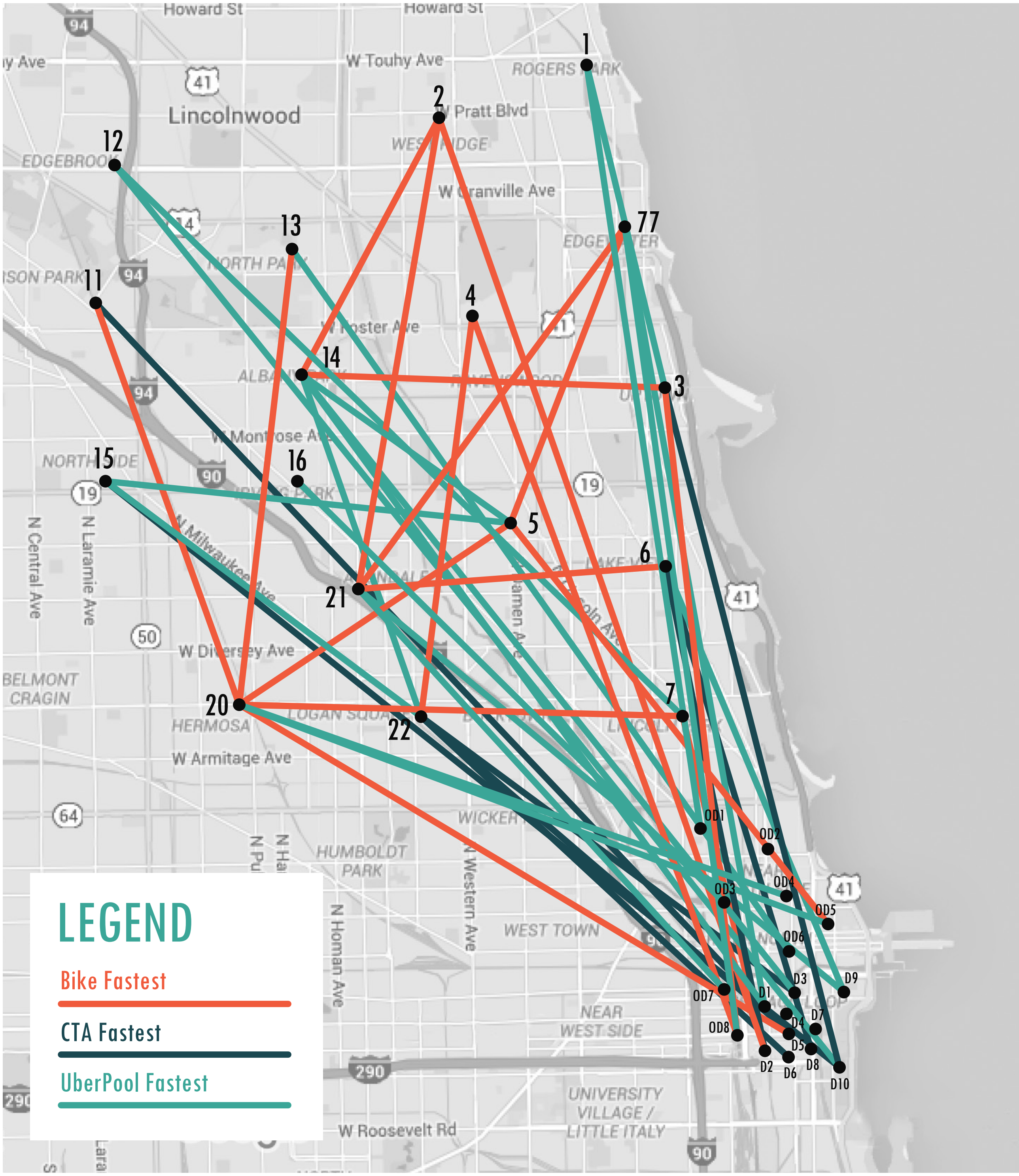
A notable explanation for the speed of bike travel compared to transit is the avoidance of both the "walk time" to transit stops and wait times. On the 45 trips considered, the average CTA trip involved a .58 mile walk, averaging about nine minutes, as well as considerable wait times. The average CTA rider spent just over five minutes (05:13) waiting at a bus stop or rapid-transit station before their bus/train arrived; many spent additional time making transfers—a factor evaluated in greater detail in Appendix B.

The following statistics illustrate the dramatic ways that the city's investments in specialized infrastructure for cyclists have shaped the character of bike travel:

- Every one of the 45 routes utilized an off-street trail or bike lane at some point. More than half of the total mileage on 38 of the 45 routes was completed on such lanes and trails.
- 36% of the total mileage was ridden on unmarked streets. Neighborhood to neighborhood trips had the highest percentage of routes using unmarked streets.
- The Lake Front Trail was utilized as the preferred route for part of 15 of the 45 bike trips. The Bloomingdale Trail (also known as"The 606") was the preferred path in eight routes, while the Chicago Riverwalk and North Shore Channel were instrumental in four routes each.

FIGURE 4: Average Time by Trip Type: 45 Trips by Bike, CTA & UberPool

FIGURE 5: Comparing Trip Differences



Neighborhood locations labeled with area number • Outer downtown locations labeled with OD • Downtown locations labeled with D

This map shows the locations of the downtown-to-neighborhood, outer downtown-to-neighborhood, and neighborhood-to-neighborhood routes. The colored lines indicate which mode was fastest among all time tests: Bike, CTA or UberPool.

DIFFERENCES IN PREDICTABILITY

The results show that cycling tends to offer greater trip predictability compared to the other transportation modes. Transit and UberPool involve wait times that can be unpredictable. Moreover, UberPool riders also face uncertainty over the number of pickups on their trip, which averages 0.85 stops per trip but reached three in several instances. Further, 60% of the transit trips involved making a transfer, which was found to add 15.84 minutes to the trip time (see Table 3 in Appendix B). Bicycle travel, particularly when dedicated lanes are available, is also less affected by traffic congestion than buses and ridesourcing, making travel time less variable.

These observations are borne out in regression analysis, which shows that travel distance (mileage) explains only 26.8% of the variation in travel time on the CTA trips and 37.2% on the UberPool trips (Table 2). The rest of the variation in travel time can be attributed to other factors such as wait times, transfers and operating delays in the case of transit, and congestion and additional pickups for UberPool. For bike trips, by comparison, mileage is an excellent predictor, explaining more than 90% of the variation in travel time. Thus, a bicyclist who knows only the trip mileage can predict travel time with considerable accuracy.

In the model, the differences between modes are also borne out in the standard error of the estimate. The typical variation between the *predicted* travel time and *actual* travel time in the model (with mileage as the only independent variable) is 17.1 minutes on transit, 11.0 minutes on UberPool, and 5.0 minutes on bike trips. In effect, this measures the anticipated error if a traveler were to estimate travel time based only on the mileage (not the origin or destination). In other words, estimating travel time for a route could vary by five minutes if the trip is completed by bike, compared to 17.1 minutes if completed by public transit. It should be emphasized that these standard errors reflect the variation *between* routes and not that incurred by a rider using the same route over and over again. Additional discussion of the regression formula is detailed in Appendix B.

TABLE 2: Predicting Travel Times

TRIP TYPE	% OF VARIATION IN TIME EXPLAINED BY MILEAGE	STANDARD ERROR OF ESTIMATE
BIKE	90.6%	5.0 MINUTES
CTA	26.8%	17.1 MINUTES
UBERPOOL	37.2%	11.0 MINUTES

CHICAGO CONDITIONS

Unlike the two other modes, these results are conditional on the weather being suitable for bike travel. A major limitation of biking remains the effects of inclement weather (extreme temperature, high wind, precipitation and high humidity) as well as available sunlight. Chicago, on average, has 182 days per year when the sun sets after 7 p.m., and there are only five months per year when average low temperatures are above 51 degrees. As a result, many commuters uncomfortable with riding their bicycle in the cold or dark will find it an unattractive transportation mode much of the time. While the specifics of such factors are not considered in this analysis, they are worth noting when comparing the various modes.

It is also important to acknowledge that cyclists benefit greatly from the availability of transit service. When cyclists face inclement weather, darkness, maintenance issues, or suffer from accidents, fatigue or illness, the CTA serves as a "plan B" option. Indeed, the CTA is largely regarded as a bike-friendly operator, often providing covered bike racks at stations, two bike slots per bus, and two bikes per train car during off peak hours (times other than 7 – 9 a.m. and 4 – 6 p.m.).[vii]

III. POLICY IMPLICATIONS

The City of Chicago's commitment to providing infrastructure and dedicated lanes for cycling has changed the dynamics of bike travel in the city. As noted previously, the Mayor's Office, Department of Transportation, and other units have made large-scale investments to support bike travel. Several findings from this study illustrate this. Among the 45 randomly selected routes evaluated, all included some use of designated bike lanes or trails. On average, more than 60% of the mileage was ridden on lanes and trails separating the rider from motor traffic. Only a decade ago, much of these designated bike lanes and routes either did not exist or were not strategically connected.

Investments in infrastructure will continue to fuel bicycle travel growth, as will riders' desire to reduce travel time and maximize predictability, even in transit-rich neighborhoods. In response, policymakers should recognize that enhancements to infrastructure must now be accompanied by steps to manage the flow of bicycle traffic, which will require more attention toward creating enforceable rules and improved policies for issuing citations.

The following policy recommendations build on the findings generated from the above analysis:

RECOMMENDATION I:

Evaluate the potential for legally permitting Idaho Stops at intersections with four-way stops, and assess incremental strategies for allowing Idaho Stops at signaled intersections.

Observations from this study show that enforcing existing rules at these intersections would seem arbitrary and capacious, with only one bicyclist in 50 complying with the law when cross-traffic is not present. Stop sign intersections, especially four-way stops, tend to be less risky for cyclists practicing the Idaho Stop because even if cross-traffic is present, motorists are required to stop. Stop sign intersections also tend to be in lower-traffic areas, such as residential areas, where traffic, overall, moves at slower speeds. Permitting Idaho Stops at stop sign intersections would also help bikers feel more confident that enforcement efforts are being directed toward cyclists who pose legitimate safety risks, and may help to bolster confidence that the law enforcement community is more wisely allocating its limited resources.

Further, a pilot program could be enacted authorizing Idaho Stops at select *signaled* intersections with relatively low traffic volumes. This could include posted signs and be limited to off-peak periods. Alternatively, one could envision allowing Idaho Stops more generally during late-night hours (i.e. 11p.m.–5:00a.m.) when traffic is very light and, no doubt, very few cyclists are likely make full stops at red traffic signals. Although such measures would require further study prior to implementation, it behooves the city to gradually move toward rules that reflect reasonable tradeoffs between convenience and safety. The City could also make known that law enforcement personnel will avoid issuing citations for Idaho Stops as a precursor to possibly legalizing them. Such efforts would help instill confidence among bicyclists that law enforcement personnel will not be arbitrary in issuing citations.

RECOMMENDATION II:

Consider lowering fines for cyclists who commit traffic violations and offering "diversion programs", such as those offered in the State of California, as an alternative to fines.

Enforcing laws regarding bicycle safety is difficult at present due to both the $50 minimum fine in Chicago and the general sense that certain rules will not be rigorously enforced. To address a similar challenge, California passed Assembly Bill 902 in 2015 which allows a person of any age who commits an infraction not involving a motor vehicle to participate in a diversion program that is sanctioned by local law enforcement. While not always free, these programs offer cyclists the opportunity to have their fine waived and avoid having the violation on their record if they attend an in-person or online safety class. Diversion programs also present an opportunity to educate cyclists about existing traffic laws. Since cyclists do not have to take any kind of course or program to ride, many likely are not aware of the details of specific laws related to biking and how the City enforces them.

In Chicago, such a program would allow the City to pursue heightened enforcement of traffic regulations without incurring as sharp a backlash from the bicycling community. Further, a diversion program and/or lowering fines for violations would make citations issued by law enforcement personnel less contentious, thereby enabling these officials to stop cyclists as more of a learning opportunity.

RECOMMENDATION III:

Prioritize low-cost infrastructure improvements along neighborhood-to-neighborhood routes.

According to the route analysis, neighborhood-to-neighborhood trips had the highest percentage of mileage ridden on conventional unmarked streets (55% on average) compared to downtown-to-neighborhood (26%) and outer downtown-to-neighborhood (27%) trips. While traffic volumes and speeds are relatively lower outside of downtown, cyclists still may hesitate to use neighborhood streets that do not have a designated bike lane. Improved signage on neighborhood thoroughfares that do not have continuous designated bike lanes, such as W. Roscoe Street which connects the Boystown, Lake View, and Roscoe Village neighborhoods, would help signal to drivers that, in the absence of a separated lane, cyclists will be riding in the road. Similar efforts have been successful elsewhere, such as Madison's "bicycle boulevards"[viii] which feature shared road signage and stop signs only facing cross streets to halt intersecting vehicles and allow bicycles to continue along the main boulevard. These types of low-cost interventions encourage vehicles to be more attentive to the presence of cyclists and adjust their speed and driving behavior accordingly.

APPENDIX A

Variance of Compliance Rates at Intersections

When reviewing the combined results at intersections under both traffic scenarios (i.e., with and without cross-traffic), the rate of non-compliance with existing laws is more than ten times greater at stop signs than at traffic signals. Just four percent of cyclists--about one in 25--complied with existing laws at stop signs, while almost half (49%) made an Idaho Stop. At traffic signals, 50% made legal stops while 42% made Idaho Stops, and only eight percent did not observe either precaution. Thus, it appears that cyclists practice the Idaho Stop at similar rates at both stop sign and traffic signal intersections.

After taking the type of intersection into account, compliance behavior differs sharply between locations. Among the exceptions are Milwaukee/Armitage, where more cyclists made legal stops during off-peak times than peak times, contrasting sharply with other signaled intersections which tend to see greater compliance during commute times than off-peak times. This variance from the norm could be due to the fact that the intersection is more heavily-populated during commuting hours by cyclists familiar with the timing of traffic signals, giving them a heightened sense of when the light will change. Such cyclists may have a better understanding of when it is safe to yield and proceed through the light before it turns green. Of course, this is only a speculative observation.

At 55th/Cornell (a four-way stop sign intersection), cyclists are more likely to practice the Idaho Stop during commute times than at other intersections with stop signs. Ninety-one percent were observed practicing the Idaho Stop at this intersection, versus 57% at all three stop sign intersections combined. Lighter traffic conditions might be a factor.

For a full summary of compliance rate variation by intersection, please email the study team at chaddick@depaul.edu.

APPENDIX B

Overview of Regression Analysis

This regression model reinforces the notion that, even though public transit involves a higher speed of travel, the overall trip time is slowed by the amount of time spent waiting and walking (Table 3). The following four model specifications predict travel time on the three modes based on the 45 matched trips considered. The results show that expected travel time for bike trips rises by 5.53 minutes per mile traveled, compared to just three to four minutes on public transit (CTA) and UberPool. Furthermore, the higher intercept for CTA and UberPool, which ranges from 11.54 to 24.09 minutes, demonstrates that the added wait time for these modes is appreciable. The model also indicates that, when using public transit, walking adds 15.84 minutes per mile to expected travel time while the need to make a transfers adds 10.07 minutes to travel times (both coefficients are statistically significant). Taken as a whole, these results illustrate that bike travel times are more closely related to the associated mileage than the other two modes, and that the slower rate of speed of bike travel can be offset by less time spent waiting and (in the case of transit) walking.

Additional analysis exploring travel times is addressed in a working paper, available upon request. Email chaddick@depaul.edu to learn more.

Table 3: Dependent Variable – Minutes of Travel Time

	TRAVEL MODE							
	Bike Travel		CTA 1		CTA 2		UberPool	
Variable	Coeff.	P value	Coeff.	P value	Coeff.	P value	Coeff.	P value
INTERCEPT	1.85	(.372)	25.09**	(.000)	11.54	(.127)	17.09*	(.000)
TRANSFERS					10.07*	(.000)		
MILEAGE	5.53**	(.000)	3.68**	(.000)	2.99**	(.000)	3.00**	(.000)
WALK					15.84*	(.042)		
R^2	0.385		0.386		0.420		0.468	
ADJ. R^2	0.365		0.360		0.389		0.428	
STD. ERROR OF ESTIMATE	5.00		17.15		13.99		10.97	

*** significant at .01 level.*
** significant at .05 level.*

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[i] For an informal summary of these efforts, see "Biking the Boulevards with Geoffrey Baer, on wttw.com, available at http://interactive.wttw.com/a/biking-the-boulevards-cycling-mayors

[ii] Jenna Caldwell and Dana Yanocha, "Is it Time to Reexamine Your Bike Code? A Review of Cycling Policies in Illinois Municipalities," *Illinois Municipal Policy Review*, Volume 1 (Issue 1), December 2016, pp. 109-121

[iii] Details can be found at Bicycling.com at http://www.bicycling.com/culture/news/the-50-best-bike-cities-of-2016/slide/1

[iv] See city of Chicago municipal code, Section 9-4-025 http://library.amlegal.com/nxt/gateway.dll/Illinois/chicago_il/municipalcodeofchicago?f=templates$fn=default.htm$3.0$vid=amlegal:chicago_il

[v] For an illustration of this, see John Greenfield, Cops Serve and Protect by Ticketing Cyclists for Totally Harmless Behavior, Streetsblog Chicago, available at http://chi.streetsblog.org/2016/11/29/cops-serve-and-protect-by-ticketing-cyclists-for-totally-harmless-behavior/

[vi] As noted in the previously cited Caldwell and Yanocha article, the New York City police issued 51,841 tickets to cyclists, about 47 per day over a three year period ending in early 2015. Averaged annually, one ticket is issued for the equivalent of every five cyclists who commute in that city, compared to a mere one in 35 in Chicago. For details of the trends in New York, see "This NYPD officer has handed out the most bicycle summonses in the city," *DNA Info*. Retrieved from https://www.dnainfo.com/new-york/20150630/upper-west-side/this-nypd-officer-has-handed-out-most-bicycle-summonses-city

[vii] For additional details on CTA's rules and regulations for riding public transit with a bike, visit: http://www.transitchicago.com/riding_cta/how_to_guides/biketrain.aspx

[viii] Details and associated diagrams for Madison's Bicycle Boulevards can be found on the City's website at http://www.cityofmadison.com/bikemadison/planning/modal/boulevards.cfm