

Study of Bicyclist Characteristics in Phoenix, Arizona

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As of July 1992 the city of Phoenix had a bicycle system of about 300 mi; another 45 mi of on-street bike lanes are planned for fiscal year 1992–1993. The addition of new facilities and encouragement of bicycling as an alternative mode of transportation will lead to greater bicycle accident exposure. Bicycle volumes and use characteristics at select commuter bike lanes during typical commute and noontime hours are summarized. This information will be used to help target bicycle safety education and training in the city. Data were also collected at five sites during the Bike to Work Week in February 1992.

The city of Phoenix has a bicycle network of about 300 mi. This system includes various types of bicycle facilities such as dedicated bike paths, on-street bike routes (signed only), striped bike lanes, and wide sidewalk facilities. The system includes more than 100 mi of on-street bike lanes, and another 45 mi are planned for installation during fiscal year 1992–1993. The ultimate system will eventually have more than 700 mi of bicycle facilities.

Phoenix is encouraging bicycle riding as a nonpolluting and healthy alternative to automobile commuting by adding bike routes, upgrading existing routes, putting bike racks on all city buses, providing showers and bike lockers at some city buildings, and encouraging private industry to do the same. Phoenix has an ideal climate for bicycling during most of the year and wants to make bike travel a viable alternative for motorists to help reduce congestion and clean the air in the valley.

There is a great concern for the safety of bicyclists, especially when higher levels of bicycling are encouraged. In 1991 there were 693 car-bicycle collisions reported in Phoenix, resulting in 646 injuries and eight fatalities. Police accident statistics indicate that the bicyclist was primarily at fault in 71 percent of these collisions. Collisions with motor vehicles are not the only danger to bicyclists, who are also susceptible to falls and collisions with pedestrians, other bicyclists, and fixed objects. The only protection available to bicyclists is head protection in the form of a safety helmet, and the knowledge and skill to avoid problems when riding.

State law defines a bicycle as a vehicle and requires bicyclists to obey the same laws that apply to motor vehicle operators when riding in the street. However, there is no minimum age, skill level, knowledge, or licensing before these vehicle operators (bicyclists) are allowed to use the roadway. Additionally, Phoenix has not conducted a bicycle volume and observation study to evaluate current bicycling practices in the city.

This paper summarizes a study to obtain baseline bicycle usage volumes and riding characteristics on nine bike lanes throughout Phoenix in November and December 1991. The information will be used to help target safety education and training efforts in the city. Data were also collected at five sites during the Bike to Work Week, which was held in the last week of February 1992.

DATA COLLECTION

A trained observer was used to collect 7 hr of bicycle volume and characteristic data at nine locations on typical weekdays under good weather conditions. This study primarily targeted commuter bicyclists (7:00 to 9:00 a.m. and 3:00 to 6:00 p.m.) as well as midday bicyclists (11 a.m. to 1 p.m.) during typical weekdays. Data were collected on bike routes at five traffic signal locations, three Stop sign locations, and one uncontrolled location. Information was also obtained on compliance to these traffic control devices. Two of the signals had special push-button actuators installed for bicyclists. All data collection locations are considered primarily commuter routes that are more likely to be used by adult bicyclists. A description of each location is given in Table 1.

Data were collected using the form shown in Figure 1. Each bicyclist observation was individually recorded during the 7-hr study period. Data collected included the time observed, direction of travel, and location where the bicyclist was riding (with traffic in the bike lane, against traffic in the bike lane, or on the sidewalk). Information was not collected for bicyclists on the cross street unless they turned onto the bike lane under observation.

The observer was asked to identify if the bicyclist was a man or a woman and estimate the bicyclist's age. Age was divided into two groups: below 14 years or 14 and older (high school age and older). These categories were selected to differentiate between the two levels of knowledge and experience. The classification of ages was made by observation only; no one was questioned to verify the observations.

Bicycling is considered to be a social activity, thus the observer was asked to identify whether the bicyclist rode alone or in a group. One of the most important pieces of data collected was helmet use. The observer also recorded if the bicyclist wore special clothing commonly associated with more experienced bike riders.

The observer was to note whether the bicyclist was carrying objects (e.g., books, briefcases) and to identify how the objects were carried. The method that may be considered unsafe is that of carrying an item in one of the hands, which may

TABLE 1 Data Collection Site Characteristics

Bike Lane	Street Classification	ADT	Traffic Control	Date Established	Route Location
23rd Ave. at Camelback Rd.	Collector	10,000	Actuated traffic signal	February 1991	Northwest Phoenix to Central Business District
Encanto Blvd. at 7th Ave.	Collector	5,000	Actuated traffic signal	February 1991	Continuation of 23rd Ave. route.
7th St. at Broadway Rd.	Major	20,000	Fixed time traffic signal	February 1991	South Phoenix to CBD
Washington St. at 28th St.	Major	45,000	Fixed time traffic signal	October 1991	East Phoenix to CBD
Campbell Ave. at 28th St.	Collector	10,000	Fixed time traffic signal	February 1991	East Phoenix
Encanto Blvd. at 39th Ave.	Collector	5,000	Four-way STOP	February 1991	West Phoenix
Lafayette Blvd. at Arcadia Dr.	Collector	4,500	Four-way STOP	February 1991	East Phoenix
Sweetwater Ave. at 28th St.	Collector	9,000	Four-way STOP	March 1991	Northeast Phoenix
3rd Ave. at Encanto Blvd.	Collector	5,000	None	Originally established in early 1970's. Modified 8/91	Central Phoenix along CBD

reduce the balance and control that the bicyclist has over the bike. The observer recorded the use of the bicyclist push buttons at the two signal locations that were equipped with actuation devices and recorded bicyclist compliance to the Stop signs or traffic signals at eight of the study sites.

Results

Observations were conducted in November and December 1991 during good weather conditions. Sixty-three hours of observations were made, 7 hr at each site, resulting in 480 observations, as presented in Table 2. Only about eight bicyclists were observed per hour throughout the study period. Bicycle volume ranged from a low of 29 on Third Avenue (which is a one-way northbound route) and Sweetwater Avenue to a high of 90 on Lafayette Boulevard.

Bicycle volumes were highest during the afternoon hours and lowest during the noon-time hours. The location with the highest midday volume was 23rd Avenue at Camelback. It is important to note that these counts do not reflect recreational bicycle use during weekends or evening hours or during early commute hours, which may occur before 7:00 a.m., when traffic volumes are lower.

Nearly two-thirds of the bicyclists were observed correctly riding with traffic in the bike lanes. However, 18 percent were observed illegally riding the wrong way in the bike lane (against traffic) and 19 percent were riding on the sidewalk (which is acceptable, but bikes must yield right of way to pedestrians). Even though pavement arrows were placed in the northbound bike lane for Third Avenue (four arrows per mile) to show clearly that bicyclists must ride with traffic, 21 percent of the bicyclists observed on Third Avenue were riding against traffic. The highest percentage of wrong-way riders was observed on Lafayette Boulevard, which was formerly a two-way bike lane

on the south side of the street. The highest sidewalk usage was observed on Campbell Avenue and Washington Street. The highest overall correct use of bike lanes was on Encanto Boulevard at Seventh Avenue, where no bicyclists were observed riding the wrong way in the street.

Most of the bicyclists observed were men, and most were high school age or older (classified as adults). Furthermore, most of the bicyclists observed did not ride in groups. This may not be consistent with characteristics of recreational bicycling.

Helmet use was at a disappointing low rate of 15 percent. This ranged from a high of 34 percent on Third Avenue to a low of 0 percent on Sweetwater Avenue. Similarly, only 11 percent of the bicyclists were observed wearing special clothing.

Forty-three percent of bicyclists were observed carrying objects. However, only 2 percent were holding the objects in their hands.

Two of the five signal locations in the study were equipped with bicyclist actuation equipment (push buttons) on the bike lane approach. The vehicle loop detectors at these signals are not sensitive enough to detect bicycles, and the pedestrian push buttons are not easily accessible from the street. The push buttons were marked with special signs and were conveniently located for bicyclists. However, only one-third of the bicyclists who arrived on the red signal used the push button to call the traffic signal.

Compliance with the traffic signal was observed at the five signalized observation sites. For those who arrived on the red signal, 80 percent waited for the green signal light before crossing. This number was highest on 23rd Avenue, where it is very difficult to cross against the signal because of high traffic volumes on Camelback Road. The highest violations of running red lights occurred at Campbell Avenue at 28th Street, where the cross traffic is not substantial and it is easy to cross on the red signal.

Location:				Observer:					Day:		Date:	
Start Time:				End Time:					Weather:			
#	Time Observed	Direction of Travel	Side of Street OK/Wrong/Sidewalk	Sex M/F	Age < 14 > 14	Group Size	Helmet Y/N *	Special Clothing Y/N	Objects Carried **	Push Button Used *** Y - N - N/A	Obey STOP/ Signal **** Y - N - N/A	Other Comments
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												
9.												
10.												
11.												
12.												
13.												
14.												
15.												

- NOTES:**
- * **Helmet Use:** Record "NC" if the bicyclist was not wearing a helmet but carrying one on the bike.
 - ** **Carrying Objects:** A = in arms B = Backpack C = Carried on Bike N = None
 - *** **Push Button Used:** For locations where bicycle button exists N/A = Bicyclist arrived on green -or- rode on sidewalk
 - **** **Obey Signal:** NA = arrived on green and crossed on green.

FIGURE 1 Bicycle volume study.

TABLE 2 Summary of Bicycle Observations (7 hr per Location)

Location	Traffic Control	Number Observed	Bikes Per Hour			Bicycling Location			Sex		Age		Group Size		Helmet Use	Push Button Used (When Arrived on Red)	Obey Signal (When Arrived On Red)	Obey STOP Sign
			7-9AM	11AM-1PM	3-6PM	Wrong Way Lane	Wrong Way Sidewalk	M	F	Child	Adult	One	Two or More					
23rd Ave at Camelback Rd	Traffic Signal	86	10.5	11.0	14.3	75%	10%	15%	85%	15%	12%	88%	86%	14%	13%	28%	95%	NA
Encanto Blvd at 7th Ave	Traffic Signal	34	4.0	1.5	7.7	94%	0%	6%	74%	26%	9%	91%	68%	32%	29%	41%	71%	NA
7th St at Broadway Rd	Traffic Signal	47	5.0	2.5	10.7	55%	17%	28%	96%	4%	19%	81%	79%	21%	6%	NA	86%	NA
Washington St at 28th St	Traffic Signal	47	7.0	3.5	8.7	58%	4%	38%	98%	2%	0%	100%	100%	0%	19%	NA	80%	NA
Campbell Ave at 28th St	Traffic Signal	60	10.0	4.0	10.7	49%	9%	42%	97%	3%	2%	98%	93%	7%	18%	NA	57%	NA
Encanto Blvd and 39th Ave	STOP Sign	58	6.0	3.0	13.3	46%	27%	27%	74%	26%	45%	55%	59%	41%	3%	NA	NA	8%
Lafayette Blvd at Arcadia	STOP Sign	90	16.0	4.0	16.7	60%	39%	1%	85%	15%	39%	61%	77%	23%	20%	NA	NA	24%
Sweetwater at 28th St	STOP Sign	29	3.5	2.0	6.0	76%	17%	7%	55%	45%	34%	66%	86%	14%	0%	NA	NA	17%
3rd Ave at Encanto Blvd (One-Way)	None	29	3.0	3.0	5.3	72%	21%	7%	72%	28%	3%	97%	86%	14%	34%	NA	NA	NA
Total		480	7.2	3.9	10.4	63%	18%	19%	84%	16%	20%	80%	81%	19%	15%	33%	80%	17%

Compliance at the three Stop signs locations was very low. Arizona state law requires all bicyclists to come to a complete stop before crossing, similarly to motor vehicles. Even though the observer was instructed to give the bicyclists the benefit of the doubt when they came to a near stop, the results show a very high level of noncompliance. Only 17 percent of the bicyclists complied with the Stop sign restriction. The observer noted that many of the bicyclists did not even slow down and completely ignored the Stop sign.

Rider Characteristics by Gender

Table 3 presents various rider summaries by gender. The table shows that the proportion of male/female ridership by time of day and riding location is similar. However, a higher proportion of the female bike riders observed were younger than 14 (43 versus 15 percent for men). Female riders were also more likely to be observed riding with other bicyclists. Helmet use was about equal between men and women, but men were more often observed wearing special clothing.

Female bike riders were more often observed to use the signal push button; however, the sample size is very small. Similarly, women were more likely to obey the traffic signals and Stop signs than men.

Rider Characteristics by Age

Table 4 provides a breakdown of rider characteristics by age for all nine locations. Virtually no young riders were observed during the midday time period (11:00 a.m. to 1:00 p.m.). It is likely that the children were in school during this time.

Younger bike riders were slightly more likely to ride on the sidewalk but much more likely to ride the wrong way in the street than older bicyclists. However, 13 percent of older cyclists rode against traffic while in the street.

Younger bicyclists were about four times as likely to ride with other bicyclists as the older bicyclists. None of the younger

TABLE 3 Bicycle Ridership Characteristics by Gender

	Men (%)	Women (%)
Time of day		
7:00 to 9:00 a.m.	26	33
11:00 a.m. to 1:00 p.m.	16	7
3:00 to 6:00 p.m.	58	60
Riding location		
Bicycle lane	63	61
Wrong way (in street)	17	22
Sidewalk	20	17
Age		
Under 14 years	15	43
14 years or older	85	56
Group size		
Single rider	84	66
Two or more riders	16	34
Helmet use	16	13
Special clothing	12	5
Objects carried		
In arms	2	3
Backpack or bike carrier	39	45
Push button used* when arriving on red	28	53
Traffic signal obeyed when arriving on red	79	88
Stop sign obeyed	14	25

* 23rd Avenue at Camelback; Encanto Boulevard at 7th Avenue.

TABLE 4 Bicycle Ridership Characteristics by Age

	Less than 14 Years (%)	14 Years and Older (%)
Time of day		
7:00 to 9:00 a.m.	34	25
11:00 a.m. to 1:00 p.m.	1	18
3:00 to 6:00 p.m.	65	57
Riding location		
Bicycle lane	40	68
Wrong way (in street)	38	13
Sidewalk	22	19
Group size		
Single rider	51	89
Two or more riders	49	11
Helmet use		
Special clothing	0	19
Objects carried	1	13
In arms		
Backpack or bike carrier	43	40
Push button used* when arriving		
on red	25	34
Traffic signal obeyed when		
arriving on red	90	79
Stop sign obeyed	26	12

* 23rd Avenue at Camelback; Encanto Boulevard at 7th Avenue.

bicyclists was observed wearing a protective helmet, and only 1 percent wore special clothing. Almost 20 percent of the adult riders wore a helmet.

The older bike riders were more likely to use the push buttons at the two actuated traffic signal locations. Younger bicyclists were more likely to comply with the red traffic signals and were twice as likely to obey the Stop signs than the older riders.

Other Characteristics

Table 5 gives a summary of other characteristics for bicyclists wearing safety helmets. Helmet use was highest during the morning commute period and lowest during the midday hours. Helmet use was higher for bicyclists properly riding the bike lane and was much lower for those riding the wrong way in

TABLE 5 Helmet Use by Time of Day, Riding Location, and Group Size

	Helmet Use (%)
Time of day	
7:00 to 9:00 a.m.	21
11:00 a.m. to 1:00 p.m.	10
3:00 to 6:00 p.m.	15
Riding location	
Bicycle lane	22
Wrong way (in street)	5
Sidewalk	3
Group size	
Single rider	17
Two or more riders	9

the street or those on the sidewalk. Helmet use was nearly twice as prevalent for single riders than for those riding in groups.

BIKE TO WORK WEEK

Phoenix participated in the Bike to Work Week (February 24–28), which was sponsored by the Arizona Department of Commerce Energy Office, the Arizona Department of Environmental Quality, Maricopa County, the Phoenix Chamber of Commerce, and the Regional Public Transportation Authority as part of the Clean Air Force Campaign. Commuters were invited to ride their bikes at least one day of that week or drive to one of the valley's 64 park-and-ride lots and pedal the rest of the way to work. Two special group rides were organized for Tuesday of that week. One included a ride with Mayor Paul Johnson from the Metrocenter Transit Center to downtown Phoenix via the 23rd Avenue bike lane. The promotion included a bike fair at Patriot's Park (downtown Phoenix), and bicyclists who registered to ride in before the event were eligible to win prizes.

Bicycle volume and characteristic data were obtained at five of the previous commute routes, as presented in Table 6. Data were collected only in the morning and afternoon commute times and on the same day of the week as the baseline study for four of the five locations, and the 23rd Avenue bike lane was observed on the organized group ride day.

A total of 283 bicyclists were observed in 25 hr of observation (11.3 bicyclists per hour). The number of bicyclists observed was relatively unchanged on the Washington Street, Encanto Boulevard, and Seventh Street bike lanes. There was a 50 percent increase in ridership on the Campbell Avenue route and a 67 percent increase on the 23rd Avenue route that was observed on the special group ride day.

The percentage of female riders was similar to the earlier observations in three of the four study sites; overall, the number of female riders remained low. There was also a higher proportion of adult riders observed during the Bike to Work Week study.

Helmet use doubled during Bike to Work Week, and a large factor was a result of the 23rd Avenue group ride route, which had nearly 50 percent helmet use. In fact, most of the bicyclists riding to work with the mayor were observed wearing a safety helmet. Helmet use increased along the other routes, except Washington Street, where it dropped to 8 percent of bicyclists.

Bicycle push-button use nearly doubled at the two signalized crossings equipped with convenient push-button detectors for bicyclists.

Compliance with the traffic signal was also higher than in the previous observation, except on Washington Street bike lane at the 28th Street signal. This may result from all observations during the peak traffic hours where it is very difficult to cross the major street without the assistance of the traffic signal. In the one exception (Washington Street) the bike lane is on the major street and 28th Street is a lower-volume collector street that is easier to cross. However, the number of bicyclists that arrived on the red signal at 28th Street was small.

Table 7 gives the distribution of helmet use that was observed during the Bike to Work Week. Helmet use increased

TABLE 6 Bicycle Observations During Bike to Work Week (5 hr per Location)

Location	Traffic Control	Number Observed	Bikes per Hour		Bicycling Location Bike Wrong on			Sex		Age		Group Size		Helmet Use	Push Button Used (When Arrived on Red)	Obey Signal (When Arrived On Red)
			7-9AM	3-6PM	Lane	Way	Sidewalk	M	F	Child	Adult	One	Two or More			
23rd Ave at* Camelback Rd	Traffic Signal	100	24.5	17.0	67%	8%	25%	77%	23%	13%	87%	53%	47%	48%	60%	100%
Encanto Blvd at 7th Ave	Traffic Signal	30	4.5	7.0	90%	3%	7%	93%	7%	0%	100%	87%	13%	37%	59%	94%
7th St at Broadway Rd	Traffic Signal	38	5.0	9.3	57%	13%	30%	92%	8%	13%	87%	95%	5%	21%	NA	90%
Washington St at 28th St	Traffic Signal	36	5.5	8.3	43%	3%	54%	94%	6%	0%	100%	89%	11%	8%	NA	33%
Campbell Ave at 28th St	Traffic Signal	79	15.5	16.0	76%	5%	19%	80%	20%	4%	96%	78%	22%	24%	NA	71%
Total		283	11.0	11.5	68%	7%	25%	84%	16%	7%	93%	74%	26%	31%	60%	89%

*Data Collected On The Group Ride Day

for both men and women, and helmet use for women was slightly higher than for men. There were a few younger bicyclists observed wearing helmets, unlike the original observations. Helmet use was only slightly higher for single riders (22 percent compared with 17 percent during the first observations), but it increased six times for those riding in a group of two or more cyclists. Once again this was heavily influenced by the special group ride on the 23rd Avenue route.

CONCLUSIONS AND RECOMMENDATIONS

The level of commuter bicycle travel in Phoenix observed thus far is low, but the city is taking steps to change this. These steps include putting on special promotions and adding bicycle facilities, most notably bike lanes.

There is a major concern with bicycle safety and education, especially where young, inexperienced bicyclists are encouraged to ride on high-speed major streets with cars, trucks, and buses. Although bike helmet use is low (15 percent), a

few years ago it was virtually nonexistent. As expected, children were more apt to ride without helmets than adults. Young children are often not exposed to any education or training before riding in the street, and generally they do not realize that they must also obey Stop signs and traffic signals and ride with traffic. It appears from the baseline data that older bicyclists had even lower compliance rates with Stop signs and traffic signals and that education is needed at all age levels.

The Traffic Safety Plan prepared by the city's traffic safety coordinator has recognized this and recommended a strong public information and education campaign for both adults and children. The Street Transportation Department Traffic Safety Function received funding from the Governor's Office of Highway Safety to provide 10 to 12 bicycle rodeos in various city parks and schools during 1992. These rodeos provide hands-on training by the bicycle detail police officers and free bicycle inspections and tune-ups. Bicyclists are required to wear safety helmets while on the training course, and the city loans helmets to cyclists, when needed, during the training sessions.

Phoenix is continually updating the bicycle system map and distributing it to the public through the parks department and other distribution centers. These maps also provide tips for safe bicycling as well as the rules of the road that all bike operators must follow.

Another avenue to pursue is an increased level of police enforcement. Unfortunately, as with pedestrian violations, it appears that the only time bike enforcement occurs is after a collision. A greater level of police enforcement can be a helpful educational tool. Enforcement need not be a negative experience and result in a citation or fine. An increased level of observation resulting in police warnings or authoritative instructions from police officers may provide better overall results, especially for younger offenders. There already exists a wealth of bike knowledge within the police department due to the Downtown Police Bicycle Detail. These officers can be used to train other officers and identify problems needing correction and to help direct enforcement activities.

It appears that the Bike to Work Week in February 1992 had mixed results. Ridership increased on only two of the five routes and in some cases was slightly lower than the

TABLE 7 Helmet Use During Bike to Work Week

	Helmet Use (%)
Gender	
Male	30
Female	39
Age	
Less than 14 years	5
14 years or older	34
Time of day	
7:00 to 9:00 a.m.	43
3:00 to 6:00 p.m.	24
Riding location	
Bicycle lane	43
Wrong way (in street)	16
Sidewalk	7
Group size	
Single rider	22
Two or more riders	57

baseline study. The organized group ride was successful and is a concept that should be used more often. Additionally, helmet use was much higher during Bike to Work Week, possibly the result of a greater awareness associated with the Bike to Work Week activities.

Phoenix will continue to pursue a greater level of cycling and concentrate on efforts to increase helmet use and safe riding practices. Although it is unrealistic to expect bicycling to replace the automobile, bikes should and can be used to make a measurable difference in air quality. Good bike cor-

ridors are needed to promote this healthy alternative to the single-occupant automobile and help complement carpools and other forms of mass transit. Further observation studies will be made at appropriate intervals to help guide educational efforts and monitor bike ridership, helmet use, and compliance with traffic control devices and rules of the road.

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