Contraflow Bus Lanes in Chicago: Safety and Traffic Impacts

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ABSTRACT

Contraflow bus lanes were installed on the downtown portions of four Chicago streets in 1980 and 1981. They were installed as a part of a federally mandated air quality improvement program and also to increase bus patronage by improving east-west bus service reliability across the central business district. Since their installation there has been public concern about the pedestrian safety aspects of the bus lane operation as well as increased traffic congestion on the remaining lane street space. Regarding vehicular congestion, it was found that nonbus traffic did travel somewhat more slowly with the installation of the lanes. However, in terms of bus operations, there was a significant improvement both in average travel speeds (22 percent increase) and in service reliability, which resulted in annual cost savings to the Chicago Transit Authority of about $400,000. Patronage studies indicate that during peak periods the contraflow lanes move more people in one lane per street than are moved on the remaining through traffic lanes, and in only one-tenth of the number of vehicles. Concerning the safety of the bus lane operation, the actual accident data indicate that although there was an initial jump in bus-pedestrian accidents, these accidents have now returned to less than one additional accident per month on each street, and that there has been a 19 percent overall decrease in all pedestrian accidents and a 52 percent decrease in all bus accidents. The primary conclusion is that the bus lanes are operating in a safe and effective manner, and it is recommended that they be retained.

The City of Chicago installed contraflow bus lanes on the downtown portions of Adams Street and Jackson Boulevard on August 31, 1980. A second bus lane pair was installed on Washington and Madison streets on September 13, 1981. The contraflow bus lanes on Adams, Jackson, and Washington extend from Michigan Avenue west to Jefferson Street, whereas the Madison bus lane extends west to Desplaines Street (see Figure 1).

Bus lane implementation resulted, in part, from the 1973 U.S. Environmental Protection Agency (EPA) regulations promulgated to reduce air pollution in the central business district (CBD) of Chicago. This federally mandated air quality improvement program included both implementation of CBD parking restrictions and the contraflow bus lanes. For the parking restrictions, 10 one-way downtown streets had parking completely prohibited along one side. Tow-away zones were instituted on these 10 streets between

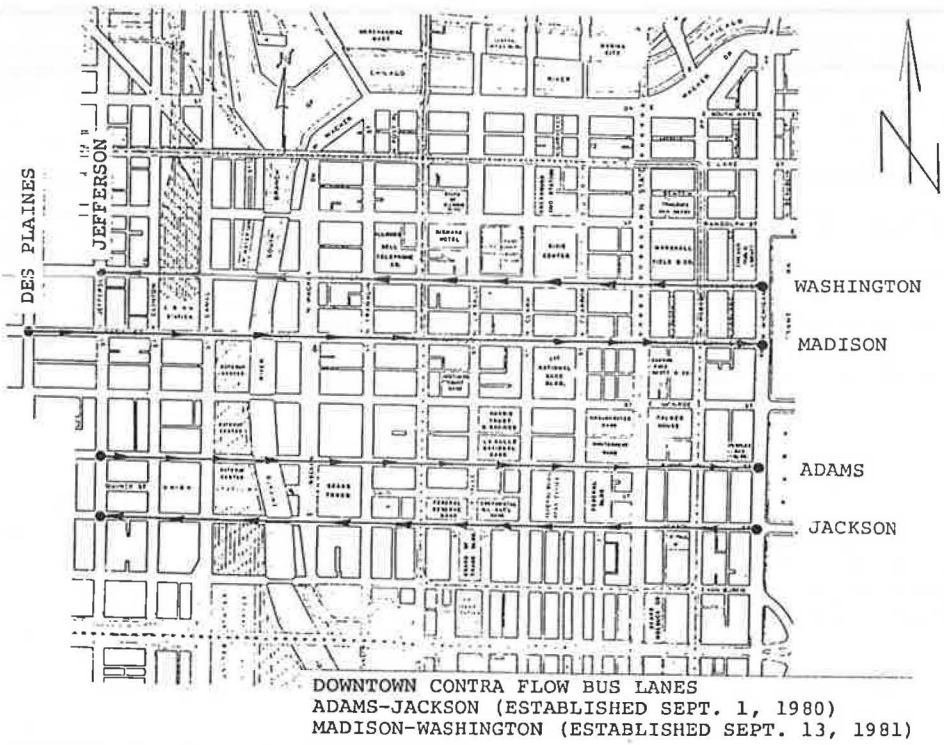

FIGURE 1 Map of contraflow bus lanes.

November 1974 and July 1975. The exclusive bus lanes, the second part of this program, were authorized by the Chicago City Council through an ordinance passed on July 7, 1977.

Response to the federal mandate was neither the sole reason nor the most important reason for implementation of the contraflow bus lanes. Historically, bus service crossing downtown had been unreliable, including that between the commuter rail stations west of the Chicago River (Union Station and North Western Station) and sections of the CBD to the east. Buses were subject to delays encountered in CBD traffic, which at times were substantial, and reliable schedules often could not be maintained.

Before the installation of the contraflow bus lanes buses operated on all east-west downtown streets with the flow of traffic. The majority of buses loaded and unloaded passengers on the near side of each intersection at the right-hand curb. These buses then moved into the second lane to pass parked vehicles in proceeding to the next stop. Conflicts between buses and right-turning vehicles occurred at virtually every stop because of pedestrians blocking turning vehicles or buses engaging in passenger interchange. In addition, the Chicago Police Department found it difficult to strictly enforce the No Parking Tow-away Zone indicated on one side of these one-way streets.

In the late 1950s Chicago experimented with a same-direction bus lane in the middle of Washington Street in the CBD, but this operation was discontinued in the 1970s because of difficulties in keeping the lane free of nontransit traffic, severe congestion on the remaining travel lanes because of the elimination of the center lane of travel, and safety hazards with the midstreet passenger loading islands.

In an effort to reduce or eliminate these problems, contraflow bus lanes were established. These bus lanes were implemented in two pairs, each pair providing east-west bus service across the Loop and serving the commuter rail stations on the west end. The south bus lane pair, Adams and Jackson, consolidated nine bus routes onto two streets; the north bus lane pair, Madison and Washington, consolidated seven routes onto these two streets. This consolidation has removed nearly all buses from other east-west Loop streets.

PROBLEMS

Each of the four bus lane streets is an east-west one-way street, with transit vehicles operating in the opposite direction. One curb lane on each bus lane street is exclusively used for contraflow transit vehicles. These reserved bus lanes and the adjacent painted median that separates the bus lanes from regular traffic are up to 4 ft wider than the parking lanes they replaced.

The operation of the contraflow bus lanes gave rise to two public concerns: the safety of bus lane operation, and the traffic congestion on bus lane streets. The public concern about bus lane safety relates to perceived pedestrian hazards at the Loop. The lack of awareness of the bus lane's location (immediately adjacent to the sidewalk) and the direction of bus traffic opposite to the direction of other vehicular traffic could cause possible safety problems to downtown pedestrians. The public's concern about traffic congestion on bus lane streets stemmed from initial slower traffic speeds and goods delivery problems on bus lane streets, when viewed next to the often empty bus lanes.

BACKGROUND OF EVALUATION STUDY

In response to these perceived problems, two Chicago aldermen submitted a resolution to the Chicago City Council on June 13, 1982, "to cease the use of reverse-flow bus lanes and reinstitute the previous system of center lane bus lanes." This ordinance was referred to the Chicago City Council Committee on Traffic Control and Safety, which directed the Mayor's Traffic Management Task Force to undertake a comprehensive evaluation of the safety and traffic impacts of the contraflow bus lanes.

A Traffic Management Task Force Contraflow Bus Lane Subcommittee was formed that included representatives of the city departments of Police, Public Works, and Streets and Sanitation; the Chicago Transit Authority (CTA); the Chicago Area Transportation Study; the Chicago Association of Commerce and Industry; and the Chicago Central Area Committee.

TRAFFIC OPERATIONS ANALYSIS

Vehicular Congestion

The primary objectives of the contraflow bus lanes were to decrease bus travel times and to improve bus schedule regularity. The bus lanes were implemented, noting that a negative effect on nonbus traffic speeds could result, and nonbus traffic during just the peak periods has slowed somewhat since the installation of the lanes. This reduction in travel speeds was particularly severe immediately after the lanes were installed, but recent efforts by the Mayor's Traffic Management Task Force have significantly lessened these adverse traffic impacts.

Specifically, when the lanes were first installed, traffic speeds during all downtown traffic peak periods (morning, noon, and evening) dropped precipitously. Comparison of data gathered in 1975 and 1981 (see Table 1) indicate that average traffic speeds on the bus lane streets fell from 8.41 to 4.34 mph, a 48 percent drop. Another way of viewing these statistics is to translate these average speeds into average travel times for the trip across the CBD between Michigan Avenue and the Chicago River. In 1975 this trip on these four streets took an average of 5.0 min, whereas in 1981 the average time for the same trip on the same streets was 9.7 min, a 94 percent increase. (There was little added congestion during nonpeak periods.)

A number of factors created this reduction in travel speed during peak travel times. First, the

TABLE 1 Contraflow Bus Lane Streets: Average Automobile Speeds

Street	Avg Automobile Speed (mph)					Change from 1981 (%)
	1974	1975	1980	1981	1982	
Adams						
Morning	9.61	8.09	6.75	5.22	9.66	+85
Noon	8.75	7.91	5.71	3.76	7.07	+88
Evening	9.40	8.58	6.48	2.71	7.25	+167
Daily avg	9.25	8.19	6.31	3.90	7.99	+104
Jackson						
Morning	8.30	7.05	6.38	3.49	6.78	+94
Noon	8.51	5.80	5.12	3.17	6.58	+108
Evening	6.28	5.68	4.10	3.81	6.62	+74
Daily avg	7.70	6.18	5.20	3.49	6.66	+91
Washington						
Morning	9.20	7.60	-	4.15	5.87	+41
Noon	5.99	6.08	-	4.93	9.13	+85
Evening	6.38	6.28	-	5.83	7.84	+34
Daily avg	7.19	6.65		4.97	7.61	+53
Madison						
Morning	10.03	14.57	-	7.01	11.61	+66
Noon	7.16	11.50	-	4.76	6.21	+30
Evening	9.86	11.83	-	3.21	8.71	+170
Daily avg	9.02	12.63	-	4.99	8.84	+77
Total avg	8.29	8.41	5.76	4.34	7.78	+79

impact of delays made by turning vehicles was exacerbated by the bus lane occupying one traffic lane for exclusive bus use, thereby leaving only two lanes available for nonbus traffic. Heavy CBD pedestrian traffic delays a turning vehicle and consequently blocks through traffic in that lane. Where a bus lane street crossed a two-way north-south street (Wabash Avenue, LaSalle Street, Wells Street, Franklin Street, or Wacker Drive), both of the through traffic lanes could be delayed by pedestrian traffic blocking turning vehicles in each of these lanes, thus consequently blocking all nonbus traffic movement on the bus lane street. (Before the installation of the lanes there were often three lanes available at these intersections, which left at least one lane for through traffic.)

These blockages have been all but eliminated in the last year through actions taken by the Traffic Management Task Force. One-way traffic flows have been instituted on Franklin Street, Wells Street, and Wabash Avenue, and peak-hour turning restrictions have been added as needed on LaSalle Street and Wacker Drive. As a result of these actions at least one lane at every intersection on bus lane streets in the CBD remains open for through traffic movement.

A second cause of these lower traffic speeds in a few locations was CTA bus travel with the prevailing flow in the regular traffic lane. To accommodate the bus lanes, most nonbus lane widths were reduced to 9 ft. The presence of even a few CTA buses in narrow 9-ft lanes inhibits the flow of traffic on those and adjacent lanes. The Task Force has worked closely with the CTA, a member agency, to eliminate as many of these with-the-flow bus movements as possible.

A third reason for traffic delays was the occasional double parking by delivery vehicles. Formerly, if a loading zone or metered parking space was not available, a delivery vehicle would temporarily use the tow-away zone while making a delivery, thus blocking only one of the three available through traffic lanes. However, after the installation of the bus lanes in this former tow-away zone, a double-parked vehicle blocked one of only two available traffic lanes. The recent work of the Traffic Management Task Force in ensuring better on-street parking enforcement, as well as cooperative measures with building owners and managers to develop more efficient use of the existing off-street loading areas, has reduced but not eliminated this problem.

The final, and perhaps most important, factor influencing traffic speeds was the occasional roadway narrowing that occurred at building construction sites and utility repair locations. Construction activity in both 1980 and 1981 appears to have been a critical factor in explaining much of the decrease in travel speeds on bus lane streets. Because the congestion caused by these activities was one of the prime motivating factors in the creation of the Traffic Management Task Force, the coordination of these activities was a priority item when the Task Force was formed in June 1982.

The results of these coordination efforts (and the other traffic management efforts mentioned previously) have had a beneficial impact on traffic speeds throughout the CBD, and particularly on the four bus lane streets. Speed-and-delay runs taken in 1982 indicated an average increase in travel speeds of 79 percent on Jackson, Adams, Madison, and Washington when compared to 1981 (see Table 1). In terms of travel time, it currently takes an average of 5.4 min to cross the CBD in a regular traffic lane, which is only 0.5 min more than the 1975 travel time.

The data in Table 1 give average travel speeds in October 1974 (before the installation of the tow-away zones and parking meters), in November 1975 (after these measures), in October 1980 (after installation of the Jackson-Adams bus lanes), in October 1981 (after the installation of the Madison-Washington bus lanes), and in October 1982 (after 6 months of operation of the Mayor's Traffic Management Task Force).

During this entire before-and-after period of bus lane implementation, there were no significant traffic signal timing changes in the CBD. This is because the City of Chicago currently has no real control of the coordination of traffic signals within the CBD. In 1976 a computer-controlled CBD signal system was installed, using an experimental signal system program and newly developed equipment. This program did not work as promised, and the equipment manufacturer ceased manufacturing replacement parts. Thus the computer control has proved to be completely useless, and equipment malfunctions have prevented communication with and coordination of the various signalized intersections. The city is now in the midst of a feasibility study to determine what would be the best and most efficient signal system to use to replace the present system. However, this means that during the entire time period of this particular study, all of the downtown traffic signals operated independently of one another, and no signal timing changes other than directional split were studied or even contemplated with respect to the contraflow bus lanes.

Bus Operations

Implementation of the contraflow bus lanes has had a positive impact on bus operations across the CBD. The nine bus routes that use the Adams-Jackson bus lane pair and the seven routes that use the Washington-Madison pair have benefited from the exclusive transit street space. The average time a bus takes to cross the CBD (between Michigan Avenue and the Chicago River) during the evening rush period has decreased from 10.25 to 8.00 min, a 22 percent improvement, since the lanes were installed.

In addition, because the contraflow bus lanes provide a virtually congestion-free route across the Loop, the reliability of bus service has also improved. People waiting for bus service are now more confident that buses will be evenly spaced at their pickup point and that long waits for buses will not occur. Also, the consolidation of virtually all east-west bus routes onto the two pairs of contraflow lanes assures frequent bus service across the Loop. Consequently, passengers rarely have to wait for more than a couple of minutes to board a bus for a cross-Loop trip. Once on the bus, the 55,000 passengers who travel these bus lanes daily can expect the trip to their downtown destination to be made in consistent times from one day to the next.

This improvement in service reliability, however, also benefits all passengers on these routes, whether or not they ride in the Loop area. A far greater proportion of buses arrive at their downtown destinations on time or within the additional period of time provided for schedule recovery. Consequently, most buses are able to begin their outbound trip from downtown on schedule and, particularly in light of a congestion-free return trip across the Loop, are able to avoid the bunching of buses that is characteristic of routes that are subject to heavy street congestion. An orderly, evenly spaced flow of buses leaving downtown translates directly into better service in outlying areas and benefits each of the more than 200,000 daily passengers that ride routes that use the downtown contraflow bus lanes.

The combination of decreased downtown travel time and improved reliability results in reduced round-trip travel time, and allows CTA to provide the same level of service with fewer total buses and operators. A five-bus reduction in vehicle requirements has been realized, which yields an annual operation cost savings of about $400,000.

Patronage

The contraflow bus lanes were designed to provide fast and reliable east-west bus service in the Loop. The reservation of one full lane on each bus lane street, however, decreased street space for remaining automobile and truck traffic. Such reservation of public space for exclusive use raises questions of both equity and efficiency; namely, are enough people served by transit on the bus lanes to justify removal of automobile and truck traffic?

On an average weekday 123,000 persons are transported in cars, taxis, trucks, and buses over the four contraflow bus lane streets. Of these 123,000 persons, 55,000 (45 percent) are served by buses on the contraflow lanes (see Table 2). Use of the contraflow lanes does have peaking characteristics, however, that make the lanes more efficient during periods of heaviest traffic. Patronage figures were estimated from October 1982 traffic counts and CTA ridership data that give the number of people served at critical periods of the day.

TABLE 2 Persons Transported on Bus Lane Streets

	Traffic Lanes		Bus Lanes		Total, All Lanes
	No.	Percent	No.	Percent	
Daily (24-hr)	68,000	55	55,000	45	123,000
Morning peak period (6:00-9:00 a.m.)	10,950	41	15,500	59	26,450
Evening peak period (3:00-6:00 p.m.)	14,150	46	16,750	54	30,900
Morning peak hour	4,700	38	7,600	62	12,300
Evening peak hour	5,000	39	7,950	61	12,950

During the morning and evening peak periods, when the loss of one lane to automobile and truck traffic has its most significant effect on automobile and truck traffic flow, the contraflow lanes move more people in one lane per street than are moved on the remaining two or three through traffic lanes, and in only one-tenth of the number of vehicles.

Contraflow Bus Lane Survey

As part of the contraflow bus lane evaluation, surveys were conducted to determine the attitudes of bus lane user groups (CTA drivers and passengers), nonbus lane user groups (taxi, truck, and automobile drivers), police officers assigned to Loop traffic duty, and pedestrians. The attitudes of persons who use or who are affected by the bus lane streets are important for two reasons: (a) these attitudes can influence travel behavior, and (b) they are one measure of the success or failure of the bus lanes. Survey questions sought information on people's attitudes toward bus lane effects on both traffic efficiency and safety. (Survey data on the safety impacts will be presented in the next section of this paper.)

A summary of survey responses on traffic effects for each of five groups--police, CTA personnel, bus passengers, drivers, and pedestrians--is given in Table 3. The driver group is subdivided into automobile, taxi, and truck drivers. [A more complete report on these surveys can be found elsewhere (1).]

Those who benefit directly from bus lane implementation (bus drivers and instructors and bus passengers) have an overwhelmingly positive attitude about the bus lanes. Not surprisingly, those toward whom the bus lanes and their benefits were not directly targeted (automobile, taxi, and truck drivers) found the lanes to be inconvenient, but they were not as strong in their expression of disfavor as the bus-related group were in their positive expression. Both police officers responsible for directing traffic in the Loop and pedestrians who use these streets were positive about the lanes. Discussion of each group's responses follows.

Chicago Police Department

Sixty-three Chicago Police Department officers completed the bus lane questionnaire. Each of these officers is either currently responsible for on-street traffic direction in the Loop or supervises such activity. Police Department personnel perceived the bus lanes to be an advantage by almost a 5-to-2 margin. The greatest concern expressed about traffic issues was related to enforcement, with 21 percent of officers commenting on illegal use of the lanes, automobile and truck parking in the bus lane, jaywalking, delays caused by turning buses, or the need for tow zones on bus lane streets. Forty-six percent of those officers surveyed believed that the lanes saved time for buses, whereas 17 percent believed that the lanes saved time for automobiles and trucks. Only 24 percent believed that the lanes lost time for automobiles and trucks.

Chicago Transit Authority

CTA drivers now working the contraflow lanes and CTA instructors were extremely supportive of the bus lanes. Positive responses, 89 percent of the total

TABLE 3 Contraflow Survey Responses—Traffic Effects

	Police		CTA Drivers and Instructors		Bus Passengers		Drivers: Automobile		Drivers: Taxi		Drivers: Truck		Pedestrians	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Total respondents	63		636		334		222		50		50		617	
General perception of bus lanes														
Good	41	65	568	89	257	77	89	40	11	11	18	36	315	51
Bad	17	27	22	3	57	17	104	47	33	66	27	54	197	32
Time savings														
Bus	29	46	474	75	210	63	-		-		-		-	
Automobile	11	17	105	17	-		67	30	6	12	6	12	-	

636 operating and supervisory personnel surveyed, included drivers who perceived a time savings or who specifically indicated the lanes were good or should be retained. Only 3 percent believed that the lanes were bad or should be removed. Limiting responses to drivers who specifically called for the retention or abandonment of the lanes, 82 percent called for retaining the contraflow lanes. Nearly one-quarter (23 percent) of the respondents believed that automobiles saved time or benefited from the bus lanes. Ninety-five (15 percent) of the CTA personnel called for greater traffic control at construction sites and intersections, whereas 29 (5 percent) called for the installation of bus lanes on other central area streets.

Bus Passengers

Sixty-nine percent of the 334 bus passengers interviewed use a bus lane street every day. Slightly more than three-fourths (77 percent) were on business trips, and 67 percent had traveled on the street before. An overwhelming majority (77 percent) perceived the bus lanes as beneficial, whereas only 16 percent felt they were bad, and 7 percent had no opinion. A time savings was indicated by 63 percent of the persons interviewed.

Automobile Drivers

Sixty-four percent of the 222 motorists interviewed use a bus lane street daily. Eighty-eight percent of the motorists had used the street before, and 83 percent were on business trips. Only 40 percent of all motorists surveyed perceived the bus lanes as good, 47 percent indicated that they were bad, and 13 percent had no opinion. Even though 47 percent believed that the bus lanes were bad, 30 percent indicated that they saved time. Seventeen percent of the automobile drivers believed that the lanes caused delay or should be removed. Nine percent specifically commented that implementation of the lanes improved traffic flow.

Truck Drivers

Fifty truck drivers were interviewed at both on-street and off-street locations (52 percent off and 48 percent on). Seventy percent indicated that they made 26 or more deliveries per week. Ninety-six percent had used the streets before the implementation of the bus lanes, and 58 percent believed that they affected deliveries. Although 36 percent of the drivers had a favorable impression, only 12 percent indicated any time savings. A majority of the drivers (54 percent) indicated that they were delayed, and they believed that the bus lanes were bad.

Taxi Drivers

The 59 taxi drivers interviewed indicated that 88 percent of them worked 5 or more days per week, and the same percentage indicated that they were driving in the Loop before the implementation of the bus lanes. Most of the drivers (66 percent) generally did not like the bus lanes; however, 22 percent had a good impression and 12 percent had no opinion. Twelve percent of the drivers saved time, 76 percent were delayed, and again 12 percent had no opinion.

Pedestrians

Seventy-six percent of the 617 pedestrians interviewed used a bus lane street every day. Almost three-fourths (72 percent) of the pedestrians were on business trips, and 88 percent had used the street before the implementation of the bus lanes. A majority of all pedestrians surveyed (51 percent) perceived the bus lanes as good, 32 percent believed that they were bad, and 17 percent had no opinion.

General Observations

The combined survey activities of the Chicago Police Department, the CTA, and the Chicago Area Transportation Study resulted in 1,972 interviews. The majority (66 percent) had a good opinion of the bus lanes, whereas 23 percent believed the lanes were bad. The part of the survey that questioned the general public resulted in 1,273 completed interviews, with good opinions on the contraflow lanes outnumbering bad by a 54 to 33 percent margin.

Although the majority of respondents believed that the lanes were good, the attitude split along user group lines is important to note. All bus lane user groups (bus passengers and CTA personnel) believed the bus lanes were good, whereas all driver groups that use nonbus lane street space had a generally negative opinion. Both groups that did not specifically use the lanes for transportation (police officers and pedestrians) had a majority good opinion of the lanes. The perceived time savings attitudes aligned in the same way, with the majority of bus users and a minority of drivers noting time savings for the trip across the CBD.

TRAFFIC AND PEDESTRIAN SAFETY ANALYSIS

Contraflow Bus Lane Survey

As noted previously, the contraflow bus lanes have been perceived by some as being a pedestrian safety problem. One of the goals of the various bus lane surveys was to try to measure the extent of the perception that, as one respondent stated, "These lanes are great for buses, but are really dangerous for pedestrians."

However, when all the comments of pedestrians and other users of bus lane streets are tabulated, this perception is clearly in the minority. For example, of the 617 pedestrians surveyed, only 19 percent perceived the bus lanes as dangerous, and another 3 percent termed them confusing. Similarly, only 14 percent of the bus passengers perceived the lanes as dangerous or bad for pedestrians. Surprisingly, only 5 percent of the motorists, taxi drivers, and truck operators, who tended more toward opposition to the lanes, thought the bus lanes were dangerous or confusing.

Of the 63 police officers surveyed, 29 percent believed that there was some danger to pedestrians, and the 612 bus operators surveyed submitted a total of 393 pedestrian safety improvement suggestions. However, many of these were multiple comments from a smaller number of drivers. The people who must deal most directly with lanes on a day-by-day basis as a part of their job have noted a number of areas where safety improvements can be made. However, as noted in an earlier section, both the police and bus operators are clearly in favor of retaining the contraflow bus lanes.

Accident Analysis

The best test of the public opinion that a possible pedestrian safety hazard exists is an analysis of

actual accident data along all of the streets involved. To this end, the Bureau of Traffic Engineering and Operations conducted a comprehensive evaluation of vehicular and pedestrian accidents on all of the east-west streets that carried buses, both before and after the consolidation of the bus routes into the four contraflow bus lanes.

The accident analysis of the contraflow bus lanes considered the downtown east-west streets as two groups. Van Buren, Jackson, Adams, and Monroe streets were the group of streets whose traffic characteristics were affected by the consolidation of bus routes onto the Jackson and Adams contraflow bus lanes. A before-and-after tabulation of accident data was done for these four streets. Inasmuch as almost all of the buses had been consolidated onto Jackson and Adams streets, nearly all bus-related after accidents occurred on these streets.

A second group of streets (Madison, Washington, Randolph, and Lake streets) had traffic patterns affected by the consolidation of bus routes onto the Madison-Washington contraflow bus lanes. The aforementioned before-and-after rationale was also used in the traffic accident tabulation of these streets. The accident data used in the analyses of the Adams-Jackson group of streets contained 24 months of before data and 30 months of after data. For the Madison-Washington group of streets, 36 months of before data and 18 months of after data were available. The before-and-after traffic accident data for these two groups of streets are summarized in Table 4. The data are expressed in accidents per month to simplify comparisons.

TABLE 4 Contraflow Bus Lane Summarized Traffic Accident Experience

	Accident Experience (accidents/month)		
	Before	After	Last 6 Months Alone
Combined Avg Monthly Traffic Accident Data for Van Buren, Adams, Jackson, and Monroe[a]			
All accidents	84.3	86.6	72.2
All pedestrian accidents	6.5	8.0	4.5
All bus accidents	9.6	8.3	4.0
Bus-pedestrian accidents only	0.5	2.4	1.2
Bus-vehicle accidents only	9.1	5.9	2.8
Combined Avg Monthly Traffic Accident Data for Madison, Washington, Randolph, and Lake[b]			
All accidents	93.5	83.5	81.2
All pedestrian accidents	8.9	10.7	8.0
All bus accidents	12.9	10.7	6.9
Bus-pedestrian accidents only	0.8	2.7	2.2
Bus-vehicle accidents only	12.1	8.0	4.7

[a]Based on 24-month before and 30-month after data.
[b]Based on 36-month before and 18-month after data.

The types of accidents chosen for analysis, in addition to the total number of accidents on the eight streets involved, were total pedestrian accidents, all accidents involving CTA buses, only those pedestrian accidents reported as occurring with CTA buses, and only those vehicular accidents reported as occurring with CTA buses. In the last three categories all CTA bus accidents were included whether or not the buses were traveling in the contraflow lanes.

Analysis of these data indicates that there has been an increase in bus-pedestrian accidents on downtown streets. On the four streets affected by the Adams-Jackson bus lanes, an initial jump in bus-pedestrian accidents has been followed by a decline that has left the average rate at only 0.7 bus-pedestrian accidents per month higher than before the installation of the bus lane. On Madison-Washington bus lanes the rate is up by 1.4 bus-pedestrian accidents per month. However, the increase in this type of accident has been offset by a substantial reduction in total bus accidents (52 percent) and all pedestrian accidents (19 percent) on both sets of streets. The total of all accidents has decreased 10 percent in the last 6 months, as compared with the before condition.

To further describe the nature of the pedestrian safety experience on these streets, two graphs were prepared, which break the total pedestrian and bus-pedestrian accident data down into 3-month groupings for each set of streets (Figures 2 and 3). These graphs demonstrate just how variable these types of accidents are, with peaks and valleys occurring both before and after the installation of the contraflow bus lanes. They also both show a definite peak immediately after the lane installation, and a general decline after those dates.

Figure 4 is a spot map that shows all the bus-pedestrian accidents that have occurred on the contraflow bus lanes since the start of their operation. This map shows a high concentration of bus-pedestrian accidents on Adams Street at the entrance to Union Station just west of the river, and on three of the four contraflow bus lane streets (Washington, Adams, and Jackson) as they cross the State Street transit mall. This map identifies those areas where additional corrective action is most needed and would have the most beneficial impact.

The Bureau of Traffic Engineering and Operations, in conjunction with CTA, also conducted a video camera study of bus-pedestrian interactions along the contraflow bus lanes. This video study also documented violations of the bus lanes by other motor vehicles.

These video studies were largely concentrated at the specific problem areas previously identified. These video displays indicate that many pedestrians cross the street at all locations, in and out of the crosswalks, and they do not look in either direction as they cross a street. On streets where parking occurs this is not too great a problem, because parked cars protect the pedestrian for the first 7 or 8 ft of their journey, giving motorists and bus drivers an opportunity to warn them or take evasive action. However, whenever vehicles are traveling in the lane immediately adjacent to the curb, and the pedestrian suddenly decides to cross the street, there is little time for the driver to take appropriate countermeasures. This suggests that any improvements to signing and markings that might help further alert the pedestrian to this unusual situation would be beneficial; also, physical barriers (such as pedestrian fencing) to force pedestrians to cross at the expected crosswalk locations could make a significant difference.

Contraflow Bus Lane Experience in Other Cities

An evaluation of the experience of other cities with contraflow bus lanes has revealed that the bus lanes have been generally considered successful. However, most operations are not the same as that in Chicago, either in that the lanes are wider or that they are not located in CBDs. The one installation that is similar to Chicago's is in Pittsburgh. City officials there believe that these bus lanes are successful, although they noted that some of the public considers these bus lanes to be a safety problem. City officials do not believe this to be the case,

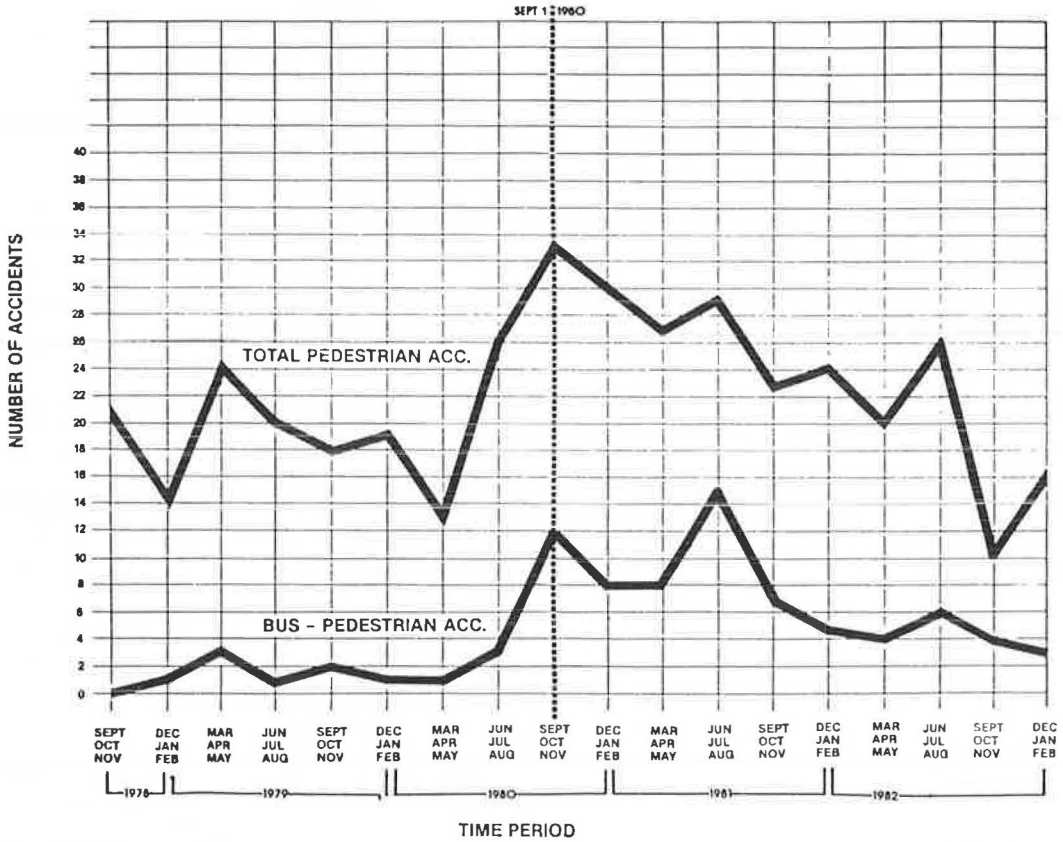

FIGURE 2 Downtown contraflow bus lane traffic accident statistics for Van Buren, Jackson, Adams, and Monroe.

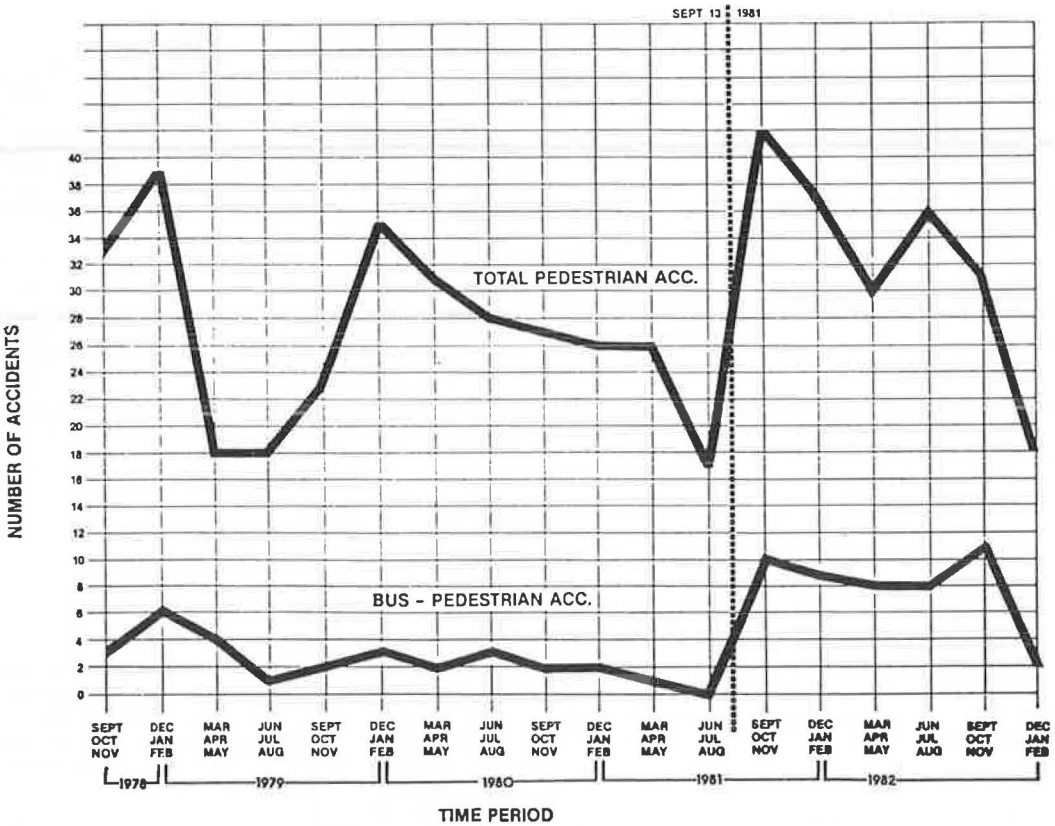

FIGURE 3 Downtown contraflow bus lane traffic accident statistics for Madison, Washington, Randolph, and Lake.

FIGURE 4 Bus-pedestrian accidents.

however, and no documentation regarding this operation has been prepared.

RECOMMENDATIONS

The primary conclusion of this study is that the bus lanes are operating in a relatively safe and effective manner, and it is recommended that they be retained. There are some operational and safety problems, but these problems are manageable and are already being addressed through various actions of the Mayor's Traffic Management Task Force.

Following is a list of specific recommendations for improvement, along with the actions already taken in each area.

Improved Signing and Pavement Markings

Less Confusing Signing

In response to numerous suggestions from both citizens and the police, new one-way signs have been posted at all of the cross streets. The sign previously used consisted of a standard one-way arrow sign with the message EXCEPT CTA BUSES at the bottom. The new signs were installed in late April 1983 and use the standard black-on-white one-way arrow sign followed by a black-on-yellow arrow sign with the work BUSES (see Figure 5).

State Street Mall Signing

There are no one-way signs posted at the State Street transit mall because the only vehicles on the mall are buses and emergency vehicles that can turn

FIGURE 5 One-way sign modification.

in either direction on the bus lane streets. New pedestrian-oriented signs that show two or three black-on-white arrows in one direction, and a black-on-yellow arrow with the word BUSES in the other direction, were posted facing all four crosswalk movements on State Street in June 1983 (see Figure 6).

FIGURE 6 One-way signing at State Street.

More Frequent Pavement Markings

The Department of Streets and Sanitation has been asked to apply the pavement markings on the contraflow bus lane streets twice a year instead of the usual once yearly CBD pavement marking. This schedule will ensure that these markings are fresh and visible throughout the year. In addition, the method of separating the opposing traffic directions has been changed from yellow cross-hatching to two 8-in. parallel yellow lines, which are much easier and cheaper to apply, thus reducing the time and cost of this operation.

Curb Line Pavement Markings

The addition of an 8-in. yellow line on top of the curb adjacent to the contraflow bus lanes should further help to alert pedestrians to the presence of buses in that curb lane. This curb marking was first installed in fall 1982.

Special Pavement Messages

The application of the WATCH FOR BUSES pavement marking message has been expanded to include various midblock locations where sizable pedestrian crossings have been observed, in addition to the usual crosswalk application of this message (see Figure 7).

Pedestrian Fencing

Union Station

In November 1982 special pedestrian fencing was installed along both the north and south curbs of

FIGURE 7 WATCH FOR BUSES pavement marking.

Adams Street between Canal Street and Wacker Drive to reduce the haphazard and dangerous pedestrian crossings throughout this area (see Figure 8). Although it is too early to develop any meaningful before-and-after accident statistics, video studies of this area reveal much more orderly and safe pedestrian traffic flows in this area.

State Street Transit Mall

A test installation of a more aesthetically designed pedestrian fencing is to be installed on the south curb of Adams Street east of State and on the north curb of Washington Street west of State in order to better channel pedestrians into the crosswalks and

FIGURE 8 Adams Street pedestrian fencing.

FIGURE 9 Improved pedestrian fence design.

reduce midblock crossings. This more aesthetic design was developed with the Bureau of Architecture (see Figure 9) and will be installed with the cooperation of the Department of Streets and Sanitation.

Additional Pedestrian Fencing

The Bureau of Traffic Engineering and Operations will be asking for a $40,000 budget item next year to cover the installation of additional aesthetically pleasing pedestrian fencing (as needed) or to replace some of the older standard fencing where there are complaints regarding its appearance.

Bus Operator Safety Training

Current Training Procedures

Currently, the CTA gives all bus operators special instructions on how to drive on the contraflow bus lanes. In addition, street supervisory personnel are instructed to constantly observe the bus lane operation and report any problems or questionable operating procedures, and bus operator instructors are regularly assigned to ride these buses and take whatever corrective measures may be needed.

Use of Video Tapes

The CTA is planning to use specially edited versions of the contraflow bus lane video tapes as an additional training tool for bus operators. Viewing of these tapes will give both new and regular bus operators some feeling of the unexpected pedestrian movements that regularly take place along these lanes, and a much better idea of where and how these incidents would most likely occur.

Continued Surveillance

On-Site Inspection

The Police Department, the CTA, and the Department of Public Works will continue to monitor the operation of the contraflow bus lanes, taking whatever corrective actions are necessary as soon as a problem develops.

Ongoing Accident Analysis

The Bureau of Traffic Engineering and Operations will continue to maintain up-to-date accident records of the contraflow bus lane streets to identify both long-term trends and specific problem locations. Again, immediate action will be taken as soon as a problem becomes apparent.

Traffic Management Task Force

The Mayor's Traffic Management Task Force will continue to monitor the activities of all its member agencies with respect to the contraflow bus lanes, act as a sounding board for complaints and problems brought to it from outside sources, and make whatever regular reports are necessary to maintain a continued public awareness and appreciation for the contraflow bus lane operation.

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REFERENCE

1. Contraflow Bus Lanes Survey Results. Chicago Area Transportation Study, Chicago, Dec. 1982.

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Traffic Restraint on New York City's East River Bridges

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ABSTRACT

The analysis of traffic impacts associated with the New York City Department of Transportation's 1980 proposed morning peak-period driver-only ban on the four East River bridges is summarized. The ban would involve some 25,000 out of the 94,000 vehicles that enter Manhattan from 6:00 to 10:00 a.m. on the four free and three toll East River crossings. Its goal was to manage capacity consistent with transportation, economic, and air quality objectives. Driver-only cars occupy about half of all Manhattan-bound road space between 8:00 and 9:00 a.m., yet they carry less than 25 percent of the people. The traffic impact analysis considered likely changes in where, when, and how people travel. The changes were based on the equilibrium condition that would occur as traffic continually redistributes to where there is capacity. The analysis indicated that about 65 percent of the 25,000 driver-only cars on the free bridges would be diverted to toll crossings. The remaining 35 percent would be distributed in a variety of other ways. Under equilibrium conditions it is expected that queues would dissipate by 10:30 a.m. on both the Midtown Tunnel and Brooklyn-Battery Tunnel (currently, queues last until about 9:00 a.m. on the Brooklyn-Battery Tunnel and 10:00 a.m. on the Midtown Tunnel). These estimates assume that the reversible lanes would be available on both of these facilities by 6:00 a.m. A contraflow bus lane on the approach to the Brooklyn-Battery Tunnel was implemented during 1980 as a traffic management complement. However, the ban was not allowed by the state court. The community and court response suggests that implementing such automobile-restraint measures will be a difficult task in U.S. cities.

The procedures used in analyzing the traffic impacts associated with the New York City Department of Transportation's (DOT) 1980 proposal to ban driver-only cars from the four free East River crossings during the weekday morning rush periods are described. Also, the associated planning and policy implications are summarized.

The proposal to ban driver-only cars was set forth by New York City DOT in June 1980. This demonstration project was suggested as a response to the New York City DOT's desire to reduce car trips in Manhattan. It was proposed for implementation by October 1980. Adding a toll to the free East River crossings--a much discussed proposal--was ruled out because of the time, costs, and impacts involved. The analyses herein reflect both the city's policy and the time constraints that were placed on the analysis.

CONCEPT

The number of vehicles entering Manhattan has nearly