Public Opinion and Traffic Flow Impacts of Newly Installed Modern Roundabouts in the United States

THE PURPOSE OF THIS STUDY WAS TO EXAMINE PUBLIC OPINION REGARDING ROUNDABOUTS BEFORE AND AFTER CONSTRUCTION IN SEVERAL U.S. COMMUNITIES AND TO EVALUATE THEIR IMPACT ON TRAFFIC FLOW. ROUNDABOUTS REDUCED OVERALL VEHICLE DELAYS, REDUCED THE PROPORTION OF DRIVERS THAT CAME TO A STOP AND REDUCED THE LEVEL OF TRAFFIC CONGESTION.

BY RICHARD A. RETTING, GREG LUTTRELL AND EUGENE R. RUSSELL

INTRODUCTION

Prior research has documented significant reductions in motor-vehicle crashes when conventional intersections have been converted from stop sign or traffic signal control to modern roundabouts. Modern roundabouts are a type of circular intersection that require drivers to yield to traffic in the circle when entering, and allow for continuous traffic flow through the intersection at low speed. Particularly noteworthy are the large reductions in injury crashes. For example, Persaud et al.[1] evaluated 23 intersections in the United States converted from stop sign or traffic signal control to modern roundabouts, and reported that crashes were reduced by 40 percent and injury crashes were reduced by 80 percent. Schoon and van Minnen[2] studied 181 Dutch intersections converted from traffic signals or stop signs to modern roundabouts and reported that crashes and injuries were reduced by 47 and 71 percent, respectively; the more severe injury crashes (resulting in hospital admissions) were reduced by 81 percent. Troutbeck[3] reported a 74 percent reduction in the rate of injury crashes following conversion of 73 roundabouts in Victoria, Australia. Crash reductions resulting from installation of modern roundabouts can be attributed primarily to two factors: reduced traffic speeds and elimination of specific types of motor-vehicle conflicts, particularly right-angle collisions that frequently occur at typical perpendicular intersections. Despite reductions in traffic speeds, modern roundabouts actually improve traffic flow and increase intersection capacity.[4–6]

Given the large numbers of injury (700,000) and property damage (1.3 million) crashes that occur each year at traffic signals and stop signs in the United States,[7] widespread construction of modern roundabouts can substantially reduce injury and property damage losses. However, a considerable obstacle to the construction of roundabouts in many U.S. communities has been opposition—in some cases, strong opposition—from local residents to the conversion of specific intersections from stop sign or traffic signal control to roundabouts. Some communities have constructed roundabouts in spite of such public opposition, and anecdotal evidence suggests that public acceptance generally increases once local residents experience and adapt to this new form of traffic control. But no formal studies have documented public opinion in U.S. communities regarding modern roundabouts or specific reasons why many drivers unfamiliar with roundabouts oppose their construction.

The purpose of this study was to sample public opinion regarding modern roundabouts, both before and after their construction, in several communities and to evaluate the impact of roundabout construction on traffic flow and intersection performance.

METHOD

Three U.S. communities—Hutchinson, KS; Harford County, MD; and Reno, NV—that constructed modern roundabouts in place of existing two-way stop-sign-controlled intersections in the summer of 2000 were the subject of this research. The Hutchinson roundabout was located at the intersection of 23rd Avenue and Severance Street, in a primarily residential setting adjacent to the state fairgrounds. This intersection experienced traffic congestion, particularly during the annual state fair, and had a history of right-angle collisions. The Harford County roundabout was installed at the intersection of two rural arterial roads, Maryland State Routes 24 and 165, approximately 0.25 mile from a large county public school complex. This roundabout was constructed to improve access for drivers on the minor approach crossing a high-speed rural arterial and to assist drivers turning left across oncoming traffic. The Reno roundabout was located at the intersection of Clear Acre Lane and Wedekind Road, in a residential neighborhood, approximately 0.25 mile from a public high school. This roundabout was part of a roadway realignment project designed to connect two sides of an offset cross street.

Table 1 provides estimated average daily traffic volumes for the three study sites. Traffic volume estimates were obtained prior to construction. As indicated by these data, the three study sites had low to moderate traffic volumes and consequently operated without significant congestion or traffic backups under normal conditions.

Random-digit-dial telephone interviews, field observations and analysis of traffic operations were conducted before and after roundabout construction to evaluate the impact of roundabouts on public opinion and traffic flow.

Telephone Surveys

In each community, representative random-digit-dial telephone surveys were conducted approximately six weeks before and eight weeks after the roundabouts were constructed. Separate samples were selected for the before and after periods. Telephone interviews were conducted by a market research company. Within each household, one respondent was verified as a licensed driver, age 16 or older, and as a resident of the given community prior to completing the interview. A total of 1,801 interviews were completed. Respondents were asked if they were familiar with the specific intersection in their community where installation of a roundabout was planned (before survey) or recently installed (after survey) and, if so, how often they drove through this intersection. Interviews were completed for respondents who said they drove through the intersection frequently or occasionally, and terminated for drivers who said rarely or never. In the before survey, respondents were provided with a brief description of roundabouts and then asked if they had previously driven through roundabouts. In the after survey, drivers also were asked if they had driven through the intersection since the roundabout was built; interviews were completed only for drivers who said "yes."

Field Surveys

Observations of traffic flow were made several weeks before and after conversion of the intersections from stop sign control to roundabouts using a specially designed videocamera. Videotape allowed for collection of traffic data with a minimum of field personnel, and the tapes could be reviewed several times to verify observations. The videocamera was designed to provide a 360-degree view when mounted above the intersection and had a ratio of horizontal field of view to vertical height of approximately 9 to 1. Thus, when mounted at 30 feet, the camera monitors a circular area of approximately 270 feet. With this mounting, the whole intersection and all approaches could be viewed with a single camera. At each location, the camera was mounted on a streetlight pole arm.

Images of traffic flow were recorded on videotapes, with each tape recording for six hours. Two site visits per day were required to obtain morning and afternoon peak-hour flows. Blank tapes were installed between 6 a.m. and 7 a.m. and between 3 p.m. and 4 p.m. A minimum of five days of weekday traffic flow (30 hours) was recorded at each site for both the stop-sign-controlled and roundabout conditions. Once the videotapes were collected, traffic flows were evaluated through observation of the tapes. Traffic-flow data were recorded in 15-minute intervals on data sheets and later used as input for the computer program SIDRA (Signalized and unsignalized Intersection Design and Research Aide). SIDRA provides output for the following measures of effectiveness: *average delay*—average vehicle delay for all entering vehicles; *maximum approach delay*—average vehicle delay for the approach with the highest average vehicle delay; *proportion stopped*—proportion of entering vehicles that are required to stop; *maximum proportion stopped*—proportion of entering vehicles that are required to stop on the approach with the highest proportion stopped value; and *degree of saturation*—the ratio of demand at the intersection/roundabout entry to the available capacity of the entry. The degree of saturation also is referred to as the vehicle-to-capacity, or v/c, ratio. Capacity is defined in terms of the maximum flow rate that a given traffic facility can accommodate under prevailing conditions. The maximum v/c ratio, under fully saturated conditions, equals 1.0, with lower values associated with less traffic congestion. Capacity estimates were produced by SIDRA for stop-sign-controlled and roundabout conditions.

Table 1. Estimated average daily traffic volumes.

	Kansas	Maryland	Nevada
Northbound	2,400	1,500	1,350
Southbound	3,100	1,000	250
Eastbound	3,400	3,000	500
Westbound	3,100	2,800	1,400
Total	12,000	8,300	3,500

To minimize possible effects due to fluctuations in traffic volume, before-after analyses were based on comparisons of subsets of the video observations that contained statistically similar hourly traffic volumes for the periods before and after construction. Videotapes were classified by time of day (a.m. or p.m.), and traffic counts were conducted for each tape. Sets of hourly traffic observations for the before and after periods were examined for similarity. Suitably matched sets of traffic observations then were used for input to SIDRA for analysis. For the three sites combined, a total of 126 hours of videotape were analyzed for the before period and 160 hours for the after period. Also, to limit potential seasonal variability effects, the data collection periods were scheduled to avoid major seasonal impacts on traffic flow (i.e., at the Maryland and Nevada sites, data for both the before and after periods were collected when nearby schools were in session; at the Kansas site, data were not collected during the period of the annual state fair).

Table 2. Percent of respondents who previously had driven through roundabouts.				
	Kansas	Maryland	Nevada	Total
Yes	46	95	50	64
No	52	5	47	35
Don't know	2	0	3	1

n = 300 per city

Table 3. Percent of respondents in favor of/opposed to roundabouts.

	Kansas		Maryland		Nevada		Total	
	Before	After	Before	After	Before	After	Before	After
Strongly favor	9	31	15	29	23	37	**16**	**32**
Somewhat favor	13	29	11	34	21	30	**15**	**31**
Somewhat oppose	16	15	14	14	12	11	**14**	**13**
Strongly oppose	44	15	51	18	26	11	**41**	**15**
Don't know	17	10	8	5	18	12	**14**	**9**

n = 300 per city per time period

Measures of effectiveness were analyzed and compared for selected time periods several weeks before and after construction of the roundabouts. Wilcoxon nonparametric and t-tests were applied to determine whether results were statistically significant.

RESULTS

Telephone Surveys

In the surveys conducted prior to roundabout construction, there was considerable variability among communities with regard to the extent to which respondents said they had previously driven through roundabouts. Overall, 64 percent of drivers had previously driven through roundabouts; drivers in Maryland were far more likely than those in Kansas and Nevada to have done so (Table 2), possibly reflecting the larger number of roundabouts built in Maryland.[1]

Table 3 indicates that the majority of drivers (55 percent) opposed the planned installations of roundabouts before construction, with 41 percent strongly opposed. In Nevada, a smaller but still sizable proportion of drivers (38 percent) opposed the planned roundabout. After construction, there was a substantial change in public opinion. The proportion of drivers opposed to the roundabouts declined from 55 to 28 percent, and the proportion strongly opposed declined from 41 to 15 percent. The proportion favoring roundabouts increased from 31 to 63 percent.

Respondents who were surveyed after roundabout construction were asked if they had held an opinion about the roundabout before it was built—40 percent said they did. Of these, 226 (69 percent) said they had opposed it, and 103 (31 percent) said they favored building the proposed roundabout. Table 4 shows the opinion results separately for drivers who said they had favored and those who said they had opposed construction of the roundabout. Almost all drivers who said they favored the roundabouts before construction continued to favor roundabouts after they were built (94 percent), whereas 40 percent of drivers who said they opposed the roundabouts before construction were in favor of roundabouts after they were built.

Drivers who did not favor roundabouts were asked about the reasons for their opposition. Before the roundabouts were built, the most common reasons given for opposing their installation were that drivers would rather have traffic signals (22 percent) or that roundabouts would make the intersections unsafe (21 percent) or confusing (21 percent). After construction, these same primary reasons for opposition to roundabouts prevailed, but with a slightly greater proportion of drivers claiming that roundabouts were unsafe (27 percent) or confusing (27 percent), and a smaller proportion claiming

Table 4. Opinions after roundabout construction of drivers who had previously favored or opposed construction of the roundabout (percent).

	Opinion before construction	
Opinion after construction	Favored (n = 103)	Opposed (n = 226)
Strongly favor	74	15
Somewhat favor	20	25
Somewhat oppose	2	22
Strongly oppose	2	33
Don't know/refused	2	4
Total	100	100

Table 5. Field survey measures of effectiveness.

	Kansas			Maryland			Nevada		
	Before	After	Percent change	Before	After	Percent change	Before	After	Percent change
Average vehicle delay[a]	14.2	11.5	–19	14.1	10.9	–23	12.3	10.7	–13
Maximum approach delay[a]	29.3	12.7	–57	22.4	11.7	–48	27.0	12.1	–55
Percent stopped	51	44	–14	41	27	–34	46	29	–37
Maximum percent stopped	70	50	–29	55	32	–42	64	46	–28
Degree of saturation (v/c ratio)	0.55	0.24	–56	0.52	0.20	–62	0.49	0.20	–59

[a]*seconds/vehicle*

they would have preferred traffic signals instead of roundabouts (17 percent).

Finally, before and after construction, drivers were asked about the impact of the roundabouts on traffic congestion and safety. Before construction, 27 percent of drivers thought the roundabouts would reduce traffic congestion; after construction, 42 percent felt that roundabouts had reduced congestion. About one-third of drivers who were questioned before construction thought the roundabouts would make intersections safer, whereas after construction 50 percent of drivers felt the roundabouts had made the intersections safer.

Field Surveys

Table 5 summarizes five measures of effectiveness for the three intersections. The unit of analysis for each location was the entire intersection, combining values for both the major and minor intersection approaches. At the Kansas, Maryland and Nevada intersections, conversion from stop sign control to roundabouts reduced overall vehicle delays by 19, 23 and 13 percent, respectively; reduced the proportion of drivers that came to a stop by 14, 34 and 37 percent, respectively; and reduced the degree of traffic saturation (or vehicle-to-capacity ratio) at the intersections by 56, 62 and 59 percent, respectively. Roundabouts were particularly effective in reducing average vehicle delays for the approach with the highest average vehicle delay (maximum approach delay). Results were fairly consistent for the three study sites. All changes were statistically significant at the $p < 0.05$ level.

DISCUSSION

Many motorists in the three communities surveyed initially opposed the construction of modern roundabouts in place of stop signs or traffic signals; however, this opposition substantially declined as drivers experienced and adapted to roundabouts. The large reduction in the proportion of drivers strongly opposed to roundabouts suggests that opinions of even those with strongly held views can be influenced by exposure to modern roundabouts. This is further supported by the finding that among drivers who said they were opposed to the roundabouts before construction, 40 percent said they were in favor of roundabouts after they were built.

The finding of reduced traffic delays after construction of roundabouts is consistent with prior research findings.[4–6] Although crash reductions associated with roundabout construction may not be obvious to many drivers, operational improvements such as reduced traffic stops, vehicle delays and traffic conflicts can provide immediate positive feedback to drivers and may account for changes in driver opinions regarding roundabouts.

Because roundabouts are controversial and often face opposition at first, communities where roundabouts are planned should consider developing effective educational and promotional programs to familiarize drivers with the operational characteristics and safety benefits of modern roundabouts. Publicity efforts also should point to the benefits of reduced traffic congestion. Appropriate measures could then be developed to address driver concerns and thus further increase public support for modern roundabouts.

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RICHARD A. RETTING *is Senior Transportation Engineer with IIHS. His areas of specialization include urban crashes, traffic control devices, roadside hazards, pedestrians, speed studies and photo enforcement. Prior to joining IIHS, he served as Highway Safety Director for the New York City Department of Transportation. Retting is a Member of ITE.*

GREG LUTTRELL, *Ph.D., P.E., is an Assistant Professor of Civil Engineering at Southern Illinois University–Edwardsville. He holds a B.S. degree from North Dakota State University, an M.S. degree from the South Dakota School of Mines and Technology, and a doctorate from Kansas State University. He has 13 years of experience in government traffic engineering positions in South Dakota and Florida. Luttrell is a Member of ITE.*

EUGENE R. (GENE) RUSSELL, *Ph.D., P.E., Professor Emeritus and former Transportation Center Director, Kansas State University, has had 37 years of experience in teaching and research in all areas of highway engineering and safety, and for the last five years has performed considerable research on traffic operations at roundabouts, on roundabout safety and on public acceptance of roundabouts. Russell is a Fellow of ITE.*