Safety Comparison of Types of Parking on Urban Streets in Nebraska

PATRICK T. MCCOY, MURALI RAMANUJAM, MASSOUM MOUSSAVI, AND JOHN L. BALLARD

Without exception, previous research has found that streets with no parking are safer than similar streets with parking. But the common conclusion of many studies, that parallel parking is safer than angle parking, has been questioned by some researchers, particularly in regard to low-angle parking. The objective of this study was to determine the safest type of parking on urban sections of the state highway system in Nebraska. The accident experience on the urban sections of the state highway system with parking was analyzed. Results of the analysis were used to identify the safest type of parking over the range of traffic, roadway, and land use conditions on the urban system. The accident analysis indicated that (a) parking results in accidents on urban streets, (b) the type of parking affects highway safety even when parking use, land use, and type of roadway are taken into account, (c) the safest type of parking on urban streets is parallel parking, and (d) low-angle parking may be safer than high-angle parking, but it is not as safe as parallel parking. Thus, whenever feasible, parking should not be allowed on urban sections of the state highway system. However, when parking must be allowed, consideration should be given to using parallel parking instead of angle parking.

Several studies (*1*) comparing accidents involving angle and parallel parking have been conducted. Accident reduction factors from 19 to 71 percent were reported after a change from angle to parallel parking. Therefore, the common conclusion of these studies was that parallel parking is safer than angle parking. But none of these studies accounted for the change in accident exposure associated with a change from angle to parallel parking. When angle parking is converted to parallel parking, the accident exposure is reduced, because fewer parking stalls are available after the conversion. In addition, the parking activity may also change with the conversion to parallel parking and the reduction in the number of spaces. Thus, the reductions in accidents that have been experienced with changes from angle to parallel parking may have been caused more by the change in accident exposure than by the change in parking maneuvers associated with the parking configurations.

In 1971, Zeigler (*2*) analyzed the operational characteristics of low-angle and parallel parking patterns. Graphical methods and full-scale vehicle tests were used to evaluate the parking and unparking maneuvers of each pattern. The evaluation indicated that low-angle parking results in less disruption of traffic flow and improved safety for pedestrians entering and exiting parked vehicles. Zeigler (*2*) concluded that low-angle parking provides safer and more efficient traffic operations than parallel parking. However, the study did not include an analysis of accident data related to type of parking.

One of the most comprehensive studies of the safety effects of curb parking was conducted by Humphreys et al. (*3*) in 1978. This study involved the collection and analysis of parking and accident data on over 170 mi of streets in 10 cities. A comparative-type statistical analysis was performed on the accident data using parking type, parking use, abutting land use, and functional classification of the street as the independent variables. Parking use was found to be a primary factor affecting midblock accident rates. Increases in parking use up to 1.5 million annual space hours per mile resulted in higher accident rates. The study also found that an increasing accident rate was generally associated with changes in land use from single-family dwelling to apartment, from apartment to office, and from office to retail. Because each of these changes in land use indicated an increase in parking turnover rates and pedestrian activity, the associated increases in accident rates were deemed appropriate. However, type of parking was found to have no effect on accident rates when parking use, abutting land use, and street classification were taken into account. In other words, angle parking was found to be no more hazardous than parallel parking for similar levels of parking demand, land use, and street type.

Without exception, previous research has found that streets with no parking are safer than similar streets with parking. But the common conclusion of many studies, that parallel parking is safer than angle parking, was brought into question by the findings of Zeigler (*2*) and Humphreys et al. (*3*), particularly with respect to low-angle parking (i.e., 30 degrees or less).

OBJECTIVE AND SCOPE

The objective of this research was to determine the safest type of parking on urban sections of the state highway system in Nebraska. A review of the state highway system was conducted to identify the urban sections that had parking on them. The urban sections with parking were surveyed to obtain information about the type and amount of parking, the roadway and traffic conditions, and the land use characteristics of each section. The accident experience on the urban sections surveyed was analyzed to determine the relationship between highway safety and type of parking. The results of the accident analysis were used to determine the safest type of parking

P. McCoy, M. Ramanujam, and M. Moussavi, Department of Civil Engineering, and J. Ballard, Department of Industrial and Management Systems Engineering, University of Nebraska, Lincoln, Neb. 68588.

over the range of traffic, roadway, and land use conditions found on urban sections of the state highway system.

PARKING INVENTORY

An inventory of the state highway system was conducted to determine the types and amounts of parking on the urban sections of the system. The roadway, traffic, and land-use characteristics of each section with parking were also determined. These data were used in the accident analysis to examine the relationship between accident experience and type of parking.

Procedure

A listing of all urban sections on the state highway system was obtained from the roadway inventory computer file maintained by the Nebraska Department of Roads (NDOR). This listing was reviewed to identify urban sections that might have parking on them, on the basis of number of traffic lanes and roadway width. Sections that were obviously too narrow to provide parking were eliminated from further consideration. Approximately 603 sections, comprising over 274 mi of roadway, were identified as possibly having parking. The NDOR photologs of these sections were examined to determine which of them actually had parking. A total of 491 sections were found to have parking. These sections were in 126 cities and comprised 183 mi of roadway. Surveys of the sections were made to collect the necessary information about the parking, roadway, and land use characteristics. Two types of surveys were used—field and questionnaire surveys.

Field Surveys

To obtain as much first-hand information as possible within the limits of the available resources, the field surveys were made in the cities that had the most sections with parking. Field surveys were conducted in 55 cities, which included all cities with 1980 populations greater than 4,000. Altogether, 260 sections comprising 86 mi of roadway were surveyed in the field. The accidents on these sections accounted for 87 percent of the parking accidents that occurred during 1985 and 1986 on the 491 sections with parking. The following parking and roadway information was recorded for each section: (a) amounts and types of parking, (b) numbers and types of land uses, (c) numbers and lengths of blocks, (d) speed limits, (e) intersection controls, (f) numbers of driveways and alleys, (g) numbers of lanes, (h) directional controls, and (i) roadway alignment. Also the number of each of the following types of land use was counted on each block face: (a) retail, (b) service, (c) office, (d) medical, (e) institutional, (f) industrial, (g) recreational, (h) agricultural, (i) residential, and (j) other.

In addition to these data, parking use on each block face was measured. At the beginning of the field survey in each city, the number of vehicles parked on each block face was counted. A second count was made at the end of the field survey. The time of day that each count was made was also noted. These data were used to estimate the vehicle-hours of parking on each block face. The estimates were computed from parking-use curves for similar block faces. The parking-use curves related percentage of average daily vehicle-hours of parking to time of day. They were developed from the results of parking-use studies, which were conducted on typical block faces in central business districts and residential neighborhoods in cities representative of the following population ranges: below 8,000, from 8,000 to 35,000, from 35,000 to 200,000, and over 200,000.

Questionnaire Survey

Conducting field surveys in all 126 cities that had sections of the state highway system with parking was not possible because of resource limitations. Therefore, a questionnaire survey was conducted to obtain the necessary information from the 71 cities in which field surveys were not made. To keep the questionnaire as short as possible and maximize the likelihood that it would be returned, only information that could not be obtained accurately enough from the photologs was requested. Therefore, the questionnaire was limited to questions about parking layout, use, and restrictions.

The questionnaire consisted of a parking survey form for each block face. Each parking survey form was prelabeled with the name of the city, the highway number, and the block designation. A plat of the city designating each block face was included with the parking survey forms to facilitate proper identification of the block faces. The form was divided into three sections. The first section asked for information about the parking layout on the block face. If the parking stalls were painted, the dimensions of the stalls and their number were requested. If the stalls were unpainted, the type of parking and number of stalls were requested. The second section of the form asked for a count of the numbers of vehicles parked on the block face at 9:00 a.m., noon, and 4:00 p.m. These data were used to estimate the parking use on the block face. The third section of the form asked for information about any parking restrictions that might be in effect on the block face.

The responses to the questionnaire were checked for accuracy by comparing them to the parking data obtained from the photologs. If a discrepancy was found, a letter was sent to the city asking that the particular discrepancy be checked. Unverified data were not used.

Of the 71 cities surveyed, 44 (62 percent) responded to the questionnaire with usable data. These towns accounted for 162 sections comprising 85 mi of roadway. The accident experience on these sections accounted for 10 percent of the parking accidents that occurred during 1985 and 1986 on the 491 sections with parking. Thus, the field and questionnaire surveys together provided the data for 422 of the 491 sections, which amounted to 171 of the 183 mi of urban sections of the state highway system with parking. The accident experience on the 422 sections included 97 percent of the parking accidents that occurred on the 491 sections.

Findings

The 422 urban sections surveyed included 2,336 block faces. Of these block faces, 292 had more than one type of parking

TABLE 1 DISTRIBUTION OF PARKING TYPES

Type of Parking	No. of Stalls	Miles
Painted Parking:		
Parallel	3,036	15.7
Low-Angle	377	1.6
High-Angle	3,259	10.9
Unpainted Parking:		
Parallel	19,536	97.9
Angle	2,678	9.4
Total	28,886	135.5

pattern on them. In order to avoid confounding the results of the study with the effects of uncommon combinations of parking patterns, the block faces with more than one type of parking were not included in the study. Thus, 2,044 block faces, each with only one type of parking, were used. The 2,044 block faces included 28,886 parking stalls on 135.5 mi of street.

Types of Parking

The distribution of the types of parking patterns on the 2,044 block faces with only one type is shown in Table 1. Only 6,672 stalls were painted. The other 22,214 stalls were not painted. Of the painted stalls, 3,036 were for parallel parking and 3,636 were for angle parking. Only 377 stalls were for low-angle parking.

Roadway Type

The distribution of the types of parking by roadway type is presented in Table 2. Parallel parking was the most common parking pattern on all roadway types. On major streets (i.e., one-way; two-way divided; and two-way, multilane, undi-

TABLE 2 DISTRIBUTION OF PARKING TYPES BY ROADWAY TYPE

	Number of Stalls			
Type of Parking	One-Way	Two-Way Divided	Two-Way Multilane Undivided	Two-Way Two-Lane
Painted Parking:				
Parallel	692	320	1,012	1,012
Low-Angle	0	0	0	377
High-Angle	219	20	159	2,861
Unpainted Parking:				
Parallel	926	1,177	1,190	16,243
Angle	0	0	57	2,621
Total	1,837	1,517	2,418	23,114

vided roadways), over 90 percent of the stalls were for parallel parking. Most of the angle parking was on two-way, two-lane roadways. In fact, this was the only type of roadway with all types of parking. Also, it was the only type of roadway with low-angle parking.

Population

The distribution of the types of parking by city population on the major streets and the two-way, two-lane streets is presented in Tables 3 and 4, respectively. Practically all parking on urban sections of the state highway system in cities with populations of 8,000 or more was parallel parking. Angle parking was found primarily on two-way, two-lane streets in cities with populations below 8,000.

Land Use

The distribution of land uses served by the types of parking on the major streets is presented in Table 5. On major streets, the distribution of land uses served by painted parallel and painted angle parking was similar: about two-thirds served by both types were retail, service, and office land uses. The unpainted parallel parking on major streets served mainly residential and retail land uses.

The distribution of land uses served by the types of parking on two-way, two-lane streets is presented in Table 6. On two-way, two-lane streets, both painted parallel and high-angle parking had similar land-use distributions, serving about 75 percent retail, service, and office land uses. The painted low-angle parking and the unpainted angle parking on two-way, two-lane streets had similar land-use distributions, serving mostly retail, office, and other land uses. Residential land uses were most commonly served by unpainted parallel parking.

ACCIDENT STUDY

The accident experience on the urban sections with parking was analyzed to determine the relationship between highway safety and type of parking. The results of the analysis were used to determine the safest type of parking for the conditions on urban sections of the state highway system in Nebraska.

Procedure

Data were obtained from NDOR's computerized accident record system on all reported accidents that occurred during 1985 and 1986, in the 422 urban sections surveyed. The data included the following information for each accident: date, day of week, time of day, reference post of location, directional analysis code, intersection code, severity code, movements of vehicles involved, and directions of travel of vehicles involved. The block within which each accident occurred was

TABLE 3 DISTRIBUTION OF PARKING TYPES BY POPULATION ON MAJOR STREETS

	Number of Stalls		
Type of Parking	Population Below 8,000	Population Between 8,000 & 35,000	Population Over 35,000
Painted Parking			
Parallel	756	551	717
Low-Angle	0	0	0
High-Angle	318	40	40
Unpainted Parking:			
Parallel	820	780	1,693
Angle	19	38	0
Total	1,913	1,409	2,450

Note: Major streets include one-way, two-way divided, and two-way multilane undivided streets.

TABLE 4 DISTRIBUTION OF PARKING TYPES BY POPULATION ON TWO-WAY, TWO-LANE STREETS

	Number of Stalls		
Type of Parking	Population Below 8,000	Population Between 8,000 & 35,000	Population Over 35,000
Painted Parking:			
Parallel	897	115	0
Low-Angle	377	0	0
High-Angle	2,861	0	0
Unpainted Parking:			
Parallel	15,516	529	198
Angle	2,583	38	0
Total	22,234	682	198

found by comparing the reference post of the accident location with those at the ends of the blocks. Once the block was found for an accident, the block face on which it occurred was determined from the type of accident and the directions of travel and the movements of the vehicles involved in the accident. After the accidents were assigned to the block faces, the number of accidents for each accident type was computed for each block face.

Regression Analysis

Regression analysis was conducted to determine the relationship between safety and type of parking. The stepwise regression analysis procedure of the SAS system (*4*) was used to evaluate numerous regression models. Separate regression runs were made for each type of street. The dependent variables in the models investigated were total number of nonintersection accidents and total number of parking accidents. The independent variables tried included type of parking, parking use, number of parking stalls, speed limit, average daily traffic (ADT), roadway alinement, roadway width, block length, percentages of land-use types, and land-use density.

None of the models was found to adequately explain the relationship between the numbers of accidents and the type of parking on a block face. Although some statistically significant variables were found, the highest coefficients of determination were about 0.15. One reason the regression analysis failed to find any relationships was that the data were not well distributed over the ranges of the independent variables. Instead, the data were clustered, with only a few combinations of the independent variable values being represented. For example, all of the low-angle parking was found on two-way, two-lane streets in cities with populations less than 8,000, and about 90 percent of the low-angle parking was on streets with ADT below 5,000. Nearly all parking in cities with populations above 8,000 or on two-way, two-lane streets with ADT above 5,000 was parallel parking.

Accident Rates

Therefore, the relationship between highway safety and the type of parking was determined by simply comparing the mean accident rates of the parking types on each type of roadway. Nonintersection accident rates and parking accident rates were computed. The parking accident rates included only collision with parked vehicles and parking maneuver accidents. It was not possible to identify parking-related accidents, such as rear-end and sideswipe collisions caused by parking activity, because the original accident reports were not available to the study. Consequently, the parking accident rates may underestimate the safety effects of parking.

Two measures of exposure were used to compute the rates. One was millions of vehicle-miles of travel, which is the measure of exposure commonly used to compute accident rates for roadway sections. However, this measure does not account for the level of parking activity on the sections. To account for the level of parking activity, as well as the amount of travel on the sections, another measure of exposure was also used. This measure was the product of travel and parking use per stall, which was expressed in terms of billions of vehicle-

TABLE 5 DISTRIBUTION OF LAND USES SERVED BY TYPES OF PARKING ON MAJOR STREETS

	Type of Parking				
	Painted			Unpainted	
Land Use	Parallel	Low-Angle[a]	High-Angle	Parallel	Angle
Retail	53%	--	43%	25%	90%
Service	3%	--	4%	2%	0%
Office	12%	--	21%	6%	0%
Medical	1%	--	1%	2%	0%
Institutional	1%	--	1%	2%	0%
Industrial	2%	--	3%	2%	0%
Recreational	2%	--	6%	2%	10%
Residential	9%	--	3%	42%	0%
Other	17%	--	18%	17%	0%
Total	100%	--	100%	100%	100%

Note: Major streets include one-way, two-way divided, and two-way multilane divided streets.

[a]Because there was no low-angle parking on major streets, data are not available for that category.

mile-hours per stall. The parking use used to compute this measure of exposure included only daytime parking, because resources were not sufficient for collecting nighttime parking use. However, the accidents used to compute the accident rates included both daytime and nighttime accidents. Consequently, some of the accident rates based on parking use may be overestimated.

The statistical significance of the differences between the mean accident rates was determined using the Poisson distribution test (*5*). The Poisson distribution test was conducted at the 5 percent level of significance.

Percentage of Parking Accidents

The percentages of parking accidents among the types of parking were compared. The percentage of nonintersection accidents that involved a parked vehicle or a parking maneuver was computed for each type of parking on the major and two-way, two-lane streets. The statistical significance of the differences between the percentages was determined using the normal approximation test. The normal approximation test was conducted at the 5 percent level of significance.

Comparison of Similar Block Faces

In addition to the comparison of the overall accident rates and parking accident percentages, parking types on similar two-way, two-lane streets were compared in an effort to account for the effects of traffic, roadway, and land use characteristics. Block faces with painted parallel, low-angle, and high-angle parking, which had similar characteristics, were identified. The mean accident rates for the painted parallel, low-angle, and high-angle parking on these similar block faces were then computed and compared. Block faces with unpainted parallel and angle parking, which had similar traffic, roadway, and land use characteristics, were also identified. The mean accident rates for the unpainted parallel and angle parking on the similar block faces were then computed and compared.

The Poisson distribution test was used to determine the statistical significance of the differences between the mean

TABLE 8 ACCIDENT EXPOSURE IN 2-YEAR PERIOD

Type of Parking	Major Streets[a]	Two-Way Two-Lane Streets
	Travel (million vehicle-miles)	
Painted Parking:		
Parallel	120	22.4
Low-Angle	--[b]	3.85
High-Angle	7.50	23.4
Unpainted Parking:		
Parallel	232	193
Angle	1.91	12.6
	Parking Utilization (1,000 vehicle-hours/stall)	
Painted Parking:		
Parallel	2.54	2.78
Low-Angle	--[b]	3.52
High-Angle	1.67	2.78
Unpainted Parking:		
Parallel	1.72	1.24
Angle	1.19	1.38

[a]One-way, two-way divided, and two-way multilane undivided streets.

[b]Data not available, because there was no low-angle parking on major streets.

dents on major streets with painted parallel parking was lower than that on major streets with painted high-angle parking. Similarly, the major streets with unpainted parallel parking had a lower percentage of parking accidents than major streets with unpainted angle parking. However, these differences were not statistically significant.

On two-way, two-lane streets, 56 percent of the nonintersection accidents were parking accidents. Among the painted parking types, low-angle and high-angle parking had significantly higher percentages of parking accidents than the parallel parking. There was no statistically significant difference in parking accident percentages between low-angle and high-angle parking. Of the unpainted parking types, streets with angle parking had a significantly higher percentage of parking accidents than streets with parallel parking.

Comparison of Similar Block Faces

The accident experience of similar block faces with painted parking is compared in Table 12, and that of similar block faces with unpainted parking is compared in Table 13.

Painted Parking A total of 57 similar block faces with painted parallel, low-angle, and high-angle parking on two-

TABLE 9 NONINTERSECTION ACCIDENT RATES

Type of Parking	Major Streets[a]	Two-Way Two-Lane Streets
	Accidents Per Million Vehicle Miles	
Painted Parking:		
Parallel	1.65	1.83
Low-Angle	--[b]	3.38
High-Angle	1.20	3.59
Unpainted Parking:		
Parallel	1.32	0.674
Angle	1.57	1.67
	Accidents Per 10 Billion Vehicle-Mile-Hours/Stall	
Painted Parking:		
Parallel	6.50	6.58
Low-Angle	--[b]	9.59
High-Angle	7.19	12.9[c]
Unpainted Parking:		
Parallel	7.67	5.44
Angle	13.19[d]	12.10[d]

[a]One-way, two-way divided, and two-way multilane undivided streets.

[b]Data not available, because there was no low-angle parking on major streets.

[c]Significantly higher than the rate for painted parallel parking at the 5% level of significance.

[d]Significantly higher than the rate for unpainted parallel parking at the 5% level of significance.

way, two-lane streets were identified. Six of the block faces had parallel parking, 21 had low-angle parking, and 30 had high-angle parking. The similarity of the block faces was defined in terms of the range of traffic, roadway, and land use characteristics found on the block faces with low-angle parking. All of the block faces were on level, tangent sections of roadway with posted speed limits of 25 mph. The ADT on these streets was between 1,400 and 4,250. The lengths of the block faces were between 300 and 500 ft, and the land-use densities on them were between 4 and 30 land uses per 1,000 ft. The daily parking use on the block faces was between 40 and 190 veh-hr per 8-hr parking day (i.e., from 9:00 a.m. to 5:00 p.m.). The maximum percentages of any one type of land use on the block faces were 100 percent retail, 34 percent service, 67 percent office, 12 percent medical, 17 percent institutional, 50 percent industrial, 50 percent recreational, 40 percent residential, and 56 percent other.

The accident exposure and the accident rates for the similar block faces are presented in Table 12. The nonintersection accident rates for the low-angle and high-angle parking were

TABLE 10 PARKING ACCIDENT RATES

Type of Parking	Major Streets[a]	Two-Way Two-Lane Streets
	Accidents Per Million Vehicle-Miles	
Painted Parking:		
Parallel	0.550	0.848
Low-Angle	--[b]	2.60[c]
High-Angle	0.533	2.91[c]
Unpainted Parking:		
Parallel	0.284	0.264
Angle	0.524	1.11[d]
	Accidents Per 10 Billion Vehicle-Mile-Hours/Stall	
Painted Parking:		
Parallel	2.17	3.05
Low-Angle	--[b]	7.38[c]
High-Angle	3.19	10.5[c]
Unpainted Parking:		
Parallel	1.65	2.13
Angle	4.40[d]	8.04[d]

[a]One-way, two-way divided, and two-way multilane undivided streets.

[b]Data not available, because there was no low-angle parking on major streets.

[c]Significantly higher than the rate for painted parallel parking at the 5% level of significance.

[d]Significantly higher than the rate for unpainted parallel parking at the 5% level of significance.

significantly higher than those for the parallel parking. The parking accident rates for the low-angle and high-angle parking were higher than those for the parallel parking, but only the rates for the high-angle parking were significantly higher. There were no statistically significant differences between the accident rates for the low-angle and high-angle parking.

Unpainted Parking A total of 70 similar block faces with unpainted parking on two-way, two-lane streets were identified: 46 had parallel parking, and 24 had angle parking. The similarity of the block faces was defined in terms of the range of traffic, roadway, and land use characteristics found on the block faces with unpainted angle parking. All of the block faces were on level, tangent sections of roadway with posted speed limits of 25 mph. The ADT was between 4,150 and 14,750. The block faces were between 300 and 500 ft long, and the land use densities were below 35 land uses per 1,000 ft. The maximum parking use on the block faces was 155 veh-hr per 8-hr parking day. The block faces had a maximum

TABLE 11 PERCENTAGES OF PARKING ACCIDENTS

Type of Parking	Major Streets[a]	Two-Way Two-Lane Streets
Painted Parking:		
Parallel	33%	46%
Low-Angle	--[b]	77%[c]
High-Angle	44%	81%[c]
Unpainted Parking:		
Parallel	21%	39%
Angle	33%	67%[d]

[a]One-way, two-way divided, and two-way multilane undivided streets.

[b]Data not available, because there was no low-angle parking on major streets.

[c]Significantly higher than the percentage for painted parallel parking at the 5% level of significance.

[d]Significantly higher than the percentage for unpainted paralled parking at the 5% level of significance.

of 25 percent service land uses and up to 100 percent of retail, office, medical, institutional, industrial, recreational, residential, and other land uses.

The accident exposure and the accident rates for the similar block faces are presented in Table 13. The nonintersection and parking accident rates for the angle parking were higher than those for the parallel parking. There were no statistically significant differences between the nonintersection accident rates for the angle parking and the nonintersection accident rates for the parallel parking. However, the parking accident rates for the angle parking were significantly higher than the parking accident rates for the parallel parking.

CONCLUSIONS

Parking on urban streets obviously results in accidents. None of the types of parking studied had a zero parking accident rate. Overall, 26 percent of the nonintersection accidents on major streets and 56 percent on two-way, two-lane streets were parking accidents. Therefore, whenever practical, parking should not be allowed.

However, parallel parking is the safest type of parking on urban sections of the state highway system in Nebraska. Parallel parking was consistently found to have lower accident rates and lower percentages of parking accidents than low-angle or high-angle parking over the range of traffic, roadway, and land use conditions on these roadways. In many cases, the accident rates and parking accident percentages for low-angle and high-angle parking were significantly higher than those for parallel parking. Therefore, when parking must be allowed on urban sections of the state highway system, parallel parking should be used instead of angle parking whenever feasible.

Another conclusion of the study was that type of parking affects accident rates. Contrary to the findings of others (*3*), the type of parking was a factor, even when parking use, abutting land use, and type of street were taken into account. In fact, the differences between the accident rates for parallel parking and those for angle parking were more likely to be significant when these factors were considered, particularly on two-way, two-lane streets.

Finally, low-angle parking may be safer than high-angle parking on two-way, two-lane streets. In most cases considered, the accident rates for low-angle parking were lower than those for high-angle parking. However, in no case was there a statistically significant difference in the accident rates. Also, on two-way, two-lane streets, the percentage of parking accidents for low-angle parking was not significantly different from that for high-angle parking. Although low-angle parking may be safer than high-angle parking, it is not as safe as parallel parking.

The conclusions of this study were based on only 2 years of accident experience on urban sections of the state highway system in Nebraska. Although a number of statistically significant differences in safety effects were found among the different types of parking, the conclusions of this study must be substantiated by further study before they can be recom-

TABLE 12 COMPARISON OF TYPES OF PAINTED PARKING ON SIMILAR BLOCK FACES ON TWO-WAY, TWO-LANE STREETS

Variable	Type of Parking		
	Parallel	Low-Angle	High-Angle
Accident Exposure (two-year period)			
Number of Block Faces	6	21	30
Number of Stalls	82	313	562
Travel (million vehicle-miles)	0.708	3.09	4.24
Parking Utilization (1,000 veh-hr/stall)	2.82	3.45	3.12
Non-Intersection Accidents			
Number	1	12	19
Accidents Per Million Vehicle Miles	1.41	3.88[a]	4.48[a]
Accidents Per 10 Billion Veh-M-H/Stall	5.00	8.96[a]	14.4[a]
Parking Accidents			
Number	1	9	16
Accidents Per Million Vehicle-Miles	1.41	2.91	3.77[a]
Accidents Per 10 Billion Veh-M-H/Stall	5.00	8.44	12.1[a]

[a]Significantly higher than the rate for painted parallel parking at the 5% level of significance.

mended as general parking policy. Additional research should avoid the limitations of this study by considering accident severity, parking-related accidents, and nighttime parking use.

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TABLE 13 COMPARISON OF TYPES OF UNPAINTED PARKING ON SIMILAR BLOCK FACES ON TWO-WAY, TWO-LANE STREETS

Variable	Type of Parking: Parallel	Type of Parking: Angle
Accident Exposure (two-year period)		
Number of Block Faces	46	24
Number of Stalls	621	452
Travel (million vehicle-miles)	12.1	3.45
Parking Utilization (1,000 veh-hr/stall)	3.23	3.23
Non-Intersection Accidents		
Number	11	6
Accidents Per Million Vehicle Miles	0.909	1.74
Accidents Per 10 Billion Veh-M-H/Stall	2.81	5.39
Parking Accidents		
Number	3	5
Accidents Per Million Vehicle-Miles	0.248	1.45[a]
Accidents Per 10 Billion Veh-M-H/Stall	0.768	4.49[a]

[a]Significantly higher than the rate for painted parallel parking at the 5% level of significance.

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