The Nature and Causes of the 1982 Traffic Accident Casualty Reductions in British Columbia

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ABSTRACT

The extent of the 1982 traffic accident casualty reduction in British Columbia has been evaluated and found to be beyond what could be expected from chance fluctuation alone. The greatest changes were found in casualty-producing accidents involving young drivers, especially during the nighttime. These accidents were seemingly independent of alcohol use. Given this initial determination, the possible external causes for the decrease have been examined with the result that economic factors alone can be shown to account for a large part of the effect, although for a significant portion of the change, there is as yet no ready explanation. The most important conclusion arising from the analysis is that should economic conditions improve, a concomitant rise in traffic casualties can be expected unless mitigated by significant safety program interventions.

A comparison of 1982 statistics on traffic accidents in British Columbia with those for 1981 indicates a dramatic and welcome change. Total accidents decreased approximately 12 percent while injuries and fatalities decreased 23 and 30 percent, respectively. A similar effect was observed throughout Canada but British Columbia showed the greatest reduction, partially as a consequence of its high 1981 ranking. The question, of course, is why? What happened during 1982 to cause the accident and casualty reductions--was it a change in travel patterns or a change in safety attitudes? In this paper, an attempt is made to cast some light on the controversy.

THE NATURE OF THE EFFECT

The overall accident statistics (1,2) for 1981 and 1982 are as follows:

	1981	1982	Change (%)
Fatal accidents	761	524	-31
Injury accidents	30,626	23,662	-23
Property-damage-only (PDO) accidents	96,444	87,682	-9
Deaths	859	601	-30
Injuries	44,123	33,807	-23

Because the greatest changes are apparent in injury and fatal accidents or casualties, they form the primary focus for this paper. Casualties have been chosen as the best historical index because they represent a somewhat greater sample size than casualty-producing accidents and form one of the statistics normally employed in epidemiological studies.

Figure 1 shows the 1982 casualty reductions set against the monthly totals for previous years. A fairly consistent seasonal fluctuation is evident

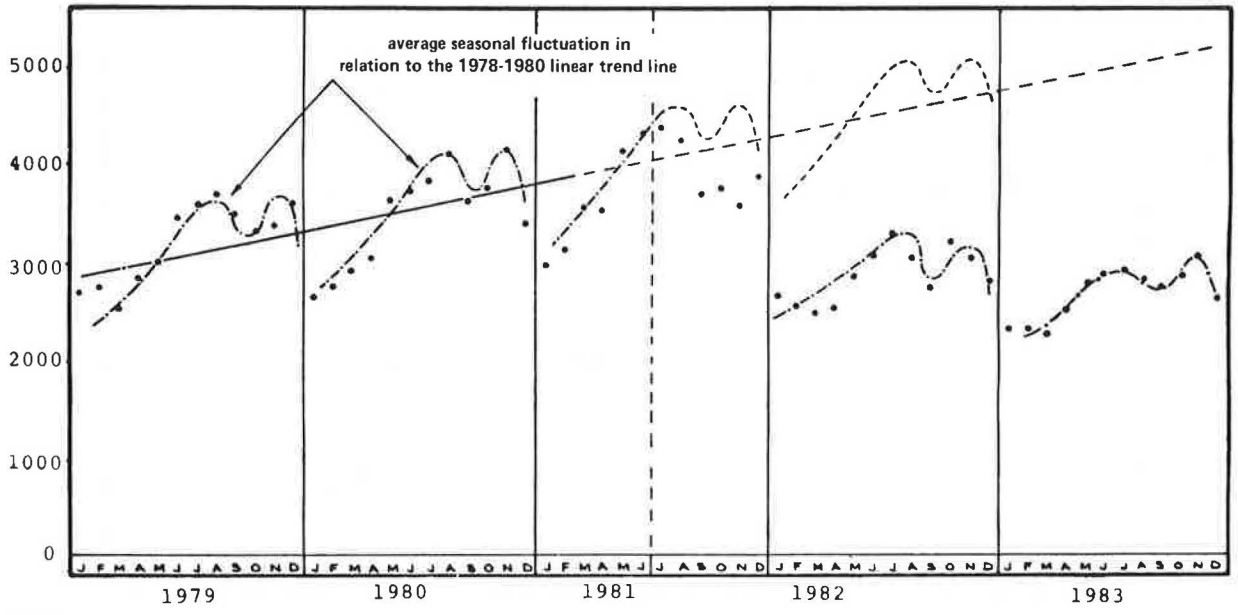

FIGURE 1 Historical traffic accident casualty trends in British Columbia.

from the 1979-1980 data and this has been superimposed on the upward trend line established by using the 1979 and 1980 information.

The first issue to address is whether or not the 1982 reduction is significant and when the reduction actually commenced. This can be accomplished fairly simply. An examination of Figure 1 would lead one to suspect that the decline in casualties actually commenced about halfway through 1981. Using the Box-Jenkins technique to project expected values for 1982 based on the time series for the previous 5 years, there was a marginally significant difference found between actual and projected values (X^2 probability of .08). The time series before 1982 is not entirely devoid of other events, however, such as periodic seat belt wearing campaigns and driving-while-intoxicated (DWI) blitzes, which may affect the significance assessment of the 1981-1982 reduction. In using analysis-of-variance techniques to test the 1979-1982 casualty data, which is grouped by half-year periods, it was learned that the reduction occurring between the first half of 1982 and

data by half year period

Dependent variable - casualties

Anova Summary Table

Source of Variation	DF	Sum of Squares	Mean Squares	F	Significance Level
Between groups	8	11466192.593	1433274.074	13.372	0.000
Within groups	45	4823283.333	107184.074		
Total	53	16289475.926			

Group Statistics

Group	Codes & Labels		N	Mean	SD
Group 1 -	01-06	1979	6	2913.333	292.757
Group 2 -	07-12		6	3520.000	136.088
Group 3 -	13-18	1980	6	3108.333	461.841
Group 4 -	19-24		6	3801.667	293.081
Group 5 -	25-30	1981	6	3598.333	530.638
Group 6 -	31-36		6	3915.000	314.372
Group 7 -	37-42	1982	6	2703.333	225.891
Group 8 -	43-48		6	3033.333	213.698
Group 9 -	49-54	1983	6	2548.333	290.063

T-Test Between Group Means - (Values of p are for a two-tailed test)
Note: Statistics are only printed if p is less than or equal to .050

t = 2.592 p = .028	Group 3 Group 5
t = 4.735 p = .001	Group 5 Group 7
t = 4.664 p = .001	Group 6 Group 8

Only comparisons involving equivalent time periods in successive years are shown above

FIGURE 2 Comparison of half-year period casualty totals, 1979-1983.

the first half of 1981, and between the second half of 1982 and the second half of 1981, were statistically significant at the .001 level (see Figure 2). The 1982 casualty decrease is thus a real effect that cannot be attributed to chance alone and, from a visual examination of the monthly figures in comparison with the seasonal fluctuations and the trend line established from the 1979-1980 data, it can be postulated that this decrease actually commenced at approximately the midpoint of 1981.

ASSESSMENT OF POSSIBLE CAUSES

There have been a number of suggested contributory causes for the effects that have just been observed. Some of these, together with an assessment of their applicability, are as follows:

1. A Change in Vehicle Occupancy--For 1981 and 1982, we can calculate both fatality-to-fatal accident and injury-to-injury accident ratios. These are 1.13 and 1.44, respectively, for 1981, and 1.15 and 1.43, respectively, for 1982. Because no major vehicle safety design advances occurred during this period, it must be concluded that vehicle occupancies as reflected in the casualty statistics were the same in 1982 as in 1981.

2. An Overall Travel Reduction--It is common practice to assess overall travel changes through fuel sales. Indeed, such an exercise indicates that a 10 percent travel reduction did occur in 1982 (as opposed to 1981 levels) and this closely matches the total accident rate reduction of approximately 12 percent but it does not, by itself, account for the much larger reductions in injuries and fatalities.

3. A Decrease in the Number of Vehicles--During 1982, the number of new passenger car sales certainly suffered a significant downturn but the number of registered vehicles in British Columbia still increased marginally. If anything, the result should have been toward less safety because there evidently were more older cars on the road.

4. A Decrease in the Number of Drivers--Actually, the total number of licensed motor vehicle operators increased by just under 2 percent from 1981 to 1982. In spite of this, however, there was a marked reduction in new licenses issued to young drivers. This will be discussed in more detail later in the paper.

5. Improved Safety Attitudes of Drivers--If something along these lines had occurred, it should be reflected in other statistics such as seat belt wearing rates. In fact, the average surveyed level of seat belt wearing among the general driver population in 1982 was approximately 55 percent for all occupants, which is not considered to be much of an improvement over 1981 when the survey results were, unfortunately, not as reliable. In spite of this, there does seem to be some indication of increased use in the fact that rural fatalities for unrestrained occupants apparently decreased at a higher rate than that for all occupants. Also, accident reports for injury-producing crashes suggest a 5 percent restraint-use increase in 1982 over 1981 for occupants of vehicles involved. This indicates that the various seat belt education and enforcement efforts were at least partially effective.

Figure 3 shows a summary of fatality reductions from 1981 to 1982 for some important accident and victim categories. Because fatalities and fatal accidents showed the greatest overall change, any casual effects should become evident within this subset. Accident categories have been selected so as to highlight the three most important areas of safety at present--age, alcohol use, and seat belt wearing.

In terms of traffic law violations, there is no indication that 1982 was any better than 1981. In fact, for young drivers, who accumulate a substantial

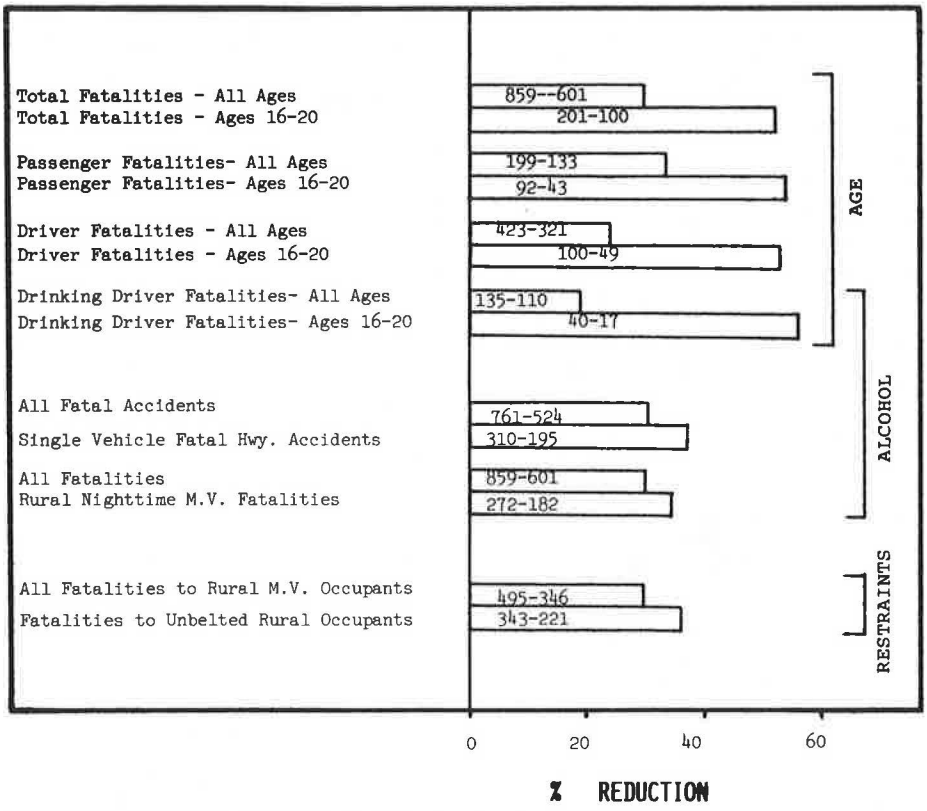

FIGURE 3 Changes in selected fatal accident categories, 1981-1982.

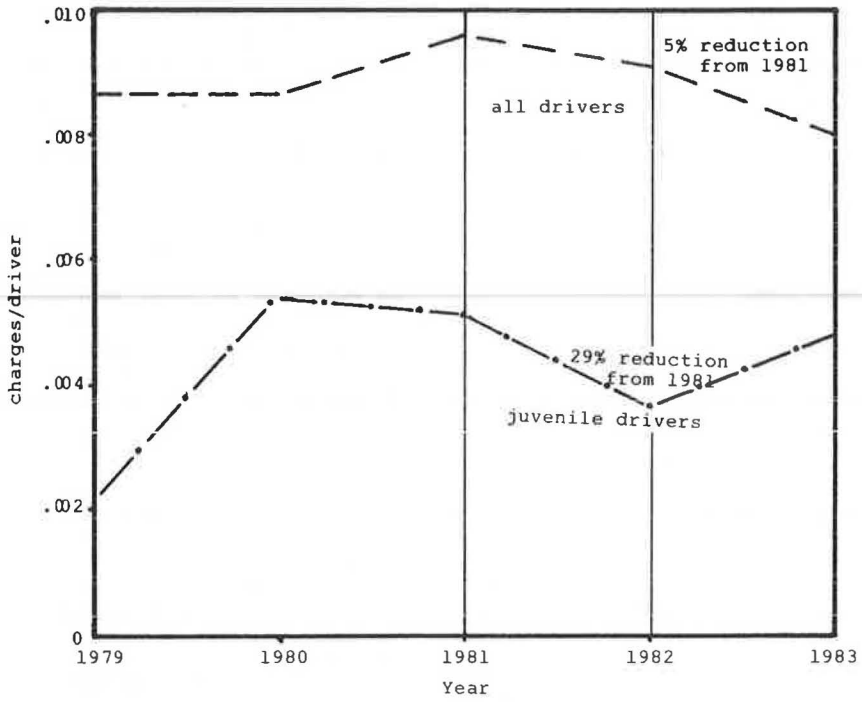

FIGURE 4 DWI charges laid per licensed driver.

number of these convictions, the number of violations per licensed driver rose by 13 percent in 1982. For the major Criminal Code conviction (DWI offenses), Figure 4 shows that there indeed were reductions from 1981 to 1982 but it is doubtful if these could be regarded as significant in light of previous fluctuations.

Alcohol and age are, to a great extent, intertwined, but the fact that two commonly utilized surrogates for alcohol-involved accidents--rural single vehicle and nighttime fatal accidents or fatalities--decreased by more than their respective parent populations, suggests that less drinking-and-driving occurred during 1982. Because alcohol sales (including beer) showed a slight overall increase between 1981 and 1982, the reduction was apparently in driving not drinking. This is supported by the similar levels of decrease for alcohol-involved driver fatalities as for all driver fatalities and by the fact that the proportions of casualty-producing accidents involving alcohol were almost identical for 1982 and 1981 in each age group. The greatest level of over-involvement in alcohol-related fatal accidents has traditionally been with the 16-20 age group and Figure 2 confirms that the most dramatic effects are evident here, specifically among drivers. Figure 5 shows that the reduction in casualty-producing accidents was most pronounced for young drivers at nighttime and that this reduction has continued through 1983. The question still remains, however, as to what could have triggered such apparent changes.

6. The Economy--There is little argument that North America in general and Canada in particular have been in the grips of a severe recession. It has previously been observed that the 1982 casualty reductions were significant and apparently had commenced following the first half of 1981. Various economic indicators that have been published may now be examined to determine whether or not there is any correspondence in timing.

Figure 6 illustrates the major economic changes. It is evident that the beginning of the downturn came close to the middle of 1981 and thus one might be tempted to conclude that the major cause of the reduction was the economy. This can only be confirmed, however, if a fairly reliable economic predictor or predictors can be identified that will reproduce the fluctuations over a number of previous years and then "predict" the 1982 reduction. The most likely candidate for a general trend predictor is the unemployment rate, which Eshler (3) reported following an examination of annual U.S. fatal accident statistics between 1949 and 1973, and which was confirmed by Partyka's work (4) using annual U.S. fatality statistics from 1960 through 1982. It might thus be anticipated that unemployment (or employment) would be a useful indicator, especially if combined with a factor representing travel exposure to help account for the month-to-month variations that Eshler and Partyka did not have to contend with. By grouping the monthly casualty data by gasoline sales and employment, it could be shown (through analysis-of-variance techniques) that both variables significantly differentiated the dependent variable groups ($p < .05$). Gasoline sales are certainly an important aspect of consumer spending but they also relate directly to travel, and therefore accident, exposure and have traditionally shown a seasonal fluctuation. Figure 7 shows how major fluctuations in employment rate alone correspond with major changes in monthly casualties. Least-squares trend lines have been fitted for the periods January 1979 to June 1981 and July 1981 to December 1982.

The question posed by the apparent correspondence between traffic accident casualties and unemployment is, of course, what will happen to traffic safety in the event of an economic recovery? Eshler (3) found that fatal accidents invariably increased following periods of recession and, while the expected recovery has been somewhat delayed, it can be expected that

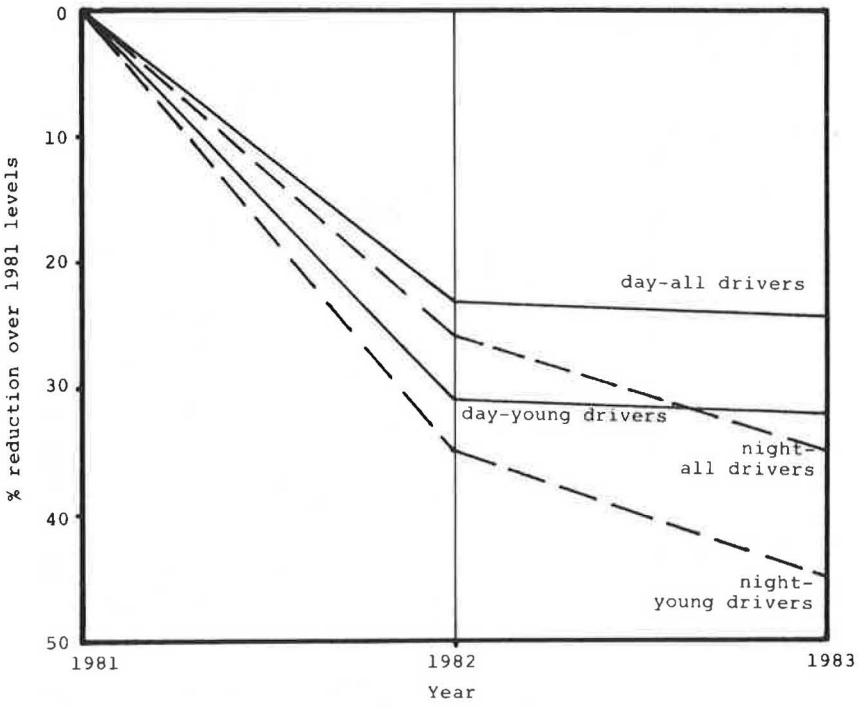

FIGURE 5 Reduction in casualty accident involvement.

the various economic indicators will eventually rise again.

A number of different models were tested using variations of casualty rate and employment statistics combined with gasoline sales and other factors (i.e., reported seat belt use in casualty-producing accidents that were perceived to have changed between 1981 and 1982). In terms of predicting actual casualty numbers, only employment and gasoline sales were found to be useful although seat belt-wearing rates were significantly related to casualties per billion vehicle kilometer (BVK) of estimated travel at a low level ($r^2 = 0.134$). Employment for young males was examined separately from total employment as it was believed that this group would have been hardest hit by the recession. In relation to all casualties, there was no difference between the correlation using total employment and that using young male employment, suggesting that there is a consistent relationship between these two independent variables. In relation to casualties resulting from young driver accidents, however, the use of young male employment in combination with gasoline sales accounted for 80 percent of the variance as opposed to 72 percent of all casualty variance explained when all employment and gasoline sales were used. The best model for total monthly casualties and the actual casualty fluctuations are shown in Figure 8 and there is obviously a reasonable correspondence not only before 1982 but also during that year and 1983 as well. In other words, simply by realizing the trend in employment and fuel sales, one could have predicted the approximate nature and magnitude of the 1982 casualty decrease. The fact that this simple model only accounts for 72 percent of the casualty population variance is not surprising since many other factors are at work. Weather effects for instance, accounted for the peaks in the last quarter of each year and gasoline sales, when considered alone (as a surrogate for travel), produced a corrected r^2 of 0.59.

Fatalities and property-damage-only (PDO) accidents were also found to correlate significantly with economic factors although at a reduced level of association. This was undoubtedly because (a) fatalities in British Columbia are relatively small in number and thus subject to considerable random fluctuation and (b) PDO accidents are not as reliably reported as those where injuries are involved. (PDO accidents are also highly weather related).

It can thus be confirmed that the major part of the 1982 reduction in the number traffic accident casualties was an expected result of the economic downturn, because a simple economic model could have predicted it without having to consider any non-economic factors. Also, this same model does reasonably well in accounting for the month-to-month and yearly variations before 1982. It should be noted, however, that just because 72 percent of the historical casualty variance can be explained by such means, it cannot be said that the potential exists to reduce casualties by no more than 28 percent no matter what safety efforts are undertaken. The economic factors are superimposed on a general climate of safety consciousness or behavior (and vice versa), which, between 1978 and 1981 in British Columbia, has been considered relatively consistent. It is still theoretically possible to lower this baseline accident level through energetic and judicious application of safety-related regulations and programs.

A POSSIBLE MECHANISM FOR CASUALTY REDUCTION IN BRITISH COLUMBIA

As seen earlier, the most noticeable reduction in fatalities during 1981-1982 was for young drivers especially where nighttime driving was involved. This suggests a possible, economically motivated reduction in high-risk driving exposure by young adults. During this period, the number of alcohol-related fatalities and DWI charges for young drivers also fell dramatically although the proportion of alcohol-related casualty accident involvement by age group remained quite stable.

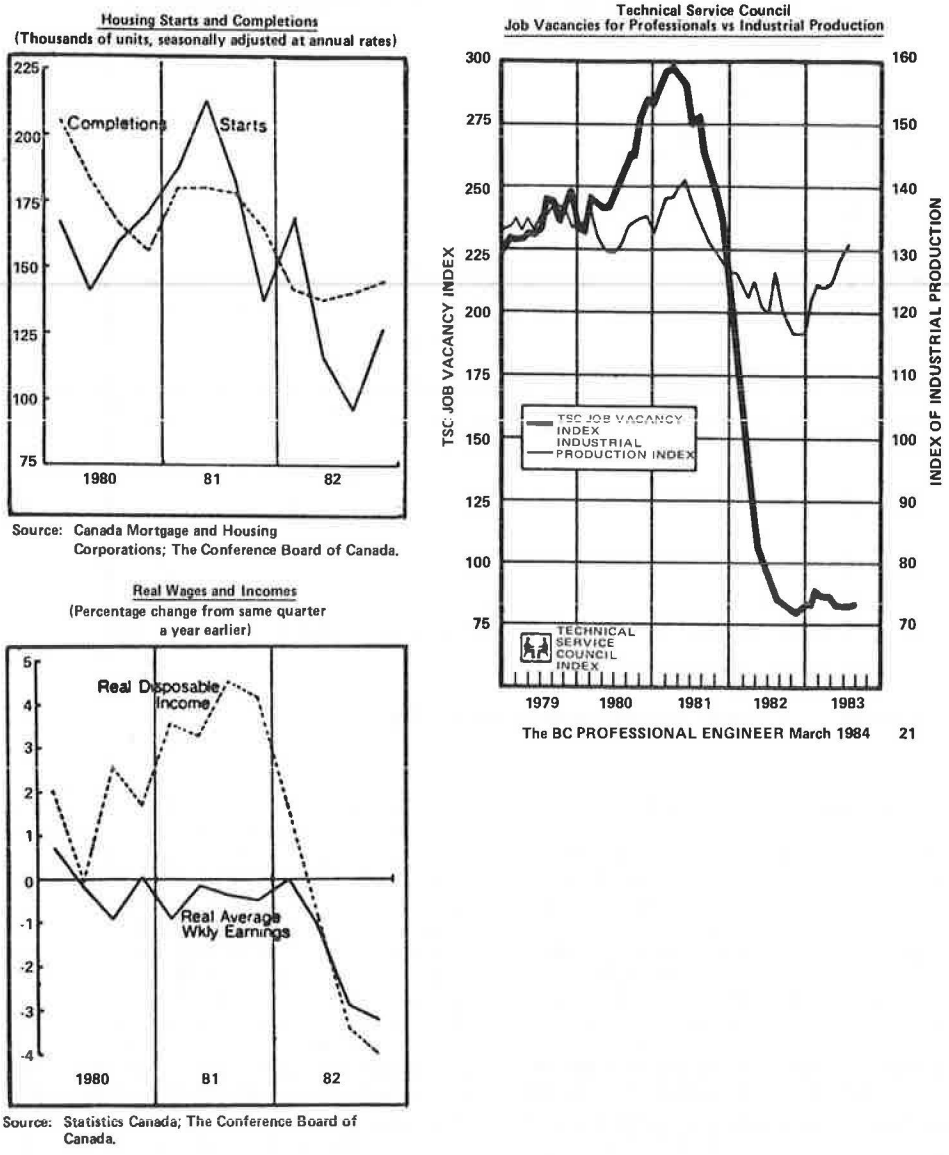

FIGURE 6 Performance of economic indicators, 1980-1982.

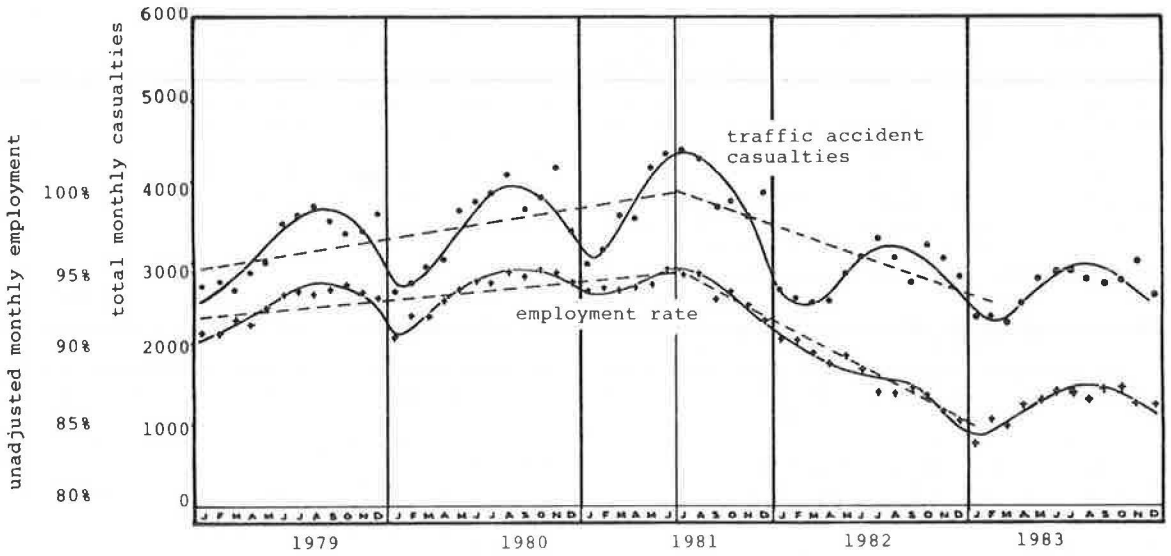

FIGURE 7 The coincidence of employment and traffic casualty trends in British Columbia.

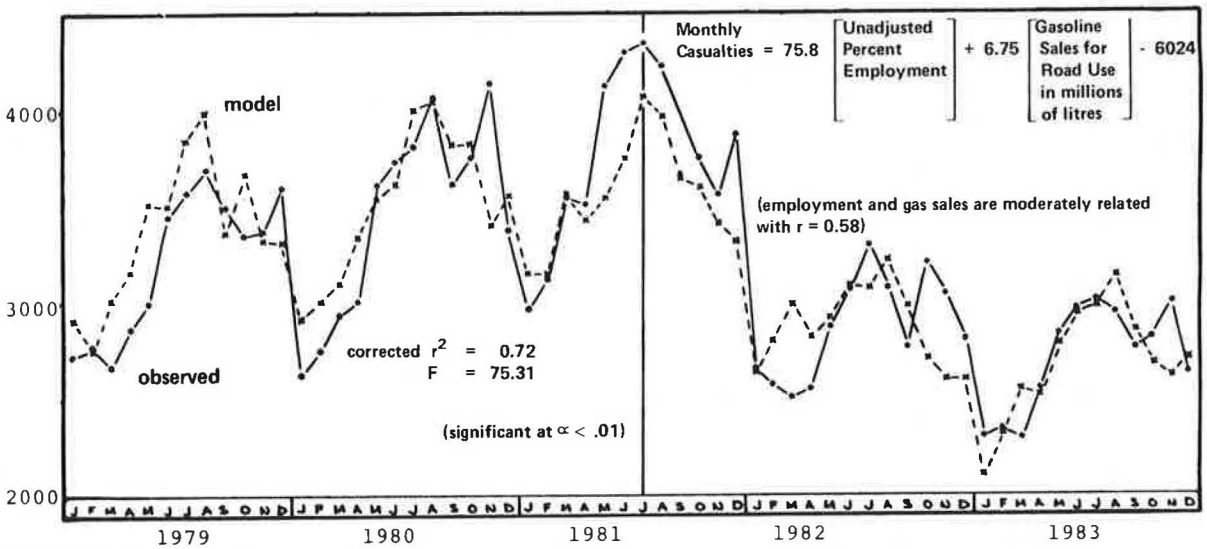

FIGURE 8 Prediction of total monthly traffic casualties in employment and gasoline sales.

Year	Age	Licensed Drivers		16-20 year old New Licenses*		16 year-old Traffic Offenses	
		Male	All	Male	All	Speeding (per lic.)	All (per lic.)
1982	16	9782	15673			2174 (0.139)	3615 (0.231)
	17-19	61396	107112	18650	34458		
	20-24	142308	259551	(-38.5%)	(-36.9%)		
	all	1182641	2079969				
1981	16	12414	19728			2429 (0.123)	4028 (0.204)
	17-19	65691	114354	30340	54634		
	20-24	142219	259228	(+14.0%)	(+14.2%)		
	all	1170963	2044721				
1980	16	10168	15941			2233 (0.140)	3527 (0.221)
	17-19	63372	109511	26607	47827		
	20-24	134739	244985	(+14.0%)	(+12.0%)		
	all	1125485	1950332				
1979	16	9311	14605			2437 (0.167)	3638 (0.249)
	17-19	61875	107117	23335	42720		
	20-24	129258	234317				
	all	1068102	1843203				
1978	16	9349	14548			different reporting procedure	different reporting procedure
	17-19	62099	106631	-	-		
	20-24	127697	229869				
	all	1033538	1769816				

* contains some estimation for ages between 17 and 20 prior to 1981 since the complete age break-down available within this group was only available following the 1980 calendar year.

1982 - expected no. of new licenses = 34588, 61791 (male & total respectively)
1982 - actual no. of new licenses = 18650, 34458
- the difference is significant (X^2) at $p < .001$

licensed drivers 1981-82 increased 1.7% (+ 0.9% for males)
but new licenses issued 1981-82
to 16-20 year-old drivers decreased 36.9% (-38.5% for males)

FIGURE 9 Changes in new licenses and traffic violations.

There are two possible explanations for reduced travel or exposure: less driving by licensed drivers or fewer licensed drivers. The latter possibility can be readily tested by examining the driver license records from 1978 to 1982 and estimating from these the historical trend in new licenses issued annually to young (16-20 year-old) drivers. Although from 1978 to 1981 the number of new licenses rose by approximately 14 percent per year as shown in Figure 9, it dropped by 37 percent in 1982. The combination of both factors can be investigated by testing the hypothesis that reduced travel was the sole cause of all the casualty accident reductions, using an inferential type of approach to the data analysis. Begin by assuming that between 1981 and 1982, there was no driver attitude toward behavioral changes, that is, the relative risk of accident involvement given a certain level of exposure for each age group did not change from 1981 to 1982. This is akin to saying that 100 percent of the accident reduction resulted from changes in driving exposure. Based on fuel sales in British Columbia (5) and fuel surveys from Statistics Canada (6), it can be estimated that travel was approximately 26.8 and 24.0 BVK in 1981 and 1982, respectively, which represents a 10 percent reduction. For 1983, the estimate was 22.8 BVK,

which represents a 5 percent reduction from 1982. Using the estimated 24-hr driving exposure in kilometers of travel based on the 1979 National Driving Survey results for British Columbia (7), and casualty accident proportions by age (taken from unpublished data on the "Counterattack" program, which was supplied by the British Columbia Ministry of the Attorney General), statistics for 1981 are given in Table 1.

TABLE 1 Casualty Accident Proportions by Age for 1981

Age Group	Likely Driving Exposure (BVK)	Drivers Involved in Casualty-Producing Accidents		Total Casualty Accident Involvement per BVK
		Total	Percentage	
16-20	10.0% x 26.8 = 2.68	11,987	25.3	4,473
21-25	10.6% x 26.8 = 2.84	9,308	19.6	3,278
26-45	42.7% x 26.8 = 11.44	17,357	36.6	1,517
46-65	30.3% x 26.8 = 8.12	6,720	14.2	828
66+	6.4% x 26.8 = 1.72	2,016	4.3	1,172
Total		47,388	100.0	11,268

TABLE 2 Casualty Accident Proportions by Age for 1982

Age Group	Drivers Involved in Casualty-Producing Accidents		Casualty Accident Involvements per BVK (from 1981)	Estimated Driving Exposure (BVK)
	Total	Percentage		
16-20	8,155	22.1	4,473	1.82
21-25	7,252	19.6	3,278	2.21
26-45	14,253	38.6	1,517	9.40
46-65	5,526	15.0	828	6.67
66+	1,746	4.7	1,172	1.49
Total	36,932	100.0	11,268	21.59

Using the 1981 ratio of casualty accident proportion to exposure, it is possible to (a) combine this with the 1982 casualty accident proportion and then to (b) work backwards to obtain what would have been the exposure percentages had no change in the ratio of casualty accident involvements per BVK of travel occurred. These statistics are given in Table 2. It is known, however, that total travel in 1982 was approximately 24 BVK--not the 21.6 BVK arrived at previously. The only solution to the discrepancy is to postulate a decrease in the driving risk, that is, a reduction in the casualty accident involvements per BVK. The mechanism for applying such a driving risk reduction across the various age groups is not known but it can be assumed that the range of eventualities will be covered by the following cases:

i. Distributing the decrease in risk in proportion to the size of the 1981 risk levels (accidents per BVK), which amounts to an equal distribution of percentage risk reduction across all age groups; or

ii. Distributing the decrease in risk in proportion to the level of casualty accident reduction between 1981 and 1982 in each age group. This amounts to a differential percent risk decrease by age group with the effect assumed greatest for those age groups having the highest levels of accident reduction.

For Case i it is found that approximately a 10 percent risk reduction applied equally to all age groups will result in bringing the total travel value up to the correct level, as given in Table 3.

TABLE 3 Total Travel Value

Age Group	1981 Casualty Accident Involvement per BVK	1982 Adjusted Casualty Accident Involvement per BVK	1982 Revised Estimated Driving Exposure (BVK)
16-20	4,473	4,024	2.03
21-25	3,278	2,949	2.45
26-45	1,517	1,365	10.44
46-65	828	745	7.42
66+	1,172	1,054	1.66
Total	11,268	10,137	24.00

TABLE 4 Risk Reduction Adjustments

Age Group	1981 Casualty Accident Involvement per BVK	1982 Adjusted Casualty Accident Involvement per BVK	1982 Revised Estimated Driving Exposure (BVK)
16-20	4,473	3,713	2.20
21-25	3,278	2,883	2.52
26-45	1,517	1,378	10.34
46-65	828	753	7.34
66+	1,172	1,090	1.60
Total	11,268	9,817	24.00

TABLE 5 Comparison of Travel Changes with Reduction in Accidents Based on Travel Decrease Alone

Age Group	1981 Casualty Accident Involvement per BVK	Apparent Change in Travel from 1981 to 1982 (BVK)		Reduction in Accidents Based on Travel Decrease Alone (BVK)	
		Case i	Case ii	Case i	Case ii
16-20	4,473	0.65	0.48	2,908	2,147
21-25	3,278	0.39	0.32	1,278	1,049
26-45	1,517	1.00	1.11	1,517	1,684
46-65	828	0.70	0.78	580	646
66+	1,172	0.06	0.12	70	141
Total	11,268	2.80	2.81	6,353	5,667

Similarly, when the level of risk reduction is adjusted to reflect the percentage of the 1981-1982 casualty accident decrease in each age category as compared to the overall percentage decrease, the result would be that the proposed risk reduction would range from a high of approximately 17 percent for 16 to 20 year-olds down to approximately 7 percent for those age 66 and older. The results of applying these decreases are given in Table 4.

To assess the degree to which reductions in driving exposure have influenced the change in accident occurrence, as opposed to any postulated changes in risk-taking behavior, the 1981 risk levels can be applied to the apparent travel changes (in BVK) and the results compared to the actual change that occurred, as given in Table 5.

Because the total recorded reduction of casualty accident involvement for drivers was 10,456 (47,388-36,932), it is apparent that an overall reduction in travel alone can account for, at most, 61 percent (Case i) and perhaps only 54 percent (Case ii). The regression model mentioned earlier showed that 59 percent of the monthly casualty variance could be explained by gasoline sales (travel) alone.

It should be noted here that even though a net travel reduction can account for, at most, 61 percent of the observed accident reduction, a substantial portion of the postulated decrease in risk of accident involvement could come about through a

switch from nighttime to daytime driving. Figure 5 lends support to the possibility that nighttime driving may have decreased considerably more than daytime driving and, because the former is associated more with nonessential social activities, it is logical to assume that the economic recession would initially affect it the most although as job-hunting activity decreases, it might be expected that the difference would become less significant.

The expected reduction, based solely on a consideration of net travel decrease, thus only accounts for at most, 61 percent of the actual change. (Within this 61 percent, it can be further estimated that approximately 7 percent is due to the fewer number of licensed young drivers as mentioned earlier.)

In other words, reduced travel cannot have been the only factor. Even seat belt usage would only add, at most, 2 percent to the reduction explained, and thus, a significant percentage is left that must somehow be related to other changes in driving behavior.

In summary, it may be unreasonable to suggest that, of the significant casualty accident decreases that occurred between 1981 and 1982, a maximum of approximately 63 percent could possibly be explained by an economically motivated reduction in travel (especially among young drivers during night hours) and the small increase in restraint use. The remaining 37 percent or so is as yet unexplained and could be associated with a change in driver risk-taking behavior. It should be noted, however, that even such postulated behavioral changes as these could be linked to the depressed economic situation and would thus be reversible in the event of an eventual improvement.

CONCLUSIONS

The major conclusions arising out of this investigation are as follows:

1. The 1982 reduction in traffic accident casualties in British Columbia was a real and significant event that cannot be attributed to chance alone.
2. The major part of this reduction can be attributed to the effects of the economic recession. Reduced travel was undoubtedly a significant factor, but there still remains a significant portion that cannot as yet be explained in such simple terms and that will require further research to uncover.
3. When the province recovers from the recession, there is every indication that traffic accident casualties will rise again; although the exact speed and extent of the rise are at present uncertain, the casualties should follow the general trend in employment levels.

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Publication of the paper sponsored by Committee on Traffic Records and Accidents Analysis.