DOCUMENT RESUME

ED 284 015 CE 047 774

AUTHOR Campbell, B. J.; Campbell, Frances A.
TITLE Seat Belt Law Experience in Four Foreign Countries Compared to the United States.
INSTITUTION North Carolina Univ., Chapel Hill. Highway Safety Research Center.
SPONS AGENCY AAA Foundation for Traffic Safety, Falls Church, Va.
PUB DATE Dec 86
NOTE 73p.; Support also provided by Takata Corporation, Tokyo, Japan.
AVAILABLE FROM AAA Foundation for Traffic Safety, 2990 Telestar Court, Suite 100, Falls Church, VA 22042.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Comparative Analysis; *Compliance (Legal); Developed Nations; Foreign Countries; Injuries; *Laws; Motor Vehicles; *Restraints (Vehicle Safety); *Traffic Accidents; *Traffic Safety; Vocational Education
IDENTIFIERS Australia; Sweden; United Kingdom; West Germany

ABSTRACT

This report examines the process of enacting laws requiring the use of seat belts in the United States. It assesses these laws against the perspective of benefits realized from such mandates in other nations. Chapter one is an introduction; chapter two provides background on seat belt installation in U.S. vehicles, introduction of belt use laws, and what is required to produce a large change in U.S. fatalities. Chapter three examines two issues involved in assessing the effects of the countermeasure: the effectiveness of seat belts in reducing injury if worn and the effectiveness of seat belt laws in ameliorating casualties in the targeted population. Chapter four is a review of findings from Australia, Sweden, Germany, and the United Kingdom. The following information is presented for each country: belt wearing rates, enforcement, publicity, and casualty reduction. It is found that high rates of belt use have been achieved and apparently sustained over significant time periods. Chapter five discusses the U.S. seat belt laws--belt wearing rates, enforcement, publicity, and casualty reduction. Chapter six focuses on certain differences between the other nations and the United States that may be relevant to a discussion of why seat belt programs of foreign countries are more successful. (YLB)

SEAT BELT LAW EXPERIENCE IN FOUR FOREIGN COUNTRIES COMPARED TO THE UNITED STATES

by

B. J. Campbell
Frances A. Campbell
University of North Carolina

Published by
AAA Foundation for Traffic Safety
Falls Church, VA

UNC HSRC

SEAT BELT LAW EXPERIENCE
IN
FOUR FOREIGN COUNTRIES
COMPARED TO
THE UNITED STATES

by

B. J. Campbell
University of North Carolina
Highway Safety Research Center

and

Frances A. Campbell
Frank Porter Graham Child Development Center
University of North Carolina at Chapel Hill

Published by
AAA Foundation for Traffic Safety
2990 Telestar Ct, Suite 100
Falls Church, VA 22042

December, 1986

3

This project was made possible by a principal grant from the AAA Foundation for Traffic Safety, Falls Church, Virginia. The authors express sincere appreciation for this support.

Support was also provided in part by the Takata Corporation, Tokyo.

The content of this report is the responsibility of the authors and does not necessarily reflect the views of the organizations that provided grant support for the project.

The authors gratefully acknowledge the contributions of officials in the four countries studied, who generously contributed materials and time to this study. Their cooperation was central to the effort and is deeply appreciated.

TABLE OF CONTENTS

UNC HSRC

SEAT BELT LAW EXPERIENCE
IN
FOUR FOREIGN COUNTRIES
COMPARED TO
THE UNITED STATES

by
B. J. Campbell*
Frances A. Campbell**

CHAPTER ONE

INTRODUCTION

A. Seat Belt Laws Finally Come to the United States

The purpose of the present study is to examine the process of enacting laws requiring the use of automobile seat belts in the United States, and to assess these laws against the perspective of benefits realized from such mandates in other nations.

Two years ago, New York became the first of the United States to adopt an adult restraint law, followed in the ensuing months by 25 other states and the District of Columbia. The passage of these laws constitutes one of the more dramatic highway safety changes to occur in this country, especially when one considers the potential strength of this casualty countermeasure and the rapidity with which the change took place. In two states, however, the statutes were repealed by public referenda in November, 1986.

Mandated use of occupant restraints was late in coming to the United States when considered alongside the rest of the industrialized world. Before the end of 1970 the state of Victoria in Australia had enacted a seat belt law, and over the years such laws spread to more than 30 other countries.

B. United States Laws An Initial Success

Now that seat belt laws have been enacted in some American states, there is naturally great interest in evaluating their success, both from the standpoint of increased seat belt use and casualty reduction. Results from the first

*B.J. Campbell, Ph.D., Director of the University of North Carolina Highway Safety Research Center.
**Frances A. Campbell, Ph.D., Coordinator of Psychoeducational Services, Frank Porter Graham Child Development Center, University of North Carolina, Chapel Hill.

eight states show increased levels of belt use following passage of the law, as will be detailed herein. In addition, front seat occupant fatalities in the eight belt law states appear to have been reduced by about 10%. It is important to remember, however, that the laws have come into being so recently that it is premature to say with confidence what their ultimate effects will be.

Nevertheless, it is worthwhile to examine the early results because future events may lead to countervailing trends. For example, a widespread national easing of the 55 mph speed limit could raise fatalities, thereby cancelling some of the benefits of the belt laws. Likewise, dramatic changes in the economy could change exposure rates and casualties so much as to obscure the trends due to the seat belt law. Thus, the span of time in which to evaluate the success of seat belt laws in this country may be all too short and 1985–87 may be the optimum opportunity.

C. United States and Foreign Experience Compared

The belated start for seat belt laws in the United States stands in contrast to the seeming success of similar laws in several foreign countries. Thus it appeared worthwhile to learn in detail what happened in response to such laws in other nations in order to search for factors associated with their success.

Table 1 is a list of countries having seat belt laws as of the summer of 1984 (Grimm, 1984). Such laws have been enacted on all continents, and in countries representing the full political spectrum from left to right; however, widespread use of belts within a given country does not appear to be simply a matter of having a mandate. As may be seen in Table 1, use rates vary widely from country to country. At the high end, rates at or above 90% are reported in Australia, Belgium, Finland, and Great Britain. At the other extreme, use as low as 33% is reported in Austria and 21% in Japan.

D. The Comparison Nations

Australia, England, West Germany and Sweden were the countries selected for further study. All have reported belt use as high as 85–90%. Australia was the first nation to have seat belt laws and therefore has the most experience to share. The United Kingdom has only recently enacted such a law, but reported very high compliance almost immediately after the law took effect. Sweden similarly has had high compliance, but the effects of their law on casualty reduction have been questioned (Adams, 1985). West Germany's law initially did not appear to be widely obeyed by the driving public, but there was a dramatic upward shift in compliance after a fine was imposed for failure to wear belts. These four nations all therefore appeared to be likely sources of valuable information that might be applicable to the United States; thus, in this report, their seat belt law experience is reviewed and compared to that of the United States.

Table 1
Countries with Seat Belt Laws

Country	Date Instituted	Usage Rates
Australia	1/1/70	87%
Austria	7/15/76	33%
Belgium	6/1/75	87%
Brazil	1977	
Bulgaria	7/1/76	
Canada (7 prov)	1975–84	50–60%
Czechoslovakia	7/75	66%
Denmark	1/1/76	75%
Finland	7/1/75	93%
France	7/1/83	78%
Greece	12/16/79	
Hungary	7/1/77	
Iceland	1983	60%
Ireland	2/1/79	46%
Israel	7/1/75	70%
Ivory Coast	1970	
Japan	12/1/71	21%
Luxembourg	6/1/71	
Malawi	1982	
Malaysia	4/1/79	
Netherlands	6/1/75	67%
New Zealand	6/1/72	67%
Norway	9/1/75	90%
Puerto Rico	1/74	
Portugal	1982	
South Africa	12/1/77	62%
Spain	10/3/74	67%
Sweden	1/1/75	80%
Switzerland	1/1/76	81%
Turkey	1982	
USA (26 states)	1984–86	
United Kingdom	1/83	95%
USSR	1/1/76	
West Germany	1/1/76	54%
Yugoslavia	1/1/77	

From: Grimm, 1984

Tables 2-6 below summarize selected characteristics of all five nations (MVMA Facts and Figures, 1985; Britannica Book of the Year, 1986). The United States is by far the largest and wealthiest of the five and has the largest population. As Table 3 shows, the United States also has the most racially mixed population, with the largest visible minority group of all the nations.

Table 2
Selected Demographic Characteristics of Five Nations

Country	Area sq. miles	Population millions	Density per sq. mile	GNP per capita
USA	3,697,192	238.7	65	$16,270
Australia	2,966,200	15.5	5	10,940
W. Germany	96,026	61.0	638	10,672
Sweden	173,732	8.3	52	10,745
UK	94,248	56.4	600	8,970

Table 3
Ethnic Composition by Country

Country	Ethnic Group	Percent
United States	White	85
	Black	12
	Other	3
Australia	White	94
	Aboriginal	1
	Other	5
Sweden	White	97
	Other	3
West Germany	White	98
	Other	2
United Kingdom	White	95
	Black	1
	Indian	1
	Other	3

Tables 4 and 5 show that a smaller proportion of the United States population is literate; fewer of our citizens have access to newspapers, but a larger proportion own TV sets and radios—one fears these factors are not unrelated. These facts may be significant when one considers the success of official attempts to educate the public about the benefits of seat belts and their proper use.

Table 4
Media Saturation by Country

Country	TV Sets per Capita	Radios per Capita
USA	1 per 1.6 persons	1 per 0.5 persons
Australia	1 per 2.4 persons	1 per 0.8 persons
Sweden	1 per 2.6 persons	1 per 2.5 persons
United Kingdom	1 per 3 persons	1 per 3 persons
West Germany	1 per 2.8 persons	1 per 2.5 persons

Table 5
Newspaper Saturation and Literacy by Country

Country	Number of Newspapers	Circulation per 1,000	Literacy Rate	(year)
USA	1668	267.1	95%	(1980)
Australia	30	337.0	100%	(1983)
Sweden	169	574.0	100%	(1984)
West Germany	380	331.0	100%	(1983)
United Kingdom	120	447.0	100%	(1984)

Table 6 below summarizes motor vehicle characteristics of the five nations. Again, the United States leads with the largest number of passenger cars and the most vehicles per capita. We also have the greatest length of roadways, although not the highest percentage of paved roads. The per 100 million kilometer death rate is lowest in the United States.

Table 6
Motor Vehicle Characteristics by Nation

Country	Passenger Cars	Cars per Capita*	Length of Roads in kms.	Percent Paved	Death Rate per 100 million km. (1983)
USA	130,364,000	.70	6,263,043	88	1.6
Australia	7,322,500	.51	817,000	47	2.4
Sweden	3,081,000	.37	174,291	68	1.8
W. Germany	25,217,800	.45	487,251	99	3.4
UK	17,158,000	.36	368,670	97	2.1

**The number of cars per capita is from Table 2.1 in Adams (1985) in which he gives the proportion of cars/ population. In that Table his data sources are described.*

CHAPTER TWO

BACKGROUND

A. Seat Belt Installation in United States Vehicles

Lap seat belts have been used in certain contexts for a long time, most notably in aviation. Prior to the 1950's aircraft-type lap seat belts were only occasionally installed in cars. However, by the 1950's increasingly insistent voices urged more attention to the "packaging" of automobile occupants.

Hugh DeHaven of Cornell University Medical School, a pioneer in the area of crashworthiness, suggested that a person's riding in a car was analogous to shipping a valued vase through the mail and that people should be packaged as carefully as such a vase would be. He insisted that a tie-down such as a seat belt was an essential part of this packaging.

In the middle 1950's the Ford Motor Company marketed, without overwhelming success, an optional safety package including two front seat lap belts. From the middle 50's into the early 60's, safety proponents sought to have belt mounting hardware made standard equipment so that belts, if purchased, could be installed more easily and safely. Up to that point, in order to install them, floor holes had to be drilled on a do-it-yourself basis. The inclusion of mounting hardware in most cars became an accomplished fact by the early 1960's.

By 1964, an increasing number of states passed laws requiring manufacturers to install two front seat lap belts in new passenger cars. In 1966 United States auto makers announced a policy of equipping all new cars with four lap belts—two front and two rear.

With the advent of the United States Department of Transportation and its National Highway Safety Bureau (NHSB) came a strong federal role in vehicle safety regulation. The Bureau required lap/shoulder belts in the two front outboard positions beginning with 1968 models and began to work toward having belts provided wherever vehicle passengers were intended to sit.

Interestingly enough, although there was a concerted effort to achieve installation of belts, there was relatively little attempt to get people to wear them, and certainly there was no discussion of state laws requiring mandatory use. In fact, there was a presumption in some cases that no official intent existed to have the available belts in use. For example, the North Carolina State Supreme Court in the late 1960's reviewed a lawsuit in which an at-

tempt was made to establish that an occupant had contributed to his own injuries by not wearing the seat belt provided in his vehicle (*Miller v Miller*, 1968). The court held, however, that while the belts were present in the car because of legislative intent, there was no evidence the legislature intended the belts to be worn. Courts in other states took a different position, but this case illustrates the fact that belt installation, not use, was the issue.

B. Introduction of Belt Use Laws in the United States

Given what was happening in other industrialized nations, it is surprising that the issue of seat belt laws did not arise earlier in the United States, but one has only to review the public stance of various leadership groups to see how belatedly the issue was raised. In the absence of this support by leadership groups, there was no movement toward seat belt laws.

Illustrative of this point is the fact that, after its creation in the 1960's, NHSB promulgated 17 different state safety standards, and by so doing, delved into almost every area of highway safety previously thought to be the unique prerogative of the states. These included requirements in driver licensing, driver education, alcohol programs, and motorcycle helmet laws. However, conspicuously absent among all these safety standards was anything to do with belt use, whether through voluntary programs or seat belt laws. From the beginning the National Highway Traffic Safety Administration (NHTSA) as NHSB came to be called, tended to emphasize automatic restraint systems more than voluntary seat belt use. NHTSA had no program aimed at inducing passage of state seat belt use laws.

Moreover, within NHTSA the occupant restraint issue had no organizational identity until the Office of Occupant Protection was established in 1982. It was not until 1984 that, for the first time, DOT Secretary Elizabeth Dole made a speech in which she publicly endorsed seat belt laws.

Like NHTSA, other safety groups also tended to ignore the issue of seat belt laws until recent times. The American Public Health Association adopted a policy favoring passage of such laws in the Fall of 1983. Consumer's Union, in November, 1984, came out in favor of seat belt use laws. The American Automobile Association and the American Medical Association adopted stances specifically favoring belt legislation only in 1985.

Similarly, the auto industry was certainly not perceived as favoring passage of seat belt laws until recently. The General Motors Corporation came out in favor of such laws late in 1983. There had been a little-noticed position statement in 1972 to the effect that General Motors would support a Federal initiative for such laws, but no Federal initiative appeared until a decade later.

Some safety organizations did in fact espouse seat belt laws earlier than the very recent positions of the others: the American Association for Auto-

motive Medicine took a public position in favor of seat belt laws in 1976, the National Safety Council did so in 1978, and the Insurance Institute for Highway Safety did so in 1974, though their advocacy of passive restraints was much more in the public view. In any case, these three were exceptional. For most leadership organizations the enactment of seat belt laws was not given high priority until well into the 80's.

C. Child Restraint Laws as a Factor in Passing Adult Belt Laws

It seems clear that, in the United States, passage of child restraint laws paved the way for adult laws. As a result of a very surprising legislative initiative, the first child restraint law took effect in Tennessee in 1978. Once triggered by Tennessee this safety regulation swept the country in a relatively short time, and Wyoming became the 50th state to enact such a law in 1985. Nationwide, child restraint laws were passed without a great deal of political opposition, and public acceptance seems to be reasonably good.

It is an interesting contrast to consider the way child restraints have been handled in other countries. In the United States the occupant restraint law movement began with child restraints, whereas in foreign countries restraint laws have been addressed more nearly toward adults. In the United States it was possible to begin restraint laws with children because of two factors: first, rear seat lap belts have been standard in United States cars since 1966, and that is where children normally ride (in several foreign countries, rear seat belts did not become standard until later). Second, there was reasonable availability of child restraint devices in the United States.

In a good many foreign countries children are either exempted from the restraint law, such as in Belgium, Finland, France, and Sweden, or in some other cases, children are required to ride in the rear seat, such as in Austria, Czechoslovakia, Denmark, Great Britain, Luxembourg, the Netherlands, and West Germany (Grimm, 1984). Thus, in some cases children are instructed to ride in the rear seat where no seat belt is available.

D. The Air Bag Versus Seat Belt Dispute

A factor in the delay of achieving occupant restraint in the United States has been the division of opinion over the desirability of such automatic restraint systems as air bags, as opposed to voluntary or mandated use of optional systems. Proponents of automatic systems have argued that the national character in the United States makes it unlikely that seat belt use can be increased to the necessary levels through laws, and in addition, that the protection afforded by lap/shoulder belts is not as good as that of air bags with supplemental use of lap belts. Opponents have criticized air bags

as unproven, expensive, and not necessarily better than properly used lap/shoulder belts.

This argument divided the scientific community and public policy spokesmen for many years, and has virtually amounted to a stalemate blocking implementation of either approach. Only very recently has the character of the discussion begun to change. The issue now appears to be evolving from belts versus air bags to a consideration of belts *plus* air bags. As 1986 ends, the movement toward seat belt laws is well under way, and simultaneously, the movement toward full implementation of automatic restraints has begun. Three years from now *all* new cars will have automatic restraints.

It is noteworthy that this issue was essentially not in dispute in other parts of the world. Both in Europe and Australia some spokesmen attribute part of their early success in passing seat belt laws to the consensus among policy makers and researchers that such laws were the most favorable alternative of the options available.

E. Seat Belt Laws Passed in 1984–86

Against this background, beginning in late 1984, seat belt laws began to be enacted in the United States. As noted above, key national organizations had become strongly supportive of the effort. The auto industry and the federal government announced active campaigns to support seat belt use and seat belt laws. The auto industry created a new organization called Traffic Safety Now which has aided nationwide efforts toward passage of seat belt legislation and has provided public information support.

The intended effort of the US Department of Transportation to mount a massive belt promotional campaign is substantially stymied by Congressional reluctance to provide the requested appropriations. Nevertheless, as of the end of 1986, with most leadership elements now supportive of the movement, the country finds itself in the midst of new and sweeping changes in public policy regarding the venerable issue of safety belts.

F. What Is Required to Produce a Large Change In United States Fatalities?

Along with the anticipation of widespread belt use following the enactment of laws, there is also the expectation of substantial reductions in the number of fatalities. Those who have promoted seat belt laws have done so on the basis that they constitute one of the most powerful and cost-effective safety measures available. Nevertheless, this countermeasure is coming into being at a time when the United States mileage death rate is already at an all time low—the lowest in the world.

There is evidence that the laws will succeed in driving the rates even lower, but an issue is how large a change in fatalities the laws can and will produce, and whether this level of change will be apparent in view of other factors that also produce large changes in fatalities. In view of this, let us consider Table 7—showing those points in the history of traffic safety when major, rapid shifts in fatality trends did occur (Accident Facts, 1986).

Table 7
Temporal Trends in Motor Vehicle Deaths

Period	Years	Direction	Number Deaths
37–38	1	down	7000
40–41	1	up	5000
41–42	1	down	16000
44–46	2	up	9000
61–66	5	up	15000
73–75	2	down	9000
81–83	2	down	9000

From: Accident Facts, 1986.

Three times over the years fatalities have increased by 5,000 or more deaths in a relatively short time, and, conversely, four times deaths have fallen by 7,000 or more in a short time.

It is interesting to speculate on the reasons for these massive changes. By the 1930's automobile accidents were already a considerable problem in the United States, and by 1937 deaths reached 39,643. The death rate per hundred million driving miles was more than five times greater than today (14.68 vs 2.58). There was a large decrease (–7,000) in 1937–38, seemingly not related to changes in exposure, for the mileage exposure before and after the decrease appears to have stayed virtually the same. This change is puzzling since it happened more or less in the middle of the Great Depression.

On the other hand, it appears more likely that the up-swing in deaths just before WW II reflects the economic expansion on the eve of the war with a consequent increase in exposure. There was an increase of 10% in mileage during the same period, but fatalities went up even more (up 5,000).

The largest down-swing in our nation's history, a decrease by 16,000 lives over a single year period, happened early in WW II, when mileage exposure dropped by more than one third. Gas rationing, tire rationing, a 35 mph speed limit, and millions of young men in armed services and off the highways all coincided with this period; all these factors presumably contributed. Actually,

fatalities per unit exposure were about the same as earlier, thus this improvement appears to have been almost entirely exposure driven.

After the war, there was an increase of 9,000 traffic fatalities within two years at the time of de-mobilization. The reduced mileage exposure seen during the war was reversed. As with the previous large decline, the increase in fatalities was largely exposure driven, but fatalities actually increased somewhat less than exposure would have indicated, suggesting the simultaneous influence of other factors.

The next up-swing was very large, though spread over a longer period—an increase of nearly 15,000 in fatalities from 1961 to 1966. In 1961 , the actual number of deaths in the U.S. was 38,091, fewer than the 39,643 recorded 24 years earlier in 1937. Thus, despite the growth in population and cars from the 1930's to 1961, the death *rate* per hundred million miles had fallen so much that the raw number of fatalities remained relatively constant. Within the next five years, however, the rate soared such that in 1966 the raw number of deaths was 53,041.

This rise is described by two phenomena: first, a great increase in cars and mileage exposure, and second, by a plateau in the improvement in mileage death rate. For approximately nine years the mileage death rate did not fall. In 1961, the death rate per hundred million vehicle miles was 5.16. In 1969, it was 5.21. This long-term stagnation in the death rate was unique to that point in history—a time when car ownership was soaring, speed limits were high, and powerful cars were a central fact of car marketing and owner preference. It was probably no coincidence that during the same period, calls for an increased Federal role in highway safety were growing more urgent, finally culminating in the activation of NHSB in 1967.

The down-swing in 1973–75 reflected a combination of the oil embargo, the related severe recession, and the 55 mph speed limit enacted in response. In that time, deaths dropped by about 9,000 despite the fact that exposure did not decrease proportionately. Likewise, during the recession of 1981–83, a drop in fatalities of 9,000 occurred though exposure remained much the same.

The point of the foregoing is that the occasional very large changes in United States highway fatalities have been "powered" by major societal forces—wars, recessions, or periods of great economic growth. It has not yet been possible to produce fatality changes of comparable magnitude by imposition of any specific highway safety countermeasure. Viewed in this perspective, it seems unlikely that seat belt laws, as powerful a countermeasure as they constitute, can be expected to effect dramatic, large downward shifts in fatalities comparable to those associated with such major historical events. This does not mean the laws cannot be a success, but it does mean that careful evaluation procedures must be employed in order to detect benefits that do occur.

CHAPTER THREE

EVALUATION

Before comparing the early results of seat belt laws in the United States with the experience of other nations, it is important to examine some of the issues involved in assessing the effects of the countermeasure. Two research questions are critical: one is the effectiveness of seat belts in reducing injury if worn, and the other is the question of the effectiveness of seat belts *laws* in ameliorating casualties in the targeted population. The two questions require different methodologies. Both are discussed below.

A. Evaluating Belt Effectiveness

There are a number of ways to evaluate the theoretical and actual effectiveness of seat belts in reducing injury: laboratory impact studies; staged crash tests using anthropometric dummies; in-depth investigation of selected crashes; or large scale statistical studies based on police records. The latter method is described here in more detail.

In most states, police investigators use a standard report form which includes several factors of interest: occupant seated position; belt use by type of restraint; type, direction, and severity of impact; vehicle characteristics; occupant age and sex; and occupant injury.

Once this information is entered into a computer's data base, it is possible to sort the data into relevant groups to address questions of interest. Consider the example of a study of lap/shoulder belts. The computer file may be searched to find cases to be sorted into categories of those reported to have been restrained by lap/shoulder belts contrasted with those reported unrestrained.

The two groups may then be compared with respect to the frequency and severity of crash injuries sustained. Such a research design would tend to display the maximum protective effects of the restraint system because 100 percent of one group is using the lap/shoulder belts, and in the other group *no one* is. Thus, findings from such a comparison may be used to estimate the benefit accruing if everyone were to use lap/shoulder belts.

In the simplest form of comparison, percent of injury among those unrestrained would be compared to injury among those wearing lap/shoulder

belts. However, one normally cannot draw a conclusion on the basis of such a simple comparison because doing so would proceed on the questionable assumption of "all other things being equal." Such a comparison cannot stand if, for some reason, the lap/shoulder belt group and the non-belt group also differ with respect to other variables related to injuries. Indeed, research has shown this is likely to be the case.

Thus, in a voluntary belt use setting where 10% buckle up, it seems probable that those who use belts differ in some important respects from the majority who do not. They may be more "safety conscious" and thus already at somewhat lower crash risk. Campbell (1984) has shown that crash-involved drivers who wore seat belts (9% at that time) were involved in less severe crashes than those who were unrestrained. Thus, part of the apparent belt benefit may be unrelated to belts themselves, but rather reflective of the predisposition of belted drivers to milder crashes in which injury is less likely. To prevent drawing a false conclusion about the effectiveness of belts, therefore, it is necessary to control for such factors using standard scientific/statistical procedures.

An additional problem when attempting to calculate belt effectiveness using traffic records is the possibility of officer reporting bias (Partyka, 1982; Mela, 1974). There may be a systematic bias stemming from the fact that officers, believing belts to be effective, may assume a person was not belted simply because the individual was injured. If this misclassification occurs in only a modest proportion of cases, it may cause belt effectiveness estimates to be substantially exaggerated.

However, the mere fact that this type of bias *can* occur does not necessarily mean it does occur with sufficient frequency to distort greatly the true benefits of belts. The net result of such misclassifications depends on their frequency and also on the extent to which other, offsetting misclassifications occur. Chi (1980), Hall, et al. (1984), and Kahane (1986) have examined the effects of such biases and concluded that, although the bias does exist, its net effect is not always in the same direction, and the size of the net effect is a relatively few percentage points—not enough to create the false impression that safety belts were effective if they in fact were not. The general conclusion is that lap/shoulder belts truly can produce a substantial reduction in serious injuries and deaths.

Tables 8 and 9 and Figures 1 and 2 below show injuries among lap/shoulder belted and unrestrained drivers who were involved in reportable crashes in North Carolina during the six year period from 1979 to 1985. Figure 1 is based on frontal impacts and Figure 2 is based on non-frontal impacts. The data are drawn from official crash reports submitted by police officers all over the state. The results are depicted in terms of the percent of these drivers who sustained serious or fatal injury. Data are arrayed accord-

ing to seven levels of vehicle damage ranging from mild to very severe.*

Figure 1
Injury (Serious Injury or Fatality) by Vehicle Deformation
by Restraint Use for Drivers in Frontal Impacts

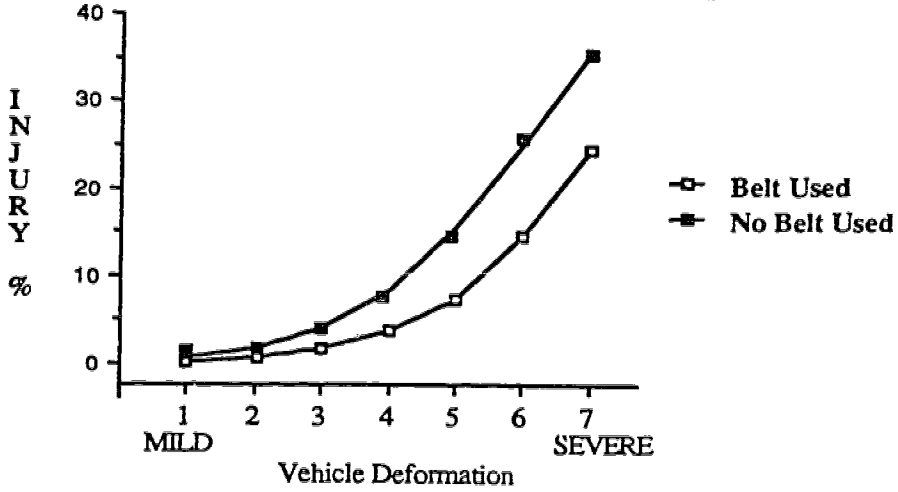
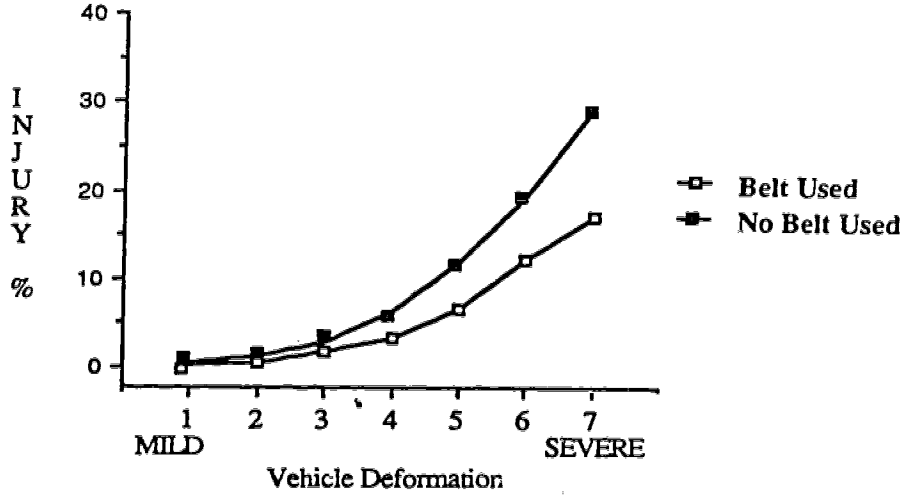


Figure 2
Injury (Serious Injury or Fatality) by Vehicle Deformation
by Restraint Use for Drivers in Non-Frontal Impacts



*Crash severity is shown for seven levels of vehicle crash deformation where level one is the mildest and level seven the most severe. This deformation is rated on the basis of the TAD scale (National Safety Council, 1984), a pictorial damage rating scale provided to investigating officers along with training to achieve inter-rater reliability (Rouse and Gendre, 1969). The scale is included as a control variable because it accounts for a useful amount of injury variance (Vilardo, 1972).

Table 8
Injury by Crash Severity for Belted and Unbelted Drivers in Frontal Crashes

		Total Occupants	Number of Serious/Fatal Injuries	Percent Serious Injuries & Fatalities
		Count	*Count*	*Percentage*
Tad Severity	Occupant Belt Usage			
Least Severe Damage	None	134635	886	0.7
	Lap & Shoulder Belt	21645	56	0.3
2	None	109729	1894	1.7
	Lap & Shoulder Belt	18557	120	0.6
3	None	79557	3241	4.1
	Lap & Shoulder Belt	12991	228	1.8
4	None	53936	4598	8.5
	Lap & Shoulder Belt	7809	308	3.9
5	None	26052	4071	15.6
	Lap & Shoulder Belt	3386	250	7.4
6	None	15712	3914	24.9
	Lap & Shoulder Belt	1966	284	14.4
Most Severe Damage	None	9766	3477	35.6
	Lap & Shoulder Belt	1117	272	24.4

Table 9
Injury by Crash Severity for Belted and Unbelted Drivers in Other Crashes

		Total Occupants	Number of Serious/Fatal Injuries	Percent Serious Injuries & Fatalities
		Count	*Count*	*Percentage*
Tad Severity	Occupant Belt Usage			
Least Severe Damage	None	148493	805	0.5
	Lap & Shoulder Belt	25803	83	0.3
2	None	110545	1372	1.2
	Lap & Shoulder Belt	18748	115	0.6
3	None	68815	1889	2.7
	Lap & Shoulder Belt	11560	195	1.7
4	None	41021	2600	6.3
	Lap & Shoulder Belt	6477	212	3.3
5	None	19002	2275	12.0
	Lap & Shoulder Belt	2779	187	6.7
6	None	11440	2205	19.3
	Lap & Shoulder Belt	1502	182	12.1
Most Severe Damage	None	7420	2190	29.5
	Lap & Shoulder Belt	910	155	17.0

Note that the injury curve for both belted and unbelted drivers rises sharply at successively higher levels of crash severity until at crash level seven (the worst 2–3 percent of all crashes) approximately 35% of unbelted drivers sustain serious injury. However, at every level of crash severity, drivers who are belted are less likely to be injured. When the data are appropriately summed, the net effect is that serious plus fatal injuries occur only about half as often among lap/shoulder belted drivers as for non-belted drivers in crashes of the same severity. Based on these data, the theoretical maximum effectiveness of a belt law where 100% of occupants used the belts, would be to reduce casualties by about half among targeted occupants. Of course, no law has actually

accomplished the theoretical maximum degree of casualty reduction, a point to be discussed below.

B. Evaluating Belt Law Effectiveness

To evaluate belt *law* effectiveness, researchers must adopt a different approach. Death and injuries under conditions of law versus no law must be compared, rather than comparing groups of accident victims where one group was 100% belted versus a group wherein no one was. The simple reason for this is that evaluation of the *law's* effectiveness implies calculating the net benefits given only partial compliance.

This is just as well because once a belt law is passed, belt use statistics from officer's reports become suspect, because, lest they be charged with violation of the law, victims may tell officers they were buckled up even when they were not.

That this is likely to be the case is illustrated by North Carolina crash data. In September, 1985, the final month before the law took effect, North Carolina crash data indicated that drivers told investigating officers they were buckled up in about 30% of the cases. This agreed fairly well with concurrent on-the-road observations that 25% were, in fact, belted. The following month, the first month after the law took effect, crash-involved occupants reported to police officers that they were buckled up in 68% of the cases. This would have been an encouraging sign of high compliance except for the fact that at the same time, on-the-road belt use had risen only to 42%. It is not believable that crash-involved persons were belted half again more often than drivers in the population at large, especially in view of previous experience indicating that crash victims are usually belted *less* often than the population.

Thus, in evaluating the belt law's effect one must compare what actually happened (fatalities subsequent to the law) versus what *would have* happened in the same state had no seat belt law been enacted. Knowing directly what did happen is easy. Knowing what would have happened in the absence of the law is, of course, impossible in any direct sense. Therefore the researcher must make estimates. Three approaches have been utilized:

1. The first possibility is to compare fatalities among those targeted by the law to fatalities among a non-targeted population in the same state during the same period. Since the seat belt law usually applies only to front seat occupants of certain vehicles, it is possible to compare fatality trends among this target group versus victims in other classes of crashes such as motorcycle, bicycle, or truck crashes, or even rear seat occupants in the targeted vehicles. This is not a completely satisfactory approach because the etiology of the "other" crashes may be sufficiently different as to limit the usefulness of the comparison.

2. A second approach would be to compare fatalities among targeted occupants in the years before versus after onset of the law. This too is not a completely satisfactory approach because of the possibility that other trends were coincidentally occurring which could parallel and thus obscure the effect of the seat belt law. As noted above, it has been shown that highway fatalities vary with such economic trends as the employment rate and gross national product (Partyka, 1984). Thus, if a state were in a period of economic decline just when the law took effect, fatalities would tend to be on the down-swing and this might create a false impression of great success. [In fact, as of the end of 1986, fatalities generally are on the rise across the United States, compared to the depth of the economic recession a few years ago, and this works to conceal, at least in part, any beneficial effect of the laws].

3. A third approach is to compare post-law experience in states with seat belt laws versus same-year trends in other states not having laws. This too is less than an ideal comparison because so many other variables can be a factor when comparing across state lines. What happens in 1985 in New York with a seat belt law is not necessarily an appropriate contrast to what happens in the same year in Oklahoma without a seat belt law.

Because none of the three approaches by itself is ideal, a comparison model might utilize all three at once assuming one derives figures for the "after law" category by forecasting what *would* have happened in the states had no belt use law been in effect. Such a comparison model is depicted in Table 10. In one way or another, evaluations in the several countries have followed a model that is conceptually similar to that described above.

Table 10
Nature of Comparison for Belt Law Evaluation

		Actual Fatals Before Law	Actual Fatals After Law	Forecasted Fatals After Law
Belt Law States	Target Occs.			
	Other Occs.			
	Other Fatals			
Non-Law States	Target Occs.			
	Other Occs.			
	Other Fatals			

CHAPTER FOUR

RESULTS: FOREIGN COUNTRIES

This chapter is a review of findings from Australia, Sweden, Germany, and England. As an introduction, Hedlund's (1986) findings and conclusions are reviewed to suggest the practical limits in magnitude of casualty reduction that might be expected from seat belt mandates.

A. What is the Practical Limit for Belt Law Results?

Hedlund (1986) summarized fatality and injury reduction experience from several countries as a function of seat belt laws, in part seeking confirmation for the intuitively logical supposition that in a country with higher belt use rates, there should be larger casualty reductions. He was able to show such a relationship with respect to injury reductions; that is, net greater injury reductions in countries with higher belt use rate, but he was *not* able to demonstrate a comparable correlation with fatality reduction.

This outcome does not mean that seat belt laws cannot be shown to affect fatalities. Quite the contrary, such reductions have been shown in a number of studies. What was not demonstrable with fatality data at hand was an *increased amount* of fatality reduction in countries with higher levels of belt use. A number of factors may be involved. First, fatalities per unit exposure are rare, and the fatality numbers are sufficiently small that chance variation can overwhelm even a strong effect.

A second point concerns the population likely to be most affected by seat belt laws. Hedlund estimated that, based on fatality reduction experience around the world, the maximum probable occupant fatality reduction achievable even with 100% belt use is about 40%. Considering a 40% reduction as the effective ceiling, he further argued that death reducing benefits at any given level of belt use are less than that expected on the basis of a linear relationship between belt use and maximum fatality reduction of 40%. That, he believes, is because the highest risk drivers are the ones who most resist being restrained. Thus at a 50% use rate, the unbelted half are the higher risk drivers. At 80% use, the non-wearers are the "hard-core," the very highest risk drivers, and will therefore account for more than their 20% share of fatalities. It follows that, unlike many programs where increased efforts are greeted by diminishing returns, in the case of belt use, increasing compliance

among this final part of the driving population should yield disproportionately greater benefits.

On the same point, Tingvall (1982), a researcher in Sweden, examined outcomes in his country and postulated the existence of three risk groups. Drivers in what he called Group A are those who wear belts even without a law; Group B includes those who did not wear belts without a law, but who became belt wearers with a law. Group C includes those who will not wear belts even in the presence of a law. Tingvall's data indicated that Group A constituted about 50% of Swedish drivers, based on voluntary belt use in Sweden before the law was passed; Group B was about 35% of the population, representing those who became belt users under the law; and Group C is the 15% who still refuse to buckle up even under the present law.

Tingvall offers a model that accounts for the actual casualty-reducing benefits of the Swedish law, based on the assumption that Group C has a risk of fatal crashes about five times as high as the A group. It follows from this that belt laws can produce large scale fatality reductions only when use rates are very high indeed. This fact underscores the need to identify these more vulnerable groups, and target belt promotion activities toward them.

B. Paradoxical Data Outcomes to be Expected

Once a successful belt law takes effect, the changes in casualty figures are likely to be in the direction one would expect, i.e., fatalities and injuries decline. However, some aspects of the data may seem paradoxical. Thus, to the extent that seat belt laws are obeyed, a higher proportion of persons who sustain fatal injuries will be belted.

In a population in which *no* one wears the seat belts, every one of those accidentally killed will be unbelted. On the other hand, if there were perfect compliance many fewer would be killed, but of those who *were* killed all would be buckled up.

For example, take Hedlund's estimate that lap/shoulder belts could prevent 40% of deaths at 100% compliance. Thus, for every 100 deaths that would occur if no one wore belts, that number might be reduced to 60 if everyone were buckled up. But that would still mean that those 60 would die buckled up.

This is important from a publicity standpoint, especially in view of the sort of belt promotion ads in which a trooper says, "In 20 years of accident investigation, I've never unbuckled a dead person." That is a compelling belt promotional message, and might have been true of an individual trooper's experience in the past, because not many people were wearing belts. Now that utilization is higher there will be more belted fatalities—that does not mean the law is failing; it in fact is an outgrowth of the law's success.

C. The Australia Seat Belt Laws

1. Introduction

The Commonwealth of Australia, comprised of six states and two territories, is geographically large, covering an area of 2,966,200 square miles, but sparsely populated. The 1985 population was listed as 15,543,600, with a density of 5 persons per square mile. This is somewhat misleading in that much of the country is harsh, desert-like terrain, and most of the population lives in urban areas in the more clement eastern and southern coastal regions. The population is racially homogeneous, mostly white and of European extraction. The Aboriginal population is small and lives mainly in one area. Literacy is high. Of the countries studied, Australia has the greatest amount of open space and by far the largest percentage of unpaved roads. Of the 817,000 km of roadways, less than half (47%) is paved.

The state government of Victoria, Australia was the first to enact a law requiring the use of vehicle safety belts; the rest of the nation soon followed suit. This first law was the outgrowth of an on-the-job safety measure at a massive hydroelectric construction site—the Snowy Mountain Scheme. This project, comprising a series of lakes over a widespread area, involved a great deal of vehicular traffic over rough roads, and officials were concerned that workers would be harmed as they drove to and fro. The seat belt requirement was credited with the fact that during the six-year project no lives were lost because of traffic accidents. From this beginning, the idea spread to incorporating the practice into state law. Victoria did so in 1970.

It was a timely idea, coming as it did in the early phase of the long term process of improving vehicle crash safety. In the early 1970s cars were less crashworthy than today, and injuries to unrestrained occupants were more severe. Requiring belt use therefore constituted an effective means of "leapfrogging" ahead in vehicle safety. Indeed, Australia may have realized greater benefits than would have been forthcoming had they waited longer to institute this policy.

From the beginning Australian researchers were interested in evaluating the casualty-reducing benefits of their seat belt laws. This evaluation had implications beyond Australia because seat belt laws then existed nowhere else. Moreover, Australia was able to carry out competent studies because the nation had (and has) a fine road safety research capability.

An interesting feature of the legislation in Victoria as well as South Australia was the relatively low percentage of cars fitted with seat belts at the time the laws came into effect. For example, in May of 1971 when the law was quite new, only 66% of cars in Melbourne and 67% in Adelaide were fitted with lap belts. In contrast, by the time the first seat belt law was passed in the United States, virtually all vehicles in the country were equipped with seat belts in the front and back.

2. Belt Wearing Rates

The law had an immediate effect on use rates in Melbourne even during the first months. Milne (1979) reported:

> "During the first month, police were instructed to educate and caution motorists rather than prosecute for non-compliance. Even during this period, wearing rates rose substantially. For example, from 25% to around 50% in Melbourne. At the end of this period, with the initiation of enforcement, wearing rates rose to over 75% (page 11)."

Short term gains in wearing rates are common immediately after passage of a law, but in several countries, and in several American states, a pattern of decline has set in as time passes. Therefore, it is of interest to consider what has happened to belt use rates in Australia over the long period since the laws were enacted. Though belt wearing is not uniform at all times and places, overall belt use is even higher now than it was shortly after the laws were passed in the early 1970s, as Table 11 attests. As can be seen, belt use is lower in the rear seats than in the front.

Milne also reports that use rates are lower in rural areas and at night, and male front seat passengers tend to wear the belts somewhat less often than female front seat passengers. Nor is belt use uniform for all vehicle types. Thus, in one South Australian survey of more than 7000 front seat passenger car occupants, only about 10% were unrestrained, but in a sample of 268 van occupants, 26% were unrestrained. As regards these differences among belt user subsets, the Australian findings are generally consistent with United States data, although overall United States values are much lower than in Australia.

The authors of this report personally experienced the high usage rates while riding a cab to a meeting in Sydney in November, 1985. Belt use rates in the first 100 vehicles met had 93 drivers buckled up. Of the seven unrestrained by shoulder belts most were in small trucks.

Table 11
Seat Belt Use Rates in Australia

State/Year	Driver	Front Passenger	Rear Passenger	Children
New South Wales 85	90%	87%	45%	68%
Victoria 85	93	88	55	69
Queensland 84	←74%→			34
South Australia 83	←90 →		54	65
West Australia 86	←93 →		71	44
Tasmania 85				50
Northern Territory 85	85	86	71	68

From: Milne (1986)

3. Enforcement

It is an article of faith that a suitable level of enforcement must be maintained for any law to be effective. Milne (1979) said:

> "Enforcement has an important role in maintaining belt wearing rates, but the nature of the relationship is little understood *(page 14)*."

Indeed, Crinion and Lane (1975) point out that prior to 1975, enforcement levels were quite different from one place to another. In reference to South Australia they say:

> "Only 17 car occupants were convicted for failing to wear belts in the first seven months during which the law was in effect, from a population of 400,000. This is in striking contrast with the enforcement level in New South Wales where Henderson and Wood (1973) report over 14,000 car occupants having been charged with non-wearing during 1972. Despite this remarkable difference in enforcement (a factor of 270 times), the observed belt wearing rates in the two states, New South Wales (Sydney) and South Australia are quite similar *(p. 83)*."

The above quote described the situation prior to 1974, but the level of enforcement continues to vary several-fold from one Australian state to the other. Most recently, Milne (1986) reported that offenses charged per 100,000 population ranged from a low of 365 in New South Wales to a high of 1331 in Queensland. Milne says that the high level of enforcement in Queensland may be related to the fact that this state imposes a somewhat lower fine than the other Australian states, therefore officers may be more willing to charge an offense. Although it can be shown that intensive, directed efforts by police can increase rates of belt wearing (Woodward, McLean and Somers, undated), differences in overall levels of enforcement show no clear relationship to wearing rates. This may indicate that once high wearing rates are achieved and maintained for several years, the actual level of enforcement becomes less critical. Presumably, however, there would have to be public perception of *some* enforcement.

4. Publicity

Over the years, Australia has devoted much effort toward publicizing the facts of seat belt effectiveness. Large scale public information efforts were carried out in preparation for the onset of the laws, and continuing attention has been given to the issue over the years with such refinements as campaigns aimed at increasing *correct* use of belts, campaigns designed to increase belt use among rear seat occupants, and campaigns on behalf of child restraint. Research on the effects of such campaigns has demonstrated that they can raise rates of use and increase the proportions of users who wear belts cor-

rectly (Woodward, McLean, & Somers, undated; Johnson & Cameron, 1979; Road Traffic Board of South Australia, 1982).

Australian officials have utilized the full range of outlets to promote belt use: television commercials, posters, newspaper ads, demonstrations and shows in shopping malls, and educational materials for the school system. Similar efforts have been mounted in the United States, but with less apparent public response. Thus, it seems that it is not the *kind* of publicity that accounts for any differences between the two countries. However, three points are noteworthy with regard to publicity programs in Australia.

First, the governments consider these programs of sufficient importance to public welfare that they appropriate enough money to allow fairly intensive publicity of high quality to be produced and disseminated.

Second, in Australia the federal and state governments can and do purchase significant blocks of commercial time on television to advance public programs. In Victoria and New South Wales, for example, the state governments purchase commercial television time for safety promotion including seat belts, driving only while sober, motorcycle and bicycle safety. Further, as a good customer, the government enjoys a somewhat favorable relationship to the television stations when it comes to production of programs related to safety, even though these may not be purchased directly by the government. Thus, it seems fair to say that the government is able to place safety messages before the television and radio audience to a greater degree than is possible in the United States.

Third, in Australia there are not as many television channels as in the United States, therefore, the television market is more easily saturated with a given message. In the United States with our proliferation of commercial, public, and cable channels, the same amount of money and effort might reach far fewer people because of the greater range of viewing options.

5. Casualty Reduction

A number of studies were conducted to evaluate the casualty reduction benefits of the Australian seat belt use laws. In a very early analysis of the Australian law's effectiveness, Andreassend (1972) estimated that approximately a 14% reduction in casualties could be attributed to the effect of the law in the first year, but he emphasized that, with only one year of post-law experience, he could not be sure of the ultimate effect.

Foldvary and Lane (1974) analyzed in more detail the change in casualties in Victoria, where Melbourne is located. They found in the metropolitan area a drop in fatalities of about 21%, whereas in the non-metropolitan areas, the reduction was about 10%—the latter was not quite statistically significant. In terms of non-fatal injuries, there was a reduction of about 13% in the metropolitan area and about 11% elsewhere.

In a second analysis, Crinion, Foldvary, and Lane (1975), similarly analyzed the fatality data from South Australia (Adelaide). They found that after onset of the belt law, casualties were significantly lower in 1967 and later model cars, which had belts fitted by law, than in 1966 and earlier models in which belts were not required. There was a decline of 7.5% overall in the occupant fatality rate, essentially confined to 1967 and later models. Thus, these authors estimated a 21% improvement for those particular cars.

In an analysis of more long-term effects, Milne (1979) reported that statewide data analyses based on Victoria, New South Wales, and South Australia generally showed occupant fatality reduction on the order of 15–20%. In terms of absolute numbers, Milne noted that traffic fatalities had reached 3,798 in 1970, but in each of the nine succeeding years, the grand total did not again reach this level even though the population increased by 1.5 million, vehicles increased by two million, and fuel consumption increased by 67%. Milne also alluded to several studies showing reductions in the severity of head, spinal, and pelvic injuries.

Australians are justly proud of the fact that their traffic fatality rate, whether measured per number of vehicles, per unit population, or per 100 million km traveled, has fallen in a generally steady pattern. In Victoria the Road Traffic Authority released a report in March of 1985 (Road Traffic Authority, 1985) showing that the fatality rate per 10,000 vehicles was reduced by 65% from 1970, from 8.1 in 1970 to 2.8 in 1984.

D. The Sweden Seat Belt Law

1. Introduction

The kingdom of Sweden is a constitutional monarchy with a unicameral parliament. In area, it has 173,732 square miles, almost double the size of the United Kingdom and West Germany, yet it has approximately one-eighth the population of Germany, one-seventh that of the UK. Thus, the population density is less even than that of the United States. Ethnically the population is quite homogeneous, being 97% of Scandinavian origin. In 1984 there were 41 motor vehicles per 100 population, excluding mopeds. Drivers may operate cars at age 18, motorcycles at age 16. There is no requirement for formal driver training, but to be licensed, one must pass an examination. Reexamination every 10 years is required.

The seat belt law went into effect on January 1, 1975. It requires drivers and front seat passengers of all vehicles to be belted. Taxi drivers and children under 15 are exempt. As of July, 1986, rear seat passengers are also required to be restrained.

According to the authors' interviews with Swedish officials, the process leading up to passing the law was gradual and sensitive to public acceptance.

In the late 1960's a public information campaign was begun to educate the population about the benefits of occupant restraints. Volvo, one of Sweden's two major automobile manufacturers, introduced the country's first standard for belts as early as 1957 and had begun installing three point belts as standard equipment in their cars by 1959 (Swedish Institute, 1986). In 1969, legislation was passed requiring all cars to be equipped with belts.

One respected road safety researcher characterized the Swedish approach as one in which public acceptance is followed by mandates (Aldman, 1986). Thus, when approximately 50% of all cars in Sweden became equipped with belts, laws were passed making installation of belts mandatory. When about 50% of the population was using belts, use was made mandatory. Before that final step, however, a public referendum had shown that 85% of the population favored the law.

2. Belt Wearing Rates

Perhaps the best estimate of the change in belt use following enactment of the law in Sweden is to be found in a paper by Tingvall (1982) in which he reported that in a study conducted "outside built-up areas," wearing rates increased from 50% to 85% from 1974 to 1975. Thus, 50% of the population was already using seat belts prior to the introduction of the law, and approximately 35% changed their behavior thereafter.

Current use rates vary by location according to officials. Dr. Thomas Lekander (1986) of the Swedish Road Safety Office noted that observation surveys have shown that 90% of the population wear belts on rural roads; the rates vary from 50–75% within urban areas. The 90% figure for non-built-up areas is slightly higher than the 85% given by Tingvall (1982), perhaps suggesting a slight growth, or at least maintenance, of a high level of use. In October of 1986, the authors counted 100 cars in Gothenburg, Sweden, and noted 89 belted.

Research has shown that Swedes are more likely to wear belts on longer journeys and in larger cities. Young men are least likely to be belted, having a 40–50% wearing rate compared to an overall average figure of 76%.*

3. Enforcement

As of 1965, all police in Sweden are federal police. Within the police force, there is a Special Traffic Section; these officers also carry out other duties as required. Enforcement is usually carried out in clearly marked vehicles; helicopters are sometimes used. In 1982, over 300,000 persons were found guilty of traffic violations. Fines may be imposed for failure to wear seat belts, and

*The figure of 76% use rate is calculated from information from Dr. Thomas Lekander who informed the authors that use rates in Sweden today are 90% on rural roads and from 50 to 75% in urban areas. Taking the midpoint of the urban figure as 62.5 to compute the overall average, we arrived at the figure of 76%.

about 40,000 were cited for non-use of the seat belt (Official Statistics of Sweden, 1984). Other estimates say 20,000 citations in a year (Vaaje, 1986). This amounts to 650–1300 citations per 100,000 population, which is one of the more intensive levels of enforcement seen.

4. Publicity

The National Road Safety Office (Trafiksakerhetsverket) coordinates the national traffic safety effort. This bureau is responsible for public education and information about traffic safety. Within each county, there is a traffic safety association, voluntary bodies with representatives from public and private agencies, who are responsible for local coordination. There is also a privately administered organization, the National Society for Road Safety (NTF) which plays an active role in safety education and publicity. Various companies such as automobile manufacturers and insurance companies also provide information. Our sources estimated that up to 25,000,000 Kr. per year may be spent in the public educational effort. This money is partly from governmental sources and partly from private companies.

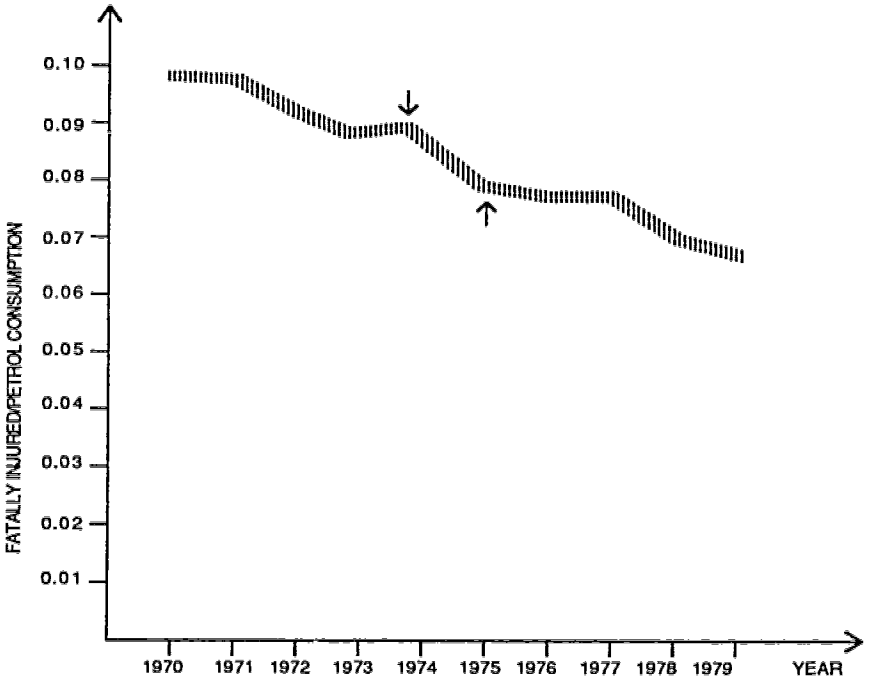
One incentive to use seat belts in Sweden is that drivers are offered a 10% reduction in insurance premiums if they pledge to use seat belts and to see that occupants riding in their vehicles do likewise.

Children are exposed to safety education along with their regular curriculum beginning in nursery school and continuing throughout. Officials estimate that about 20 hours per school year are devoted to traffic safety education (Swedish Institute, 1986). The government encourages the TV industry to emphasize safety, but the TV stations are independent, and do so at their own option. However, public service announcements are made on TV and radio.

5. Casualty Reduction

Figure 3 (from Tingvall , 1982) shows the ratio of fatalities to petrol consumption for the years 1970 to 1979. The ratio decreased by 10% from 1974 to 1975, the years prior to and just after introduction of the mandatory law. Thus, Tingvall (1982) says that a comparison of 1974 (pre-law) with 1975 (post-law) shows a reduction of about 10% in fatalities. Norin (1984), indicated a fatality change of 12%, but Hedlund (1986) noted that since the ratio of fatalities to fuel consumption is generally in decline in a number of nations, this downward shift may not be due entirely to the belt law. Indeed, as is seen in Figure 3 the decline in 1974–75 does appear to be embedded in a longer-term downward trend. In any event, a decline which does not seem to be larger than 10%, seems to be present after the law was enacted.

Figure 3:
Ratio Between Fatally Injured Drivers of Private Cars and Petrol Consumption per 1000 m^3 1970-1979, Sweden
from: Tingvall, 1982



E. The German Seat Belt Law

1. Introduction

The Federal Republic of Germany, West Germany, is a republic with two legislative houses: a council and a diet. There are 11 member states, occupying a total area of 96,026 square miles. The most densely populated of the countries studied in this research, there were 61,049,000 persons as of 1985, a density of 638 per square mile. West Germany has approximately 25,000,000 cars and 1.5 million trucks and buses; there are 478,251 km. of roads, of which 99% are paved.

The seat belt law went into effect January 1, 1976. The law, requiring belt use in cars or vehicles up to 2.8 tons, thus covers drivers and passengers in small trucks and vans. Taxi drivers, and drivers of delivery vehicles that stop frequently, are exempt. Doctors may certify medical conditions that would

preclude wearing a belt. In August of 1984, the law was changed such that a fine of 40 German Marks was introduced for non-compliance. Up to that point, violation of the seat belt law had carried no monetary penalty. In addition to the monetary fine, another significant change was introduced in 1984: the law was adjusted to include provisions that if a person were unbelted in a crash, their eligibility to receive insurance compensation for injuries could be reduced.

The German law specified that all passenger cars since January 1, 1974, must be equipped with three point belts in the front seats, or equally effective restraints. A further note on Germany is that the law requires children to ride in back seats.

2. Belt Wearing Rates

In West Germany there is a Federal Highway Research Institute, whose Accident Research Branch evaluates safety programs. The Bureau for Statistics maintains data from police records. These are summarized by states and for the country as a whole. Police do not, however, routinely record belt usage in their accident reports. The Accident Research Branch has published analyses of belt wearing rates from on-road observations collected through procedures similar to those used in other states and nations. Their sampling included various types of roads, different days of the week and times of day.

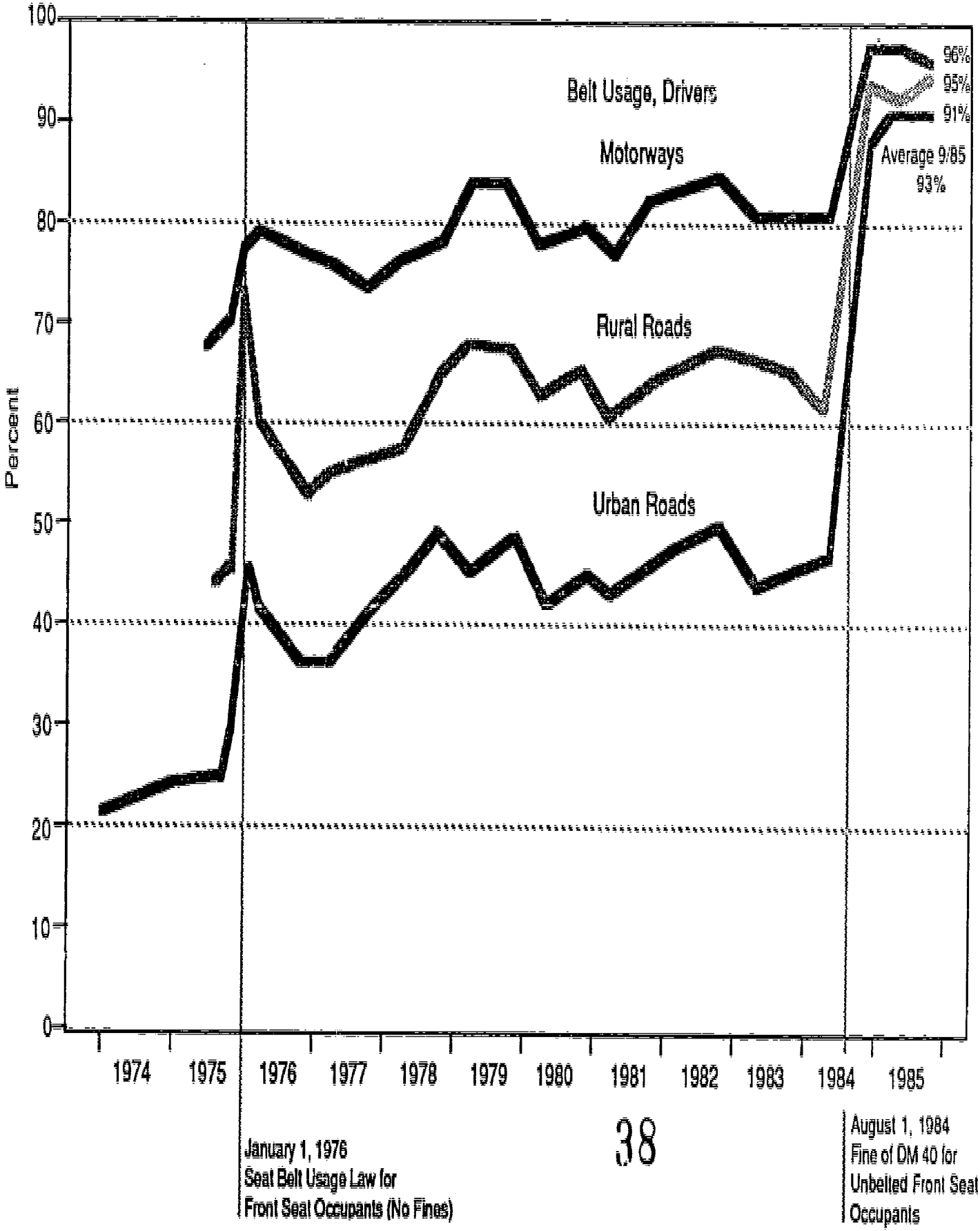
The belt use data shows dramatic increases that took place in two stages. In 1974–75 before onset of the initial law, belt use varied between 30 and 70%, depending on type of roadway; usage rates increased to 45–80% after the law went into effect, with belt use then holding relatively steady for the next six or seven years. After 1984, however, when fines for non-compliance were introduced, belt use rose above 90% on all types of roadways. This is shown in Figure 4, taken from Friedel and Marburger (1986).

From this figure it appears that the usage values during these three periods, arrayed by type of roadway, were approximately as follows:

	Belt Use Percent		
	Pre Law (75)	Post Law (76)	Post Fine (84)
Urban	30	45	92
Rural	45	75	95
Motorways	70	80	97

Consistent with these high use rates, the authors of this study made 100 observations in Cologne in the fall of 1986 and noted 93 of the drivers buckled up.

Figure 4:
Belt Use Rates in Germany 1974-1985
from: Friedel and Marburger, 1986



3. Enforcement

Officials in West Germany believe there are identifiable areas where police and public are more in favor of the law than in others. Throughout the country there is a commitment by police to enforcement, but arrests for noncompliance with the law are "rare" according to our sources. We were unable to pinpoint any specific enforcement data. Failure to wear the seat belt is a primary offense; German officials informed us that police would not be likely to emphasize belt wearing to any greater degree than other traffic regulations. Specific belt checks are occasionally made; officials stated this would happen perhaps twice within a year (Marburger, 1986). In Germany, as in Australia and England, high rates of belt use appear to be maintained with relatively modest levels of enforcement. The imposition of the fine has made a difference in the degree to which the law is enforced, having increased the seriousness of the matter in the minds of both police and public (Marburger, 1986).

4. Publicity

The Federal Government, along with such organizations as the German Traffic Safety Council (Deutsche Verkehrssicherheitsrate. V., DVR) and the German Society for the Prevention of Accidents (Deutsche Verkehrswacht e. V. [DVW]), has attempted to educate the public with regard to the need for occupant restraints. In 1983 the DVR and the Federal Minister of Transport mounted a campaign to encourage the use of seat belts, targeting urban drivers in particular. Television and radio were utilized, along with demonstrations in local cities. Discussion "evenings," "roadside campaigns," posters, buttons, and pamphlets were used, and information seminars for the press were also held. However, the publicity campaign along was seen as having little impact, compared to introduction of the fine and related insurance provisions.

5. Casualty Reduction

a. Fatalities

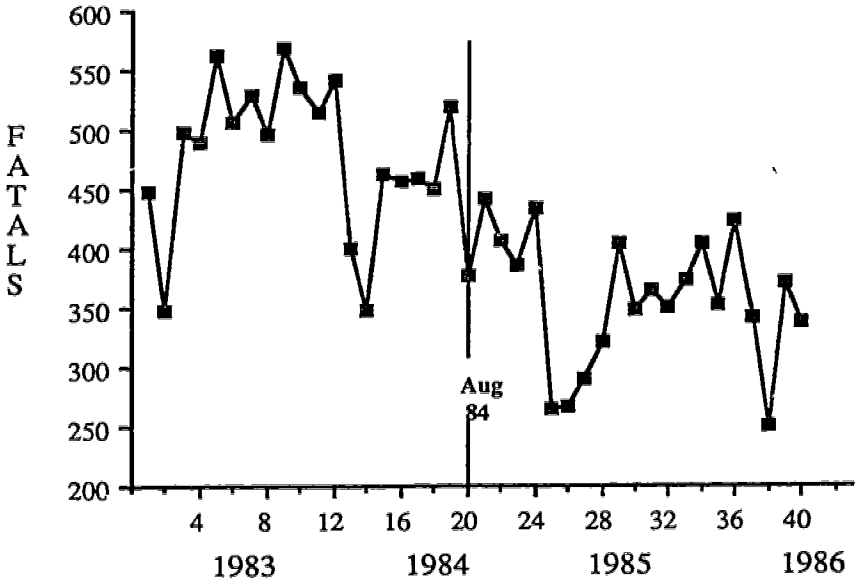
It is difficult to garner facts concerning the effect of the initial enactment of the seat belt law in West Germany. Both from within and without Germany, it was admitted that use rates were at first not as high as those observed in some other places.

German officials, however, are encouraged by the effects of the action taken to strengthen the law in 1984, by imposing the fine along with the accompanying change in the insurance provisions. As Table 12 shows, there was a substantial decrease in deaths associated with this change in the law. Table 12 and Figure 5 are based on data reported by Friedel and Marburger (1986) with updated information provided by Dr. Friedel in the Fall of 1986.

Table 12
Occupant Fatalities in West Germany

Month	83	84	85	86
1	447	400	264	342
2	347	347	266	251
3	497	463	290	370
4	490	457	321	337
5	563	459	405	
6	507	451	348	
7	530	518	365	
8	496	378	350	
9	568	441	372	
10	536	406	404	
11	515	385	353	
12	542	434	423	
	6038	5129	4161	

Figure 5:
Occupant Fatalities in West Germany
January 1983 through April 1986
from: Friedel and Manburger, 1986



German officials point out that this decrease must be substantiated over a longer period using a time series analysis. As Table 11 shows, from August of 1984, there was indeed a drop in occupant fatalities although some of that drop apparently was underway already.

From the Table note that there were 5,752 occupant deaths during the year preceding August 1984, and 4,303 occupant fatalities the following year (a 25% decrease). The researchers in Germany attribute a 15 percent decrease in fatalities to the law. Presumably the difference between that and 25% is the decrease they feel was already underway due to other factors. Whatever the reasons for it, there was a definite change in the death rate from 1984 to 1985 (Marburger & Meyer, 1986).

b. Injuries

Also of interest is a comparison of injuries before and after the 1984 change in the seat belt law. In a survey of data from several large eye clinics around the country, it was found that eye injuries from contact with the windscreen had declined from 388 in 1978 to 221 in 1982, to 75 in 1984/85 (Friedel and Marburger, 1986).

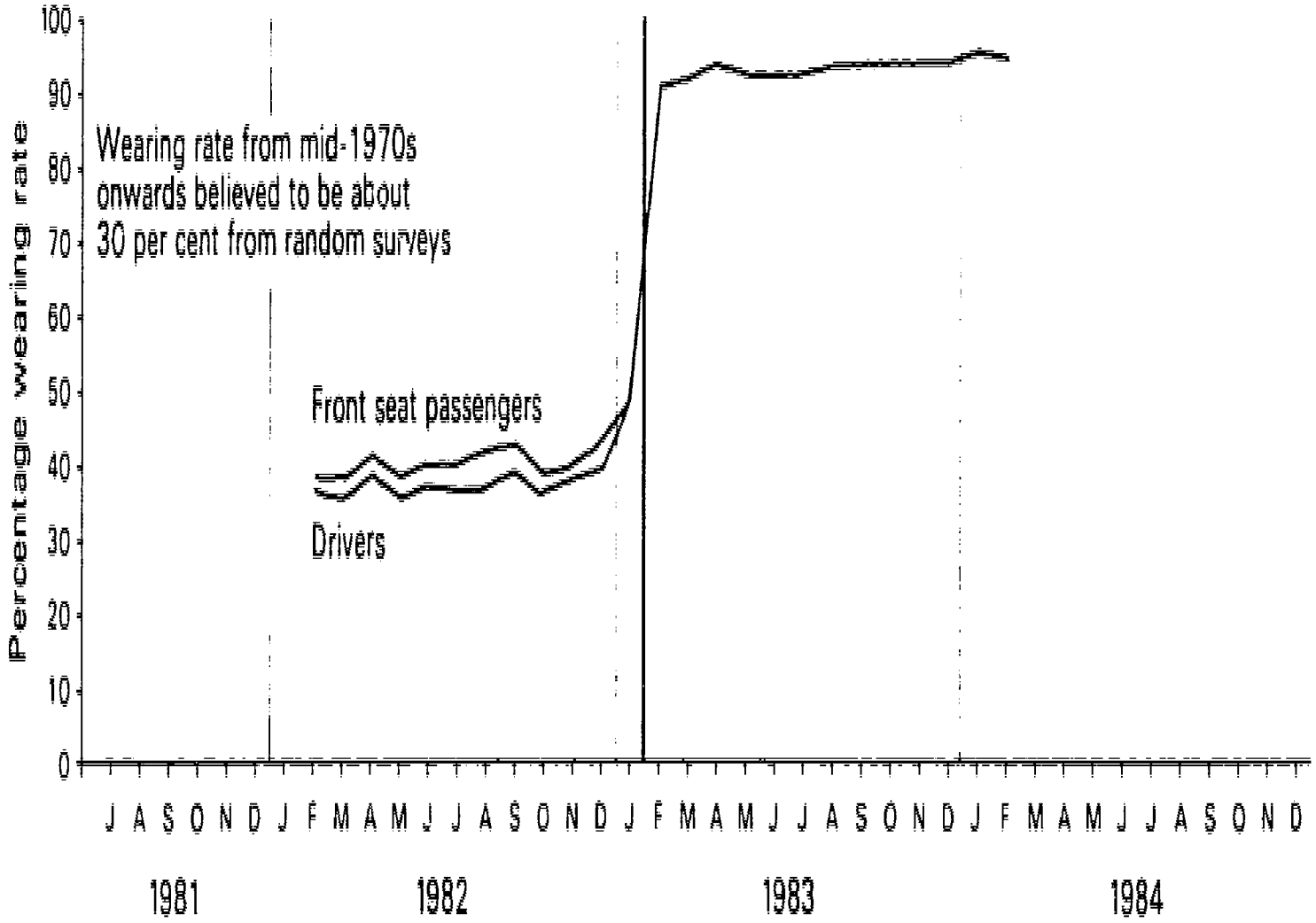
F. The United Kingdom Seat Belt Law

1. Introduction

The United Kingdom, comprised of England, Scotland, Wales, and Northern Ireland, has an area of 94,248 square miles and a current population of 56,500,000. Population density exceeds 600 per square mile, tenfold more dense than in the United States. There are 346,700 kilometers of roadways, including a relatively extensive Motorway system comprising 2,782 kilometers of dual carriageway with limited access. The maximum speed limit is 70 mph on Motorways. As of 1984 there were 20,000,000 registered motor vehicles, about 35 vehicles per 100 people, compared to about 55 per 100 in the United States. Pedal cycles continue to be utilized by significant numbers of the population.

In 1981, Parliament passed enabling legislation to allow requiring seat belt use by front seat passengers in all cars and "light goods vehicles." The law actually went into effect January 31, 1983, with a three-year provisional period. There had been eight previous unsuccessful attempts to pass the law. The opponents of the law were mainly concerned about the perceived loss of individual freedom, as has been true in the United States. In 1981, when the enabling legislation was finally passed, neither the Prime Minister, the Chief Whip, nor the Opposition Leader were pushing passage. Although there was support for the bill in the House of Lords, especially among a number of medical peers, there was also strong opposition and the vote was 10 for and 10 against.

Figure 6:
Seat Belt Wearing Amongst Front Seat Occupants of Cars and Light Vans:
GB from: Department of Transport, UK, 1986



Once passed, however, the law appears to have been a political success, and the provisional feature has been superseded by a permanent statute. At the point when the final bill was passed, there was not even a sponsor for the opposition in the House of Lords, which meant that the bill passed there by acclamation (Breen 1986).

2. Belt Wearing Rates

Surveys to ascertain belt wearing rates were carried out monthly between February, 1982 and April , 1984. Since that time, surveys continue to be made every other month. Counts are taken at each of 55 sites on one weekday and one weekend day at random daylight hours. At well-lit sites some evening data is also collected. From 100,000 to 130,000 observations were made during each survey, and the results are weighted according to traffic volume to provide a national estimate.

As can be seen from Figure 6, wearing rates were about 40% before the law took effect, and increased to about 95% almost immediately afterward. In the 1985 summary report published by the Department of Transport it is stated that belt wearing rates varied according to roadway type, from 97% on motorways to 90% on "built-up minor roads" (Road Accidents in Great Britain, 1984).

During June of 1986, the authors of this paper took 500 observations in London and several outlying cities. At that time, 92% of the 500 drivers were observed to be seat-belted. This 92% rate showed relatively little variation around the country. However, most of the observations were made in London, and London taxicabs were not counted since they are exempt from the law. Had taxis been included the observed wearing rate would have been lower since London cabbies take full use of their exemption.

3. Enforcement

When interviewed by the authors, Drs. Jeremy Broughton and David Stark of the Traffic and Road Research Laboratory stated to us that enforcement of the laws is done by local city or county police. Actual numbers of arrests for non-wearing are difficult to ascertain; it appears clear that police have not made this one of their highest priorities in the UK, but with wearing rates around 90% they may well consider other offenses more needful of their attention.

4. Publicity

The Department of Transport spent 3.9 million pounds on publicity in 1984 (Road Accidents in Great Britain, 1984). Most of this amount was spent on television campaigns, but advertisements on radio, in the newspapers, and on busses and subways as well as brochures and leaflets were also utilized. The importance of using adult and child restraints in cars, bicycle and motorcycle safety, and campaigns against drunk driving were all stressed. A 50-minute

television documentary program entitled "The Greatest Epidemic of Our Time" was aired by the BBC the week before the critical seat belt debate was held in Parliament. Officials in Britain consider this program to have been a "key turning point in the debate" on the issue (Mackay, 1985). Although no formal research on the effect of the airing of this one program was carried out, its success in educating the public about the need for and the effectiveness of seat belts was mentioned to these authors several times. Because there are so few competing television channels in the United Kingdom the promoters can assume coverage of a good share of the viewing audience, in this instance estimated by Mackay at "half the country" (Mackay, 1985, p.3). Officials also credit this program with part of the success of the law in increasing belt wearing rates (Dale, 1986).

5. Casualty Reduction

a. National Fatality and Injury Figures

Fatality figures for the years 1982, the last 12 months before mandatory use of seat belts, and 1983–84, the first 24 months of the law, are given in Table 13 (from Durbin and Harvey, 1985). The figures in this table were derived from police records, but exclude reports sent to the Department of Transport from the Metropolitan Police Department because there was known to be underreporting of fatalities from that source. In order to keep the analysis as bias-free as possible, data from that source were omitted.

As can be seen, there was a substantial drop in fatalities among drivers and front seat occupants of cars and vans after onset of the law. The decline was statistically significant. Table 14 gives figures for the frequency of serious injuries before and after the introduction of the mandatory seat belt law.

As with fatalities, the frequency of serious injuries dropped sharply. Table 15 gives figures for slight injuries among front seat occupants of vans and cars before and after the introduction of the seat belt law.

Table 13

Fatalities Among Front Seat Occupants of Cars and Vans, 1980–84

	Vehicle Type and Occupant Class				
	Car		Van		
Year	Driver	Fr. Pass.	Driver	Fr. Pass	Total
1980	1237	592	94	39	1962
1981	1261	581	75	55	1972
1982	1341	604	71	38	2054
1983	1074	434	55	37	1600
1984	1143	505	61	49	1758
Percent change from pre-law rate					
1983–84	–20	–28	–23	–3	–22
1984–85	–15	–16	–14	29	–14

from: United Kingdom Dept. of Transport (see Durbin and Harvey, 1985)

Table 14
Serious Injuries Among Front Seat Occupants of Cars and Vans, 1980–84

Vehicle Type and Occupant Class

	Car		Van		
	Driver	Fr. Pass	Driver	Fr. Pass	Total
1980	17205	8681	1265	820	27971
1981	17558	8672	1190	783	28203
1982	17807	8304	1153	772	28536
1983	13998	6087	851	584	21520
1984	14982	6473	886	570	22911
Percentage change from pre-law rate					
1983–84	–21	–31	–26	–24	–25
1984–85	–16	–26	–23	–26	–20

from: United Kingdom Dept. of Transport (see Durbin and Harvey, 1985)

Table 15
Slight Injuries of Front Seat Occupants in Cars and Vans, 1980–84

Vehicle Type and Occupant Class

	Car		Van		
Year	Driver	Fr. Pass	Driver	Fr. Pass	Total
1980	59580	29155	4357	2723	95815
1981	61026	29931	4234	2648	97839
1982	64021	31275	4100	2459	101855
1983	57182	25242	3435	1940	87799
1984	63195	27597	3752	2186	96730
Percentage change from pre-law rate					
1983–84	–11	–19	–16	–21	–14
1984–85	–1	–12	–8	–11	–5

from: United Kingdom Dept. of Transport (see Durbin and Harvey, 1985)

Professor Durbin and Dr. Harvey (1985), statisticians on the faculty of the London School of Economics, were asked by the government to conduct an independent analysis of the law's effects. Using a time-series analysis, they provided an estimate of the statistical significance of the change in casualties after introduction of the law. This method allowed them to account for historical trends, and at the same time to examine the extent to which variables other than seat belts might have influenced the casualty outcomes.

Durbin and Harvey's method allowed them to conclude that during the first two years, the law accounted for a drop in fatalities to car drivers and front seat occupants (FSOs) of 23% and a decline of 19% in deaths to van occupants. Serious injuries to drivers and FSOs of both cars and vans decreased by 25%. When the data were analyzed by direction of impact, a decrease in fatalities and serious injuries was seen in side and frontal impacts but not in rear impact crashes, a finding which agrees with *a priori* knowledge of how belts function in a crash. Curiously, there was a 16% increase in rear seat passenger deaths and also a 4% increase in serious injuries to rear seat passengers.

In the same type analysis, Durbin and Harvey found 0% significant change in the casualty rate for pedestrians, which buttressed their confidence that the reduction in deaths to persons covered by the seat belt law was, in fact, due to the law. There was a slight increase in deaths of cyclists, but the change was not statistically significant.

b. Study of Injuries Among Patients Seen at 14 Hospitals.

Rutherford, Greenfield, Hayes and Nelson (1985) conducted a study of the medical effects of the seat belt legislation as determined from hospital data on persons treated for crash-induced trauma, whether they were admitted to the hospital or not. Data from 14 hospitals were included; the study sample constituted about 4% of all such cases in the United Kingdom during that time period. Data was collected over a two-year span. Table 16 includes selected findings from among the many tables in the cited report.

For each person treated an array of data were recorded, including their location in the vehicle, belt usage by the victim (and all others in the vehicle), and registration information about the vehicle. Full data was available for 14,019 persons.

The researchers were able to examine injury patterns before and after implementation of the law. In many categories they showed, as would be expected, substantial injury reductions. In a few categories injuries increased, such as fractured sterna; most increases seen were consistent with the way a belt system is expected to perform.

As can be seen, most categories show a substantial decline. Fewer individuals were brought or came to the hospital to be treated and fewer were

Table 16
Injuries Before and After UK Seat Belt Law
(Drivers plus Front Seat Passengers)

Injury Category	Before Law (N)	After Law (N)	% Change
Number treated	4803	4121	-14%
Number admitted	1319	924	-30%
Bed days	13086	9262	-29%
Brain Injuries	956	582	-39%
Eye Injuries	151	93	-38%
Lower Extremity Frac.	64	57	-11%
Frac. Ribs	202	147	-27%
Skull Frac.	55	44	-20%
Spine Frac.	72	67	- 7%
Spine Sprains	1090	1352	+24%
Frac. Sterna	33	71	+115%
Major Brain Inj.	54	59	+ 9%

admitted. Head injuries decreased (skull fractures, eye injuries, brain injuries) except that major brain injuries showed an increase of 5 cases.

Also, whereas spine fractures decreased by 7%, the less serious spine *sprains* increased by 24%. Most of these were cervical spine sprains as might be expected for shoulder-belted persons. Associated with increased belt use was an increase of fractured sterna from 33 to 71.

All in all , the injury data are dramatically consistent with a successful belt law.

6. The Issue of Risk Compensation Theory as An Impediment to the Law's Passage in the United Kingdom

In his book, *Risk and Freedom*, Professor John Adams of the University College London sets forth a theory of risk compensation wherein he hypothesizes that once a countermeasure providing apparent protection from risk is mandated, the public, through some subtle psychological mechanism, would compensate (perhaps unconsciously) for the increased feeling of security by taking slightly more chances, thereby maintaining some apparently comfortable level of risk. Thus, if such a highway safety measure as the wearing of seat belts is mandated, the population will react by driving less safely, thus cancelling the potential safety benefits of the program (Adams, 1985).

In particular, Professor Adams theorizes that in England drivers reacted to being buckled up by driving more "heedlessly." The victims of this increased heedlessness, according to Adams, were pedestrians and bicyclists. In seeming

confirmation of Dr. Adams' position, whereas there were appreciable *reductions* in injuries to occupants of cars and vans associated with the seat belt law, there was concurrently a slight *increase* in deaths among bicyclists and pedestrians. This data was cited by Mr. Adams as evidence for his theory even though, according to Durbin and Harvey, the upward trends in injuries to cyclists and pedestrians were not statistically significant. Ashton and Mackay (undated) have suggested that most of the increase in bicycle accidents may have been due to a "craze for BMX bicycles" which they claim coincided with the increase in pedal cycle accidents (p.10). Since most of the increase in bicycle accidents appeared to involve children in residential areas, it may well be that it is only coincidental with the increased use of seat belts by motorists in the United Kingdom.

That some idiosyncratic factors in the United Kingdom may have contributed to the post-law increase in pedestrian and cycle fatalities is suggested by the fact that, in the USA, pedestrian and bicycle deaths went down after the introduction of seat belt laws (as did deaths among occupants required to be belted). Similarly, bicyclist and pedestrian deaths in Sweden did not increase following mandatory seat belt usage (Tingvall , 1982). Thus, risk compensation does not display a lawful relationship to mandated seat belt usage. Either risk compensation is *not* a factor in the United States and Sweden, or else the phenomenon behaves differently in England. In any case, prior to passage of the seat belt law in the United Kingdom, part of the focus of the opposition was Professor Adams' theory.

It is undeniably true that a phenomenon exists which one could call risk compensation. Indeed, in certain situations it is intuitively obvious how it works: if, for example, one were descending a narrow staircase alongside a high dropoff, one might ascend or descend more rapidly if there were a sturdy hand/guard rail than if there were none at all. This example, however, refers to behavior under the conscious control of the person. It is another matter entirely to hypothesize that a similar risk compensation takes place with such subtle behavior as crash involvement. In the first place, a highway crash is not a volitional matter except in bizarre circumstances. Further, it is not easy to identify behaviors that specifically lead to involvement in or avoidance of a crash. Thus, it is not apparent that behavior related to accident involvement or avoidance can be attributable to risk compensation in the same way that a frequent, volitional behavior could, and there is no persuasive evidence that the phenomenon exists when it comes to car crashes. While the issue of risk compensation was briefly prominent in the seat belt law debate in the United Kingdom, relatively little has been heard of the matter in the USA.

G. Summary for Four Nations

The experience with seat belt laws in the four foreign countries reviewed here has shown that high rates of belt use have been achieved and apparently sustained over significant time periods. Tables 17 and 18 below very briefly summarize some of the facts about seat belt laws in the four countries.

Table 17
Summary of Seat Belt Legislation in Four Foreign Countries

Country	Date of Law	Fines*	Belt Use Rates		Enforcement: % of All Tickets
			Pre	*Post*	
Australia	1970–72	$13–340	22%	90%	3–11%
Sweden	1975	$11–22	50%	85%	7%
W. Germany	1976	**	23%	60%	n.a.
	1984	$14	63%	94%	
United K.	1983	$55	40%	95%	n.a.

n.a. =not available

Converted to US dollars
***from 1976 to 1984 West Germany's law included no fine.*

Table 18 summarizes a selection of studies from among those available to show the effect of the laws on fatalities within the various countries. As may be seen in this table, reductions in fatalities are somewhat below the levels that scientists might have predicted before such laws were widely enacted.

Table 18
Effectiveness of Seat Belt Laws in Reducing Fatalities in Four Foreign Countries

Country	Years	Source	Estimated Fatality Improvement
Australia	1970–71	Joubert (1981)	–15%
	1970–71	Foldvary and Lane (1974)	–10% – 21%
	1971–72	Henderson & Wood	–25%
	1973	Crinion, et. al. (1975)	– 7.5% – 21%*
	1971–78	Milne (1979)	–15% – 20%
Sweden	1975–78	Bohlin (1981)	–12%
	1974–75	Tingvall (1982)	–10%
Germany	1976–80	Seidenstecher (1981)	–30%
	1983–86	Friedel & Marburger (1986)	–15% – 25%
United Kingdom	1982–83	Scott & Willis (1985)	–20% – 30%
	1982–84	Durbin & Harvey (1985)	–18% – 25%
	1982–84	Dept. of Transp. (IBID)	–14% – 22%

**Crinion, et. al. (1975) reported a 7.5% reduction overall, but for occupants of 1967 and later car models (those equipped with belts by law), the reduction was 21%.*

As noted by Hedlund (1986) and Tingvall (1982) the fact that the highest risk drivers are also those least likely to comply with the laws may contribute to the less-than-hoped-for benefits in fatality reductions.

CHAPTER FIVE

THE UNITED STATES SEAT BELT LAWS

A. Introduction

As stated in Chapter One, belt laws in the United States are barely two years old, but already half the states have enacted them (Table 19). However, even before the final two laws, in Indiana and Oklahoma, took effect, some setbacks occurred. In the two states with binding referenda on the ballots of November, 1986, Massachusetts and Nebraska, the public voted to abolish the statutes. In the case of Massachusetts the vote was about 53% to abolish and 47% to retain. In Nebraska, the margin was close and the final tally awaited counting the absentee ballots. The issue failed by about 1,000 votes of the half million cast.

Opposition to the law is most often mounted by those who view such mandates as an infringement upon freedom of choice. Discomfort of the belts and fears of being trapped in a burning vehicle have also sometimes been mentioned as reasons for opposing belt use.

Table 19
States Enacting Mandatory Seat Belt Laws

California	Connecticut	Dist. Columbia
Florida	Hawaii	Idaho
Illinois	Indiana	Iowa
Kansas	Louisiana	Maryland
Massachusetts*	Michigan	Minnesota
Missouri	Nebraska*	New Jersey
New Mexico	New York	North Carolina
Ohio	Oklahoma	Tennessee
Texas	Utah	Washington

**repealed November 1986*

B. Belt Wearing Rates

The passage of seat belt laws has produced unprecedented levels of belt use in the United States—estimated at tens of millions of new wearers. Pre-

Table 20
Results of On-Road Surveys of Belt Use in Several States With Safety Belt Laws

State	Survey Date	Belt Usage	State	Survey Date	Belt Usage
CT	late 85	11% pre	NE	83	11% pre
	1-86	43% post		8-85	26%
	2-86	67%		11-85	44% post
	3-86	64%		2-86	38%
FL	85	22% pre	NJ	2-85	20% pre
	2-86	28%		3-85	50% post
	7-86	40-65%		7-85	42%
HI	10-85	33% pre	NY	10-84	16% pre
	2-86	76% post		1-85	69% post
				2-85	62%
IL	4-85	16% pre		3-85	60%
	7-85	40% post		4-85	57%
	1-86	29%		5-85	58%
	3-86	32%		6-85	57%
	4-86	36%		7-85	56%
				8-85	52%
IA	82	16% pre		9-85	46%
	83	11%			
	84	17%			
	85	18%			
	6-86	27%			
LA	12-85	8% pre	NC	9-85	25% pre
				11-85	44% post
MA	12-85	20% pre		1-86	42%
	2-86	37% post		3-86	45%
				5-86	48%
MI	12-84	20% pre		11-86	44%
	4-85	26%			
	7-85	58% post			
	12-85	43%			
	4-86	44%	OH	5-86	46% post
MO	83	2% pre			
	84	10%	TX	12-85	57% post
	7-85	12%		to	75%
	10-85	19% post		3-86	

from: Campbell, Stewart, and Campbell (1986)

law belt use was generally 20 percent or less. Usage in several states with laws now clusters in the 40–46% range. Three states have reported use as high as 70%. These figures are given in Table 20.*

Each state with a belt use law has used an on-road belt-counting process to record level of compliance. Although the counting methods vary slightly from state to state, differences in the results due to these small variations are not great enough to preclude comparing rates from state to state.

Several points can be made from Table 20:

1. Usage rates in the United States are well below the levels reported after the laws took effect in the foreign countries. Recall that these rates tended to be on the order of 60 to 90 %. In contrast, several American states report post-law belt use in the 36–46% range:

Illinois	36%
Michigan	44%
Nebraska	38%
New Jersey	42%
New York	46%
North Carolina	44%
Ohio	46%.

Fortunately, belt use in some states is substantially above these levels. In Connecticut belt use is reported at 64%. In Hawaii, 76% was noted. In Texas, values of 57% to 75% were observed in several cities.

2. The initial gain in belt use is not always fully sustained. In several states, Illinois, Michigan, Nebraska, New Jersey, and New York, a drop-off in observed wearing rates is clearly seen. Australia reported a similar phenomenon in some states, and successfully reversed the trend through increased promotional and enforcement efforts.

3. The pre-law baseline usage rates seem to increase over time. With exceptions, there appears to be an upward trend for states whose laws have taken effect more recently. This is consistent with the recent growth recorded in the NHTSA 19-city survey, even for cities in non-law states (Goryl and Cynecki, 1985). Such a trend is not unexpected. There has certainly been an unprecedented attempt to increase public awareness of belts during the last year or two.

*Data from Table 20, and a considerable portion of the other materials in this chapter are in the form of liberal excerpts from another study by these authors—Campbell, Stewart, and Campbell, 1986. That study was made possible by a grant from Traffic Safety Now, Inc.

Thus, belt use changed markedly with onset of the law in virtually every state reporting, but use in several states is not as high as 50%, thus limiting the casualty reduction benefit that can be expected.

Differential use rates have been observed as a function of vehicle type, sex, and day vs night driving (Campbell Stewart, and Campbell 1986). Nebraska and Illinois reported belt use by vehicle type; Florida, Nebraska, and North Carolina reported results by sex of wearer; New York reported data by time of day. These results are summarized below in Tables 21–23.

Table 21
Belt Use by Vehicle Type

State	Vehicle Type	Belt Use
Nebraska	small car	35%
	full size car	19%
	pickup/van	13%
Illinois	large auto	40%
	small auto	45%
	large pickup truck	22%
	small pickup truck	32%

In both Nebraska and Illinois belt use in pickup trucks is less than in cars, and occupants of small vehicles show higher use rates than do those of larger ones. The small vehicles are probably newer as a group because of the recent trend toward fleet downsizing, which could partly account for the differences seen in vehicles of different size. Females use belts somewhat more frequently than do males, as shown in Table 22. This sex difference is also reported in Australia, Germany and Sweden.

Table 22
Belt Use by Sex

State	Sex	Belt Use
Florida	males	27% pre-law
	females	29%
Nebraska	males	10% pre-law
	females	13%
	males	40% post-law
	females	54%
North Carolina	males	24% pre-law
	females	28%
	males	37% post-law
	females	49%

New York collected data by time of day and found that belt use was somewhat lower at night (Table 23). This is important since the night-time crash rate is higher than during the day. Australia also reports lower belt use at night. In this context, the potential synergism of increased alcohol use and decreased belt use at night is noteworthy.

Table 23
Belt Use by Time of Day

State	Time	Belt Use
New York:	day	16% pre-law
	night	12%
	day	57% post-law
	night	50%

Clearly laws in the 24 states have induced seat belt use by many who did not use belts previously. It is estimated that 30 million additional people now use belts in the 24 states alone. This is in addition to the 20 million or more already using restraints in those states (Campbell, Stewart, and Campbell, 1986).

C. Enforcement

At this early stage it is not easy to obtain reliable enforcement statistics. From the information available, it appears that enforcement intensity varies from state to state. Even within the same state, the climate of law enforcement may vary greatly from one locale to another.

In North Carolina, the State Highway Patrol is issuing more than 9,000 warning tickets per month. Though the fine has not yet taken effect, this level of motorist contact is second only to contacts for speeding violations. On the other hand, in the same state, some local enforcement officials openly say they do not approve of the law.

That enforcement can have a significant effect on belt use has been shown by studies carried out to determine the degree to which usage rates can be increased by combined enforcement and publicity campaigns. Even if some of the gains resulting from such efforts are lost after the campaign, the expectation is that usage will remain higher than before. This was demonstrated in Canada. After initial passage of the law in Ontario, usage was at about 58%. Then, in the presence of a stringent enforcement campaign, along with appropriate publicity, the rate increased to 80%. Two years later the rate was 66%, having remained higher than before the enforcement effort (Jonah, Dawson, and Smith, 1982).

A similar program carried out in Elmira, NY (Williams, Preusser, Blomber, and Lund, 1986) illustrates several key elements of such an undertaking. First, the relevant police chiefs vocally supported the program. Second, intensive publicity was insured by the purchase of significant amounts of television and radio time. As noted earlier in this report, Australian television time is purchased by the government, not only assuring that the ads are shown often, but also that they are shown at prime viewing and listening times.

In the half-month of Elmira's publicity phase, TV "spots" were aired at least 80 times on regular network television, about 500 times on cable television, and 300 times on radio. The enforcement phase that followed was likewise very active with 500 warning tickets issued during the week of "publicity plus warning tickets." In the actual enforcement phase 189 citations were issued. In a population base of approximately 35,000, this is around 540 tickets per 100,000. This enforcement level is consistent with that reported by Australia and Sweden, the two countries with the most intense enforcement levels of those studied here.

The Elmira results clearly demonstrated a favorable impact on wearing rates. Belt use rose from 49% to 77%, and had only regressed to 66% two months later. In a comparison (control) city, the already declining belt use rate seen throughout New York State continued, whereas during the same period, Elmira's rate was growing. Detailed examination of the Elmira results showed that compliance among drivers was better than for passengers; females complied more than males; older drivers more than younger drivers; and compliance was more favorable during the day than at night.

This study suggests that enforcement combined with publicity can make an appreciable difference when good support is evident from relevant public officials. However, this campaign was not an effort without cost. Though well within the reach of other communities that might wish to pursue this type of program, it does require time and effort from enforcement officers and some expenditure for increased enforcement. Increased levels of spending for publicity were also made. Occasional public service messages on TV or radio are unlikely to have the same effect. As results from the control community showed, in the absence of such a commitment to enforcement and publicity, many citizens will continue, despite the law, to forget to use their seat belts.

D. Publicity

Enormous efforts are underway in the United States to publicize seat belts. The National Highway Traffic Safety Administration is devoting unprecedented resources to publicizing seat belts and seat belt laws. However, the agency has been somewhat handicapped because Congress has not appropriated the funds for the extended campaign proposed earlier by Secretary Dole.

The auto industry-related organization, Traffic Safety Now, is perhaps placing more resources than any other single organization into promoting seat belts and seat belt laws. In addition, other leadership organizations, having now adopted public positions in favor of seat belt laws, are giving increased public support. Most states by now have also organized seat belt programs within the framework of their Governor's Highway Safety Offices.

In the private sector, other community programs are underway using a variety of devices to augment straight publicity, notably incentive programs involving prizes and/or awards for belt wearing, and corporate-sponsored belt use policies and programs.

E. Casualty Reduction

The issue of casualty reduction is examined in three parts below: (1) hospital admissions in one NY county, (2) statewide crash injury data from NC, and (3) national fatality data.

1. Hospital Admission Data

A successful seat belt law should result in favorable changes in the number and severity of motor vehicle crash injuries treated in the hospitals to which victims are brought, as has been shown in the United Kingdom. The first known report of such changes after the inception of a United States seat belt law is a report by States, Ingersoll , Amenechiarico, et al. (1986). This medical team studied hospital admissions in Rochester NY and the surrounding county during the first half of 1984, before the advent of the law, compared to the first half of 1985, when the law was in effect.

Differences in rates of hospital admissions reflect seat belt benefits accruing to those accident victims at the more severe end of the injury continuum because they represent individuals injured badly enough not merely to go to the emergency room for treatment, but to be admitted for treatment. Thus, it may be taken as suggestive of the law's beneficial effect that States and his colleagues (States, et al, 1986) found a drop in relevant hospital admissions after the New York seat belt law was in force. However, with only six months' data available, the sample size is small and the difference reported to date is not statistically significant. The figures are given in Table 24 .

Thus, while hospital admissions of control subjects, i.e. pedestrians and mo-ped or motorcycle crash victims, increased 3%, motor vehicle occupant admissions decreased 18%, even though this subject group presumably included some rear seat occupants not covered by the law. In the UK, admissions decreased 30%. This rate represents a much greater apparent benefit, but occurred in the context of the very high belt use in that country. The NY data, collected in a context of a much lower belt use rate, does not seem inconsistent with UK data.

Table 24
Post-Law Changes in Hospital Admissions in Monroe County, N.Y.

	Pre-law 1984	Post-law 1985	% Change
Subjects*	168	137	-18%
Controls**	94	97	+ 3%
Total	262	234	-11%

*occupant victims subject to the seat belt law
**pedestrian, mo-ped, and motorcycle crash victims

from: States, Ingersoll, Annechiarico, et al. (1986)

Since one characteristic of motor vehicle crashes is the multiple injuries usually sustained, it is noteworthy that the number of injuries sustained by those admitted to hospital after the law declined 31%. The decline among control subjects was only 2%. Among substantial injuries, defined as AIS 3 or greater, there was a decline of 35% among subjects, contrasted to an increase of 27% among controls. This decline in severe injuries included injuries to all body areas. This is mentioned because it is possible that injury to those parts of the body with which the seat belt is in contact might show an increase in the presence of a seat belt law. This was not the case for severe injuries in this study.

The number of minor injuries, defined as those rated AIS 1 and 2, decreased by 30%. Within this overall decrease, however, there was an increase in the frequency of mild abdominal injuries from 28 to 30, an increase in lumbar spine injuries from 2 to 4, and, curiously, an increase in upper extremity injuries from 17 to 21.

There was also a differential change in death figures among subjects and controls. For subjects, deaths declined from 19 to 8, while for controls the change was from 8 to 7.

Although States and his colleagues are properly cautious about overinterpreting the trends they found, these results are encouraging and are supportive of the findings with respect to post-belt-law injuries in other countries. The body of evidence is that belts are associated not only with a decline in pain and suffering of accident victims, but also with a clear societal benefit in terms of reduced health care costs associated with fewer hospital admissions.

2. Injury Reduction

In order to estimate the degree of change in injury rates in North Carolina associated with the introduction of the seat belt law, the state crash data

files were used to estimate the number of occupant injuries that would have been expected from October 1985 through June 1986 had the state been without a seat belt law. This forecast was then compared with what actually happened.

The forecast was based on a time series procedure whereby autoregressive, integrated, moving average models (Box and Jenkins, 1963) were fitted to the pre-law data trends. This type of regression model is designed to take account of such temporal trends as seasonal changes, variations in exposure associated with recessions, and the like. Two models were estimated: one for the monthly numbers representing the percent of all victims who were either seriously or fatally injured (A+K), and a second for the percent of all victims who suffered moderate-to-fatal injuries (B+A+K). In both cases, the pre-law data extended from January 1981 through September 1985.

The computer program, SAS PROC ARIMA, was used in the model building. Initially, autocorrelations, partial autocorrelations, and inverse autocorrelations were computed for the original data series, the first (lag 1) differenced series, and the seasonally (lag 12) differenced series. Models were identified by examining these autocorrelation functions, and were fit to the data by least squares. Modifications were made to the models when the residuals exhibited significant autocorrelation structure. The final models were then used to forecast values of the percents of A+K and A+B+K injuries for October 1985 through June 1986.

For both series the autocorrelation functions indicated that the series should be differenced prior to model fitting. The final model for the A+K series contained an autoregressive factor at lag 1 and a moving average factor at lag 11. For the A+B+K model only a moving average factor at lag 1 was needed.

The models produced forecasts of the percents of A+K and A+B+K injuries, respectively. Multiplying the forecasted percents by the actual totals of involved occupants yielded the forecasted injury frequencies listed in Table 25. This table also contains frequencies for total accident-involved occupants, A+K injuries, and A+B+K injuries from January 1984, onward. The predicted values shown for January 1984 through September 1985 are the one-step-ahead fitted values. From October 1985 onward the predicted values are forecasts made using only data through September 1985.

Summing the actual and predicted values over the period since the seat belt law has been in effect shows A+K injuries to be 8.7% lower and A+B+K injuries to be 8.5% lower than the forecast had there been no seat belt law in North Carolina. This would amount to an estimated savings, in a nine-month period, of 1003 serious + fatal injuries, and 1705 moderate injuries.

Table 25
Actual and Forecast Values for North Carolina Accident Data

Year	Month	Crash Involved Occupants	A+K Injuries	Predicted A+K Injuries	A+B+K Injuries	Predicted A+B+K Injuries
84	1	23851	921	929	2526	2557
84	2	22228	897	852	2539	2377
84	3	23017	931	923	2591	2586
84	4	24670	1022	995	2854	2784
84	5	26898	1144	1109	3182	3098
84	6	25408	1111	1082	3090	2990
84	7	26644	1101	1149	3048	3218
84	8	26078	1129	1120	3185	3044
84	9	26521	1164	1154	3202	3204
84	10	27089	1208	1215	3344	3281
84	11	29010	1287	1269	3496	3571
84	12	28238	1134	1262	3298	3435
85	1	27491	1104	1116	3231	3262
85	2	21543	903	868	2586	2547
85	3	23410	1093	973	3050	2805
85	4	24925	1136	1140	3125	3176
85	5	27136	1283	1240	3450	3429
85	6	26199	1258	1249	3434	3334
85	7	27178	1251	1305	3370	3540
85	8	28745	1294	1337	3578	3630
85	9	24902	1134	1132	3135	3122
SEAT BELT LAW						
85	10	30439	1168	1385	3327	3838
85	11	31893	1295	1495	3554	4033
85	12	29788	1106	1399	3205	3777
86	1	24684	1066	1154	2886	3139
86	2	23655	1014	1081	2711	3016
86	3	27703	1194	1278	3175	3542
86	4	26436	1191	1213	3238	3389
86	5	27859	1196	1283	3402	3582
86	6	26306	1284	1229	3501	3391

3. Fatality Reduction

Preliminary analyses of fatality data from the first eight states to pass seat belt laws have now been reported. In general, front seat occupant fatalities in those states have declined about 10% compared to non-law states over the same time span. This is a savings of about 400 lives in the states in question, and, if projected nationally, would amount to approximately 2000 lives per year saved. Other classes of fatalities not designed to be influenced by the law—such as pedestrian victims—changed very little (Campbell, Stewart, and Campbell, 1986). This assertion is based on data supplied by the Fatal Accident Reporting System (FARS), a national census of fatal motor vehicle crashes drawn from the respective state crash data files provided by the NHTSA.

For purposes of the present analysis, three groups of fatalities were defined:

(a) *target occupants:* defined as front seat occupants of vehicles normally covered by seat belt laws—such as cars, pickup trucks, vans, etc.

(b) *other occupants:* defined as vehicle occupants and riders not targeted by the seat belt laws—such as rear seat occupants of cars, motorcycle riders, etc.

(c) *others:* fatalities among bicyclists, pedestrians, etc.

All fatalities were allocated into one of these three groups. The 50 states were divided according to the eight that had belt laws versus the 42 that did not. Then, for these six groups (three fatality classes × two state groups), monthly fatalities were examined over a span of eleven years from 1975 through 1985.

A time series model (Box and Jenkins, 1976) was used to analyze the results. For each of the three fatality groups a comparison was made of the relative trend in the eight belt law states compared to that of the 42 non-law states in aggregate. Of particular interest was any shift that coincided with the time of the law's onset in each state.

Table 26 shows the percent change in each of the three fatality groups in each of the eight states. The percent change reflects a comparison of the fatalities that actually occurred in each state versus the number of fatalities forecasted had no seat belt law intervened.

In turn, Table 27 gives calculations of the estimated changes in number of fatalities for each state, based on the changes shown in Table 26.

Table 26
Percent Change in Fatalities in Belt Law States Relative to Non-law States

State	Target Occupants	Other Occupants	Other
NY	- 8.3% p<.10	+ 11.3% n.s	- 2.5% n.s.
NJ	- 5.8% p=.10	- 21.5% p<.05	+ 4.8% n.s.
IL	- 9.3% n.s	+10.6% n.s	+ 2.2% n.s.
MI	-16.3% p<.10	+ 6.1% n.s.	-11.5% n.s.
NB	-11.3% n.s.	+17.4% n.s.	+ 0.6% n.s.
TX	-17.6% p<.01	- 31.8% n.s.	- 0.8% n.s.
NC	- 0.4% n.s.	- 8.9% n.s.	- 8.6% n.s.
MO	+4.6% n.s.	-35.9% n.s.	-22.9% n.s.

n.s. = not statistically significant
p values of .10 or less cited
from: Cambpell, Stewart, and Campbell, 1986.

Table 27
Observed versus Forecast (Expected) Fatalities by State

	Class of Victim					
	Target Ocupants		Other Occupants		Others	
State	E	O	E	O	E	O
NY	1059	971	335	373	632	616
NJ	480	452	149	117	230	241
IL	504	457	161	178	185	189
MI	547	458	172	202	166	167
NB	62	55	22	16	12	11
TX	818	676	212	225	253	224
NC	225	224	56	51	70	64
MO	175	192	39	25	35	27
TOTAL	3870	3485	1146	1186	1583	1539
diff.		-395		+40		-44
% change		-9.9%		+3.5%		-2.8%

from: Campbell, Stewart, and Campbell, 1986.

Several points can be made from the above. First, the largest change, a decline of 9.9%, occurred in the target occupant group, and the change was in the expected direction. Second, the declines in fatalities among target

occupants for several individual states were statistically significant. The change in the eight states as a group seems almost certain to be statistically significant, though it is not obvious, using this model, how one would aggregate these independent models and test the aggregate for statistical significance. Third, of all the changes in non-targeted occupants, only one was significant. The overall change in "other" fatalities in the eight states was small relative to the decline seen among targeted occupants.

On the basis of all results presented here, and on the basis of early experience with seat belt laws in the United States, the authors conclude that it is fair to say that our results will not be unlike those of other nations. Although we have not as yet attained use rates to match those of the other nations considered here, it does appear that such laws will make a significant difference in the casualty levels associated with highway crashes, just as has been true in other countries. Under conditions of mandated use of seat belts in the United States, reductions in fatalities, injuries, and hospital admissions have occurred, consistent with the 40–45% compliance level so far achieved here.

CHAPTER SIX

DISCUSSION

A. Introduction

At the outset of this study the authors assumed it might be a straightforward task to identify key factors in the successful seat belt programs of foreign countries that were as yet absent in the United States. The hope was that such information could be used to enhance implementation of seat belt laws in this country.

It is necessary to acknowledge, however, that it is not clearly obvious why belt use is much higher in Australia, Sweden, West Germany, and the United Kingdom than has so far been observed in the United States. Most of the elements deemed to be important to the success of such laws are operative in the United States as well as in the foreign countries—endorsement of the law by leadership groups and the government, publicity, and enforcement. There are, however, certain differences between the other nations and the United States which may be relevant, and some of these will be discussed below, though such discussion is necessarily speculative.

B. Readiness for Seat Belt Laws

Part of the differential success of the laws in the United States and foreign countries may be attributable to differences in the degree to which the respective citizens were ready for the mandate. In the United States, widespread organized support for seat belt laws is comparatively recent. Only within the past few years have leading safety organizations, the federal government, and the auto industry endorsed such laws. Soon thereafter several state legislatures began to consider such laws and a number were passed, sometimes by relatively narrow margins. Thus, in some states the legislature may have been at the very leading edge of public support, or perhaps even ahead of it, as implied by the two recent actions to repeal. In other states compliance is high enough to indicate solid public support.

With respect to readiness for the mandate, Sweden provides an interesting contrast. As characterized by Dr. Aldman (1986), Swedish law required manufacturers to install belts in cars as standard equipment only after about half that nation's cars were so equipped, and belt use was mandated only after

the voluntary wearing rate approximated 50%. To the extent that these characterizations are correct, it seems likely that the Swedish population was generally ready for the law when it was introduced. There, the seat belt law may have been perceived simply as a logical extension of current, well-accepted practice.

C. Controversy Regarding Occupant Restraint Issues

If there has been less readiness for the mandate in the United States, the controversy surrounding occupant restraint must surely have played a part. In the foreign countries, scientists and government officials presented a united front on the subject of occupant restraints, and the thrust was to move in the direction of seat belt laws. In contrast, in the United States, there was significant public controversy over the merits of seat belts versus automatic restraints, and it was often expressed as an "either/or" matter. The issue was a point of dispute by factions within automobile companies, insurance companies, consumer groups, the scientific community, and the government, and was contested between these interests as well. This may have worked to the detriment of acceptance of occupant restraint in any form by creating public skepticism on the issue.

It should be noted that the controversy between the automatic restraint approach versus seat belt use (voluntary or mandated) is not merely a disagreement over which technology is superior. The argument touches basic philosophical issues concerning individual versus government responsibility for assuring reasonable public safety. Feelings sometimes run deep on the issue, which is usually true when strongly held belief systems are opposed.

D. Publicity

One difference between the United States and foreign countries is the degree to which official sources have been able to make use of media to get and keep the seat belt message before the public. Publicizing belts is more difficult in the United States because of the general prohibition against government-purchased air time. Also, the large number of competing media outlets make it more difficult to reach a large proportion of the audience.

The successful foreign countries have heavily publicized the advantages of seat belts. Public education about the efficacy of belts and advocacy of their use sometimes went on for years before advent of the law itself. The level of effort varied from country to country, with Australia at the forefront in keeping the safety message before the public. There, as discussed earlier, the government plays a central role by directly purchasing substantial amounts of media time. Related to the greater official access to TV in foreign countries is the fact that there is less competition for the audience since these countries have fewer TV channels.

E. Enforcement

In the foreign countries there is not a clear relationship between levels of belt use and apparent levels of enforcement. High rates of use sometimes accompanied relatively high enforcement rates, but in other instances, high use was seen in the face of relatively low levels of enforcement. In the United States as well, the relationship is not simple. In some cases, despite relatively high enforcement, use is still not as great as would be hoped.

In North Carolina, for example, even though in 1986 the law still calls only for warning tickets (no fine), the State Highway Patrol is averaging about 9,000 such warning tickets per month for failure to wear the belts. This represents a higher rate of contact per capita than appeared to exist in any of the foreign countries surveyed. Nevertheless, belt compliance in North Carolina is only about 42%. It will be instructive to find what change may occur in NC when the fine is instituted on January 1, 1987.

There is, however, evidence that enforcement campaigns can indeed result in substantially higher levels of compliance—at least when the initial level of compliance is not very high. The enforcement emphasis program in Elmira, NY raised belt use rates from 49% to 77%. In this campaign there was a highly visible commitment to enforcement of the law by police, and sufficient financial support was allocated to pay for the necessary levels of enforcement and publicity.

On the other hand, in the case of Australia, where belt use was already in the 80–90% range, wide differences in enforcement did not lead to substantial differences in level of use. That outcome is perhaps to be expected. That is, when belt use is comparatively low, enforcement may effect a large change, but if compliance is already high, increased enforcement may have less impact. Under circumstances of high compliance modest enforcement may be enough to retain the high rates, but "hard core" non-wearers may remain relatively indifferent even to a stringent enforcement program.

F. Characteristics of the Respective Societies

The success of any attempt to effect widespread change in long-established habitual behaviors, such as the American habit of driving while unrestrained, depends in part on an understanding of the characteristics of the target population. In this part of the discussion consideration is given to such issues as socioeconomic status (SES), literacy, and the ethnic homogeneity of the populations of the various nations. All of these factors may impact upon the successful implementation of seat belt laws.

Socioeconomic differences within the population of the United States could be a relevant factor because of the relatively widespread use of private cars among the poor in America. America is considered the wealthiest large

nation on earth, but we may actually have a greater range of socioeconomic differences than exists in the foreign countries studied. That is, there may be a greater proportion of both affluent people and poor people.

Because of the unavailability of public transportation, and the presence of urban sprawl which can lead to considerable distance between workplace and dwelling, the motor car is more deeply integrated into the fabric of American society than is the case in many other countries. Thus, for many Americans, a private car is an economic necessity if employment is to be maintained. This is particularly true of low-income individuals whose vocational options are already limited. In other countries, people in the lower SES range might be more likely to use public transportation or to own motorcycles, mopeds, or bicycles rather than cars.

The fact that more low-income individuals in America may be owners or users of private cars is relevant to the issue of seat belt use because of the well-documented fact that seat belt and child restraint use is lowest among persons of lowest SES (Allen and Bergman, 1976; Freedman and Lukin, 1977; Hletko, Hletko, et al., 1983; Jones, 1979; Kielhorn and Westphal, 1980; and Philpot, Heathington, et al., 1979).

Related to SES differences is the issue of literacy. Although relatively high in all the countries considered here, literacy rates are higher in all four foreign countries than in the United States. In fact, in Australia, Germany, and the United Kingdom, literacy is considered to be universal. Lower literacy in the United States could impede the effectiveness of safety education efforts particularly if literacy is lower among groups at higher risk of crash injury.

An important part of the final success of seat belt programs in the USA is related to the ability of public officials to reach lower SES persons and persuade them to become belt users. Experience in other areas of health service delivery suggests this may be a difficult task (Wan, 1977; Bullough, 1972), and that special means must be devised.

Still another factor that may have a bearing on success is the relative homogeneity of ethnic background within a country. Sweden and West Germany, despite some recent influx of immigrants, are examples of small countries with ethnically homogeneous, well-educated populations. Australia too, despite its history of colonial settlement and a certain degree of cultural diversity, has only a very small, relatively encapsulated ethnic minority population.

On the other hand, the United States is clearly the most ethnically diverse of the five nations considered in this study. This is important in part because of the link between ethnic minority status and depressed SES. In addition to the economic factors involved, however, it has been suggested that ethnic minorities may, as a function of a conscious or unconscious need to maintain their ethnic identity, sometimes tend to reject mandates handed down by the "external" majority culture (Baber, 1984).

In such a complex and multiply-determined behavior as the wearing of seat belts in compliance to a new law, no single one of the demographic factors noted here could be expected to account for much of the variance seen, but all may enhance or impede the success of the laws to a certain extent.

Finally, it should be emphasized that the points presented above should not be construed as an attempt to ascribe to the poor the major responsibility for disappointing use levels and poor compliance with seat belt laws. Such is emphatically not the case. Compliance with seat belt laws is far from perfect in other segments of the population. It still leaves much to be desired among middle class America!

G. Concluding Thoughts

The possible reasons offered herein why the success with belt laws may be somewhat less in the United States than in some of the foreign countries may suggest avenues to follow in attempts to overcome some of the problems noted. The issue is not a trivial one. We have as much or even more to gain from the success of such laws as do any of the foreign countries. As a stand-alone issue, the further enactment of and high public compliance with belt laws can save thousands of lives. Moreover, the success of seat belt laws is not a stand-alone issue. Belt law compliance is related to the success of automatic restraints. Automatic restraints are now public policy in the United States, and in less than a year we will have both seat belt laws and automatic restraints in our country. Seat belt laws are an important component of the success of the automatic restraint policy. Belt laws will place the sanction of government against the disabling of automatic seat belts in cars so equipped, and in air bag-equipped cars, the belt will help to assure that the occupant rides positioned as intended in the air bag design.

Clearly there are many elements involved in achieving a high compliance rate in the United States and much to be gained therefrom. Ultimately, however, the success of this effort depends upon the commitment of the individual motorist to the process. No law can succeed otherwise. With appropriate public support, sensitivity to public perceptions and attitudes, consumer education, and enlightened enforcement, the United States has a chance to match the success seen in the best of other nations.

REFERENCES

Adams, J.G.U. (1985). Risk and freedom. Cardiff (Wales). Transport Publishing Projects.

Aldman, B. (1986). Personal communication. Gothenburg: Chalmers University of Technology.

Allen, D.B. and Bergman, A.B. (1986). Social learning approaches to health education: Utilization of infant auto restraint devices. *Pediatrics*, 58(3): 323–328.

Andreassend, D.C. (1972). The effects of compulsory seat belt wearing legislation in Victoria. Canberra (Australia): National Road Safety Symposium.

Ashton, S.J. and Mackay, G.M. (n.d.). Mandatory seat belt use and risk compensation. Birmingham (England): University of Birmingham.

Baber, G.A. (1984). Patterns of seat belt use among an upper middle income black community with implications for public health practice. Master's thesis, University of North Carolina, Chapel Hill.

Bohlin, N.I. (1981). Refinements of restraint system design—a primary contribution to seat belt effectiveness in Sweden. In *Proceedings of the International Symposium on Occupant Restraint*. Morton Grove, IL: American Association for Automotive Medicine.

Box, G.E.P. and Jenkins, G.M. (1976). Time series analysis: Forecasting and control. San Francisco: Holden-Day.

Breen, J. (1986). Parliamentary advisory council for transport safety. Ms. Breen kindly provided a special briefing for the authors.

Britannica Book of the Year (1986). Chicago, IL: Encyclopedia Britannica.

Bullough, G. (1972). Poverty, ethnic identity and preventive health care. *Journal of Health and Social Behavior*, 13: 347–359.

Campbell, B.J. (1984). Safety belt injury reduction related to crash severity and front seated position. Chapel Hill, NC: University of North Carolina Highway Safety Research Center.

Campbell, B.J., Stewart, J.R. and Campbell, F.A. (1986). Early results of seat belt legislation in the United States of America. Chapel Hill, NC: University of North Carolina Highway Safety Research Center.

Chi, G.Y. (1980). The effects of belt usage misclassification errors on seat belt effectiveness estimates. Chapel Hill: University of North Carolina Highway Safety Research Center.

Cowley, J.E. and Cameron, M.H. (1976). Prediction of motor vehicle occupant fatality trends following seat belt wearing legislation. In *Australian Royal Research Board proceedings*, Vol. 8, Session 27.

Crinion, J.D., Foldvary, L.A., and Lane, J.C. (1975). The effects on casualties of a compulsory seat belt wearing law in South Australia. *Accident Analysis and Prevention*, 7(2): 81–89.

Dale, M. (June 1986). Personal interview. United Kingdom Department of Transport.

Durbin, J. and Harvey, A.X. (1985). The effects of seat belt legislation on road casualties in Great Britian: Report on assessment of the statistical evidence. In *Report on compulsory seat belt wearing*. London (England): United Kingdom Department of Transport.

Federal Department of Transport (1985). Summary of national road crash statistics, October 1985. Canberra (Australia): Federal Office of Road Safety.

Foldvary, L.A. and Lane, J.C. (1974). The effectiveness of compulsory wearing of seat belts in casualty reduction. *Accident Analysis and Prevention*, 6(1): 59–81.

Freedman, K. and Lukin, J. (1977). Occupant protection for children: A survey of restraint usage, attitudes, and knowledge. New South Wales (Australia): Department of Motor Transport, Traffic Accident Research Unit.

Friedel, B. and Marburger, E.A. Belt usage rates in the Federal Republic of Germany and their medical consequences. In *American Association for Automotive Medicine, 30th proceedings*, pp. 397–407. Montreal (Canada).

Goryl, M.E. and Cynecki, M.J. (1985). Restraint system usage in the traffic population. 1984 annual report. Southfield, MI: Goodell-Grivas.

Grimm, A.C. (1984). Restraint use laws by country, as of August, 1984. *UMTRI Research Review*, 15(1).

Hall, W.L., Woodward, A.R., Ma, J.M., et al. (1984). The use of telephone interviews to verify the reliability of police accident reports on assessing the effectiveness of child safety seats. Chapel Hill, NC: University of North Carolina Highway Safety Research Center.

Hedlund, James (1985). Casualty reductions resulting from safety belt use laws. In *Effectiveness of safety belt use laws: A multinational examination*. Washington, DC: National Highway Traffic Safety Administration. [DOT HS 80 7018].

Henderson, M. and Wood, R. (1973). Compulsory wearing of seat belts in New South Wales, Australia: An evaluation of its effects on vehicle occupant deaths in the first year. *Medical Journal of Australia*, 2: 797–801.

Hletko, P.J., Hletko, J.D., and Shelness, A.M., et al. (1983). Demographic predictors of infant car seat use. *American Journal of Diseases of Children*, 137: 1061–1063.

Johnson, I. and Cameron, M. (1979). The use of TV publicity to modify seat belt wearing behavior. Canberra (Australia). Australian Government Publishing Service.

Jonah, B.A., Dawson, N.E., and Smith, G.A. (1982). Effects of a selective traffic enforcement program on seat belt usage. *Journal of Applied Psychology*, 67: 89–96.

Jones, D.W. (1979). An exploratory study of attitudes and observations on child protection in motor vehicles. *Automotive Medicine Journal*, 1(4): 26–29.

Joubert, P.N. (1981). Development and effects of seat belt laws in Australia. In *Proceedings of International Symposium on Occupant Restraint.* Morton Grove, IL: American Association for Automotive Medicine.

Kahane, C.J. (1986). An evaluation of child passenger safety: The effectiveness and benefits of safety seats. Washington, DC: National Highway Traffic Safety Administration. [DOT HS 806 890].

Kielhorn, T.G. and Westphal, J. (1980). A study of the use and non-use of child restrain· ·evices in metropolitan Oklahoma. Oklahoma Highway Safety Office.

Lekander, ,. , 1986). Personal communication. Swedish Road Safety Office.

Mackay, M. (1985). Two years' experience with seat belt laws in Britain. Warrendale, PA: Society for Automotive Engineering. [SAE Technical Paper Series 851234].

Marburger, E.A. and Meyer, L. (1986). Effectiveness of safety belts and explanation of the use rate in Germany from the imposition of the law (1974) to the imposition of the fine (1984). *Zeitschrift fur Verkehrssicherrheit*, 32(2): 82–91.

Marburger, E.A. (1986). Legislation, usage rates and reduction of injuries and fatalities in the Federal Republic. Federal Highway Research Institute of Germany.

Marburger, E.A. (1985). Safety belt usage rates. In *Effectiveness of safety belt use laws: A multi-national examination.* Washington, DC: National Highway Traffic Safety Administration. [DOT HS 80 7018].

Mela, D.E. (1974). How accurate are seat belt statistics? *Highway Safety Highlights*, 7(12).

Miller v. Miller (1968). 273 N.C. 228. Raleigh, NC. N.C. State Supreme Court.

Milne, P.W. (1979). Fitting and wearing of seat belts in Australia: The history of a successful countermeasure. (Australia): The Department of Transport. [Office of Road Safety Report No. 0R2].

Milen, P.W. (1986). Summary of the current situation related to restraint usage in Australia. Personal communication.

Motor Vehicle Manufacturers Association of the United States (1985). MVMA facts and figures–1985. Detroit, MI: Motor Vehicle Manufacturers Association.

National Safety Council (1984). Vehicle damage scale for traffic accident investigators. 3rd ed. Chicago, IL: National Safety Council.

National Safety Council (1986). Accident facts–1986 edition. Chicago, IL: Author.

Norin, H., Carlsson, G. and Korner, J. (1984). Seat belt usage in Sweden and its injury reducing effect. Warrendale, PA: Society for Automotive Engineering. [SAE Technical Paper Series 840194].

Official Statistics of Sweden (1984). People on the road in Sweden. Stockholm (Sweden): Statistics Sweden (SCB).

Partyka, S.C. (1984). Simple models of fatality trends using employment and population data. *Accident Analysis and Prevention*, 16(3): 211–222.

Philpot, J.W., Heathington, K.W., Perry, R.L., et al. (1979). The use of child passenger safety devices in Tennessee. Knoxville, TN: The University of Tennessee.

Pless, B.L. and Rohmann, K.J. (1978). Safety restraints for children in automobiles. Who uses them? *Canadian Journal of Public Health*, 69: 289–292.

Road accidents in Great Britian (1984). Middlesex (England): Department of Transport.

Road Traffic Authority (1985). Road safety initiatives and countermeasures. Hawthorne, Victoria (Australia): Road Traffic Authority [Report No. 4/85].

Road Traffic Board of South Australia (1982). Seat belt usage before and after a multi-media advertising campaign. [Mimeographed and bound].

Rouse, W. and Gendre, F. (1969). Field experience and evaluation of the TAD vehicle damage rating scale. Chapel Hill, NC: University of North Carolina Highway Safety Research Center.

Rutherford, W.H., Greenfield, T., Hayes, A.R.M., et al. (1985). The medical effects of seat belt legislation in the United Kingdom. London (England): Department of Health and Social Security.

Scott, P.P. and Willis, P.A. (1985). Road casualties in Great Britain in the first year with seat belt legislation. (England): Department of Transport. [TRRL Research Report 9].

Seidenstecher, K. (1981). Laws on mandatory seat belt use and their enforcement in the Federal Republic of Germany. In *Proceedings of International Symposium on Occupant Restraint*, Morton Grove, IL: American Association for Automotive Medicine.

States, J.D., Ingersoll, S.L., Annechiarico, R.P., et al. (1986). The effect of the New York State safety belt law on hospital admissions in Monroe County (Rochester) New York. In *Proceedings of the American Association of Automotive Medicine.* Montreal (Canada).

Tingvall, C. (1982). Is Adams right? Some aspects on a theory concerning effects of seat belt legislation. Uppsala Universitet Statistiska Institutionen.

United Kingdom Department of Transport (1986). Report on compulsory seat belt wearing. London (England).

Vaaje, T. (1986). Effectiveness of safety belt use laws: A multinational examination. Washington, DC: National Highway Traffic Safety Administration. [DOT HS 807 018].

Vilardo, F. (1972). Vehicle damage scale for traffic accident investigators: An investigation of its use and potential for predicting driver injury. Chapel Hill, NC: University of North Carolina Highway Safety Research Center.

Wan, T. (1977). The differential use of health services: A minority perspective. *Urban Health*, 6: 48–52.

Williams, A.F., Preusser, D.F., Blomberg, R.D., et al. (1986). Results of a seat belt use law enforcement and publicity campaign in Elmira, N.Y. Washington, DC: Insurance Institute for Highway Safety.

Woodward, A., McLean, Jr., and Somers, R. (n.d.). Some proven road safety measures for South Australia.

LIST OF SOURCES FOR SEAT BELT USE DATA

Connecticut: (March 5, 1986). Release from Connecticut Safety Belt Coalition.

Florida: Sapolsky, B. and Stanley, L. Seat belt use in an observational survey in selected Florida cities. Florida State University, College of Communication.

Hawaii: Kim, K.E. (1986). Hawaii's mandatory seat belt law: An initial evaluation. Manoa, Hawaii: University of Hawaii.

Illinois: Sidhu, C.S. (1985). Illinois occupant restraint usage survey plan. Springfield, IL: Illinois Department of Transportation. [Note also several subsequent reports].

Iowa: Iowa Department of Transportation (1986). Observational survey of restraint use (methods and preliminary results). Des Moines, Iowa: Iowa Department of Transportation.

Louisiana: Lago, J.A. (1986). Louisiana state observational survey of safety belt usage. Rockville, MD: Westat.

Massachusetts: Personal contact with Governor's Office of Highway Safety.

Michigan: Wagenaar, A.C., Wiviott, M.B.T. and Businski, K.L. (1986). Direct observation of seat belt use in Michigan: December 1985. Ann Arbor, MI: University of Michigan Transportation Research Institute.

Missouri: The Missouri Safety Center (1985). Survey of Missouri community's safety belt and child restraint use for 1985. Warrensburg, MO: Central Missouri State University.

Nebraska: Williams, J.B. (1983–and later monographs). Drivers and children safety restraint observation study—a study for the Nebraska Office of Highway Safety. Elmwood, NB.

New Jersey: (June 4, 1986). Communication from David Kaye Manning, Selvege and Lee, Inc., and from Mr. William Hayes, N.J. Office of Highway Safety.

New York: Rood, D.H., Kraichy, P.P., and Carubia, J. (1985). Observational survey of restraint use in New York State. Institute for Traffic Safety Management and Research.

North Carolina: Highway Safety Research Center (1986). Evaluation of North Carolina's occupant restraint law: continuous data monitoring. Chapel Hill, NC: University of North Carolina Highway Safety Research Center.

Ohio: (n.d.). Memo from Clark-Jones, Inc. [Unsigned].

Texas: (May 21, 1986). News release. Austin, TX: Texas State Department of Highways and Public Transportation.