SEAT BELTS UNDER A VOLUNTARY REGIME

Some aspect of use related to occupant and vehicle characteristics, and driving behaviour

by

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INTRODUCTION

A risk compensation theory of human behaviour has been prevalent in the field of accident research for many years. Taylor (1964) for example observed the galvanic skin response (GSR) of drivers to a variety of traffic situations, intersections, curves and other hazards, and found the speed was adjusted in relation to perceived external hazards in an attempt to maintain a stable level of emotional tension as measured by GSR.

Such observations have been generalised into a risk homeostasis theory by Wilde (1981) where it is proposed that drivers increase speeds after the introduction of some permanent safety improvement. The use of GSR has been criticised on the grounds that it does not relate directly to the subjective probability of an accident, but is influenced by other intrinsic, rather than extrinsic factors (O'Neill, 1977).

The Peltzman hypothesis has been widely quoted; in essence Peltzman examined U.S. accident and death rates from 1947 to 1974 (Peltzman, 1975). He concluded that the introduction of seat belts for all car seats, energy-absorbing steering columns, improved windscreens, dual-braking systems and padded instrument panels had failed to reduce traffic deaths. The hypothesis put forward to explain the absence of an expected reduction was that drivers increase their "driving intensity" as a compensation measure and thereby increase the risk of accidents. Conybeare (1980) in Australia conducted a similar analysis and suggested that the introduction of seat belt laws in Australian states had reduced deaths and injuries to car occupants, but a collective compensation process was operating so that there was an increase in deaths and injuries among non-car occupants such as pedestrians.

The essence of the risk compensation theory is that at both the individual and the collective level, drivers adjust their risk taking behaviour (which may or may not correlate with actual accident involvement) in order to keep their perceived levels of risk constant. Hence the provision of a measure which decreases either their exposure to accident involvement or the risk of receiving injury once a collision occurs, in reality results in behavioural change which diminishes the effect of the new measures.

O'Niell (1977) discusses a utility maximisation model of driving behaviour. Drivers, assumed to be rational, behave so as to maximise their expected gains from each environmental demand. Their objectives are to reach their destinations quickly and safely. If an external improvement in safety is introduced "rational drivers may react so that a safety innovation makes matters worse".

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The Peltzman hypothesis has been criticised by Joksch (1976) who found important omissions of some variables which make the model unreliable. More recently the Peltzman hypothesis has been adopted by Adams (1981) to explain some conclusions which he drew from an analysis of mortality figures from 17 countries. Adams proposes that "protecting car occupants from the consequences of bad driving encourages bad driving". His analysis took the form of two composite indices. 13 countries were selected which had introduced compulsory seat belt legislation and the total number of road deaths (car occupants, pedestrians, motorcyclists and others all aggregated together) were standardised to a 1971 base. The experience of those countries from 1971 to 1978 was then compared with an index from four countries which had no compulsory belt use laws, Japan, Italy, the United States and Britain, for the same period. This comparison purported to show that the greater reduction in total road deaths of all types which occurred in the four "non-law" countries in comparison to 13 "law", was because the introduction of seat belt laws increased road deaths. The methodology however is flawed because in the "law" group not all those countries introduced that law in 1971. The laws were introduced at different times between 1970 and 1977. If the analysis is conducted by shifting the countries from the "non-law" to the "law" group at the time that each country actually introduced a seat belt law, then the conclusion drawn by Adams is reversed. A number of other criticisms such as the use of all road deaths rather than just car occupant deaths in the analysis have been made (New Scientist 1981). Nevertheless the more general question remains, to what extent, if at all, does a risk compensation theory apply to the use of seat belts?

In a fundamental sense, risk compensation is likely to operate in the situations where a clear feedback exists between the presentation of risk and the driver. This occurs with most primary safety characteristics such as braking, handling and night-time visibility, factors which influence accident avoidance.

For example, Rumar et al (1976) observed that drivers using studded tyres on icy roads maintained higher speeds, but they did not take full advantage of the increased grip available and therefore were also driving with higher safety margins than drivers without studded tyres. A rather similar study (Wilson and Anderson, 1980) compared drivers' reactions to cross-ply and radial-ply tyres. No significant speed differences were measured, perhaps because drivers did not perceive the additional safety margin available with this particular feature. Evans and Herman (1976) examined headway acceptance in relation to acceleration ability of the car, and found that drivers accepted smaller headway gaps in a crossing manoeuvre in cars with a high acceleration performance.

In the secondary safety area, if anything, the risk compensation theory appears to be reversed. Van Buseck et al (1980) observed headway distances and seat belt wearing on a Detroit freeway. Seat belt users, under a voluntary regime, had longer headways than non-users. Deutsch et al (1980) examined intersection behaviour and found that non-users of seat belts jumped red traffic lights more frequently than belted drivers.

The study reported here explores some aspects of belts use in relation to the above theories. It represents the first part of a before and after comparision of a mandatory use law for seat belts which is due to be enacted late in 1982 in Britain.

THE METHODOLOGY

This project examines seat belt use in relation to travelling speed of cars and also some other aspects of belt use and vehicle features. Three rural sites were chosen where free flow conditions could be measured, and speeds were recorded by a disguised radar meter. Observations were limited to weekdays and daylight hours. Speed, car make and model, car age (from the last letter of the registration number, a felicitous feature of the U.K. system), driver and front passenger sex and belt use were recorded on magnetic tape. Throughout the data collection periods it was sunny and dry.

RESULTS

Speed - Approximately 1000 cars were sampled at each of three sites. Table 1 shows the mean speeds at each site and the maximum and minimum values for belted and unbelted drivers. The range of speed is of interest, at site B for example it was from 31 to 90 m.p.h. for unbelted drivers with a mean value of 49.2 m.p.h. At all sites the overall national speed limit of 70 m.p.h. applied. No consistent differences between belt wearing and speed emerge from these results.

The data from the three sites were aggregated and compared in Fig. 1 for belt usage. The difference in the mean speeds, 48.01 m.p.h. for belted drivers and 47.07 m.p.h. for unbelted drivers, was 0.94 m.p.h. The seat belt usage rate was 36.4%. Clearly the difference in the mean speeds of less than 1 m.p.h. is of little importance.

Fig. 2 shows the speed distributions by sex of driver and belt use. Overall wearing rates were 35% for male drivers and 40% for female drivers, that being a significant result. The mean speeds for male drivers belted and unbelted were 48 m.p.h. and 47 m.p.h. respectively. For female drivers the mean speeds were 47 m.p.h. and 46.6 m.p.h. for belted and unbelted conditions. The differences in the mean speeds were negligible.

These results suggest that seat belt use, if it does provide a sense of security, does not translate into faster driving. This is contrary to a suggestion by Adams (1981) that belt use increases the risk to other road users

Table 1 - Speeds and Belt Use

Speeds in m.p.h. B = drivers belted, NB = drivers not belted

	Minimum		Maximum		Means		$\overline{N}$
	B	NB	B	NB	B	NB	
Site A	25	21	74	71	44.6	44.9	989
Site B	33	31	85	90	50.4	49.2	1048
Site C	32	30	67	73	48.3	47.1	1060

such as pedestrians and motorcyclists.

In contrast to belt use, other variables relate more markedly to vehicle speeds. Table 2 gives the mean speeds for certain vehicle characteristics aggregated for the three sites.

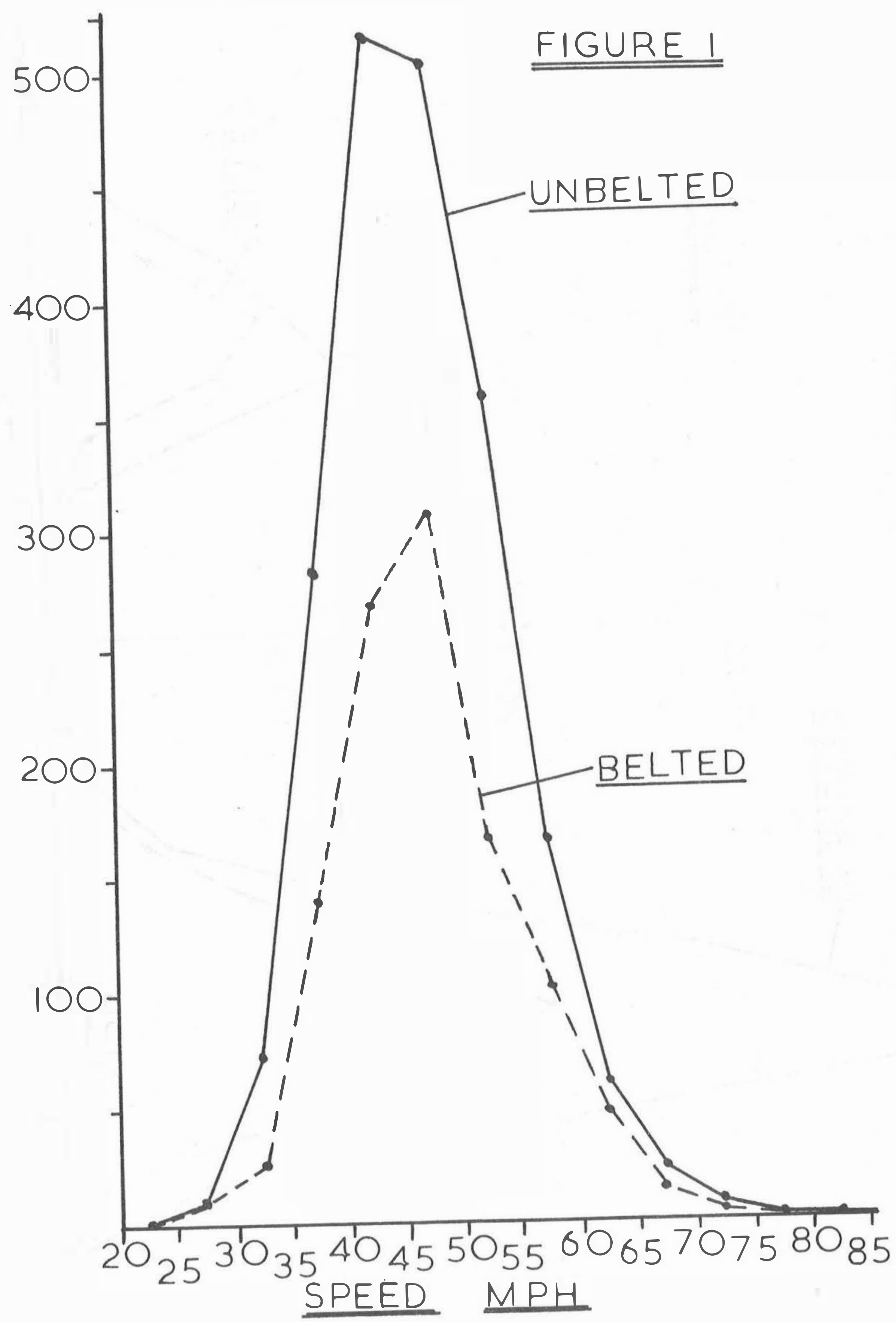
FIGURE 1
UNBELTED
BELTED
500
400
300
200
100
20 25 30 35 40 45 50 55 60 65 70 75 80 85
SPEED MPH

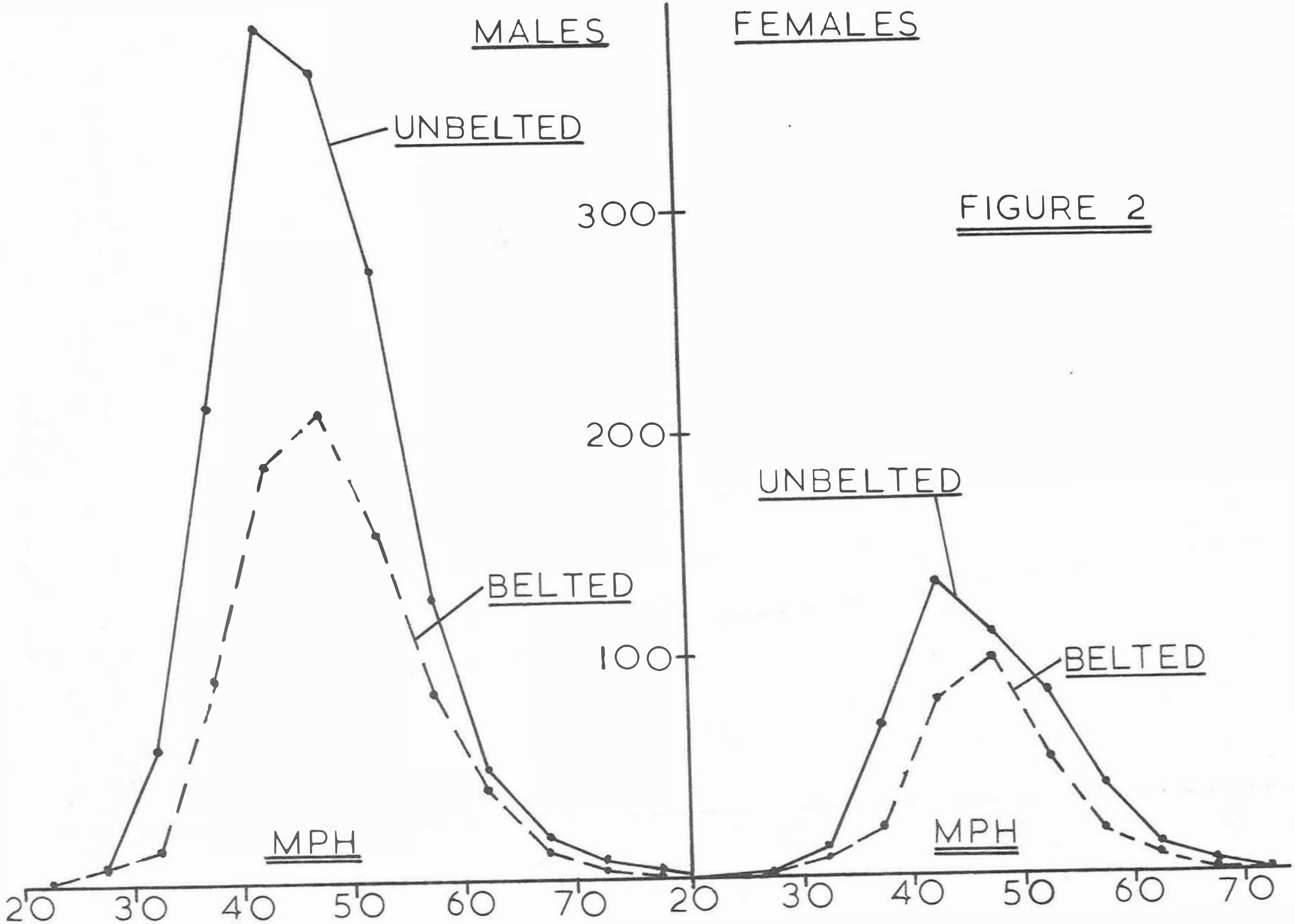
MALES
FEMALES
UNBELTED
BELTED
UNBELTED
BELTED
300
200
100
MPH
MPH
20
30
40
50
60
70
20
30
40
50
60
70

FIGURE 2

Table 2 - Speed and Vehicle Class, Nationality and Age

Vehicle Class

	Small	Medium	Large	Sports	Significance
Mean Speeds (mph)	45.91	47.32	49.54	50.29	F. Stat. @ 0.0001

Vehicle Nationality

	U.K.	European	Japanese	Significance
Mean Speeds (mph)	47.25	47.94	47.5	F. Stat. @ 0.113

Vehicle Age

	pre-1975	1975-78	post 1978	Significance
Mean Speeds (mph)	45.55	47.31	48.43	F. Stat. @ 0.0001

Vehicle nationality showed no significant variation with speed. Vehicle class and age were highly significant however, with newer larger vehicles travelling faster than older smaller ones. These results suggest that additional vehicle performance does in fact get used in the sense of giving somewhat higher travelling speeds, and in particular the sports category of car does in reality travel faster under free flow conditions. These results are in accord with Smeed (1973) who found that vehicle speeds were directly related to power/weight ratio and inversely related to vehicle age. More recent work (Lines 1981) has confirmed this trend and the general conclusion is that additional "performance", which is an expression of the characteristics of available power, handling and braking, i.e. active safety features, do result in increased speeds.

BELT USE AND VEHICLE CHARACTERISTICS

In relation to vehicle factors little work has been done on belt use; most previous studies have concentrated on situational, demographic, attitudinal and personality variables. In that different makes and models of car provide varying solutions to the comfort and convenience aspects of belt use, it seems obvious that actual on-the-road use should be analysed with this in mind. Some comparisions of static and retractor belt usage rates were made in the mid-1970s (Mackay, 1976), when retractor belts became a standard fitting on many models, co-incident with one-handed operation. Prior to that time, when retractor belts were an option for the first time buyer, their use was roughly double that of static belts. With standardisation, that difference almost disappeared and factors of vehicle make and age appear now to be more dominant than belt type.

The results from the current study of belt use by vehicle characteristics are shown in Table 3, for drivers. Sports cars at 10% show markedly lower belt usage rates, but the other classes are rather similar with rates around 37%. Imported cars showed higher belt usage rates, particularly Japanese with 46%, as against 35% for domestic cars. Age of car showed that newer cars have higher belt usage rates with almost double the rate occurring for cars less than two years of age at 43%, compared with cars over six years of age at 24%. All these results are highly significant statistically.

Table 3 - Belt Use by Car Characteristics

Vehicle Class

	Small	Medium	Large	Sports	Significance
% in sample	14%	72%	12%	2%	$\rho<.005$
Overall wearing rate	34%	37%	38%	10%	

Vehicle Nationality

	U.K.	European	Japanese	Significance
% in sample	73%	22%	5%	$\rho<.01$
Overall wearing rate	35%	39%	46%	

Vehicle Age

	Pre-1975	1975-78	post 1978	Significance
% in sample	26%	22%	52%	$\rho<.005$
Overall wearing rate	24%	35%	43%	

Clearly there may well be interactions between these variables. For example the numbers of Japanese cars have increased markedly in recent years, so that they tend to be newer than domestic cars. Such cross-tabulations were made. If model class and age are controlled, then belt use showed no significant difference by vehicle nationality. Moreover, for some groupings the position was reversed with for example small, post-1978 domestic cars having a significantly higher belt usage rate than imported cars. Vehicle age thus appears as the dominant variable rather than nationality per se.

This conclusion held when, within the domestic group, manufacturer A had a usage rate of 32% and manufacturer B had a rate of 38%. Manufacturer B had a greater proportion of newer cars in this sub-sample and that factor appeared to influence the belt usage rates.

One factor not studied in this survey was the effect of two versus four doors in the bodyshell on belt use. Ergonomic work indicates that belts in two door cars are less convenient to put on and less comfortable for normal driving; such influences might well appear in usage rate observations.

Bergan et al (1979) in Canada looked at usage rates and found that U.K. cars, naturally classified in Canada as foreign, had higher wearing rates than Japanese cars, which in turn had higher wearing rates than domestic makes. Clearly owner characteristics may well reflect on belt usage. The most extreme population for example may be seen in the U.S. amongst those car buyers who chose to purchase VW Rabbits with passive seat belts. Such a population very probably have different levels of knowledge and attitudes from the general driving public (Reinfurt 1981).

If the higher usage rates in newer cars is in fact because of greater comfort and convenience factors, then with time usage rates in older cars should improve. In an environment where belt use is not mandated it would be interesting to explore this factor if it could be isolated from other variables such as journey length and driver knowledge.

PASSENGER PRESENCE

The effect of company on behaviour, at least in cars, has not been the subject of much investigation. Some general social theories have been developed (Zajonc, 1965) in relation to the audience effect. The presence of an audience will either improve or impair performance depending on which responses are dominant among the individuals concerned. Improved performance may result if the dominant responses are correct, whilst impaired performance results if the dominant responses are incorrect. Zajonc's interpretation of these theories is that people are more aroused and motivated by the presence of others, and this leads to improved performance of well-learnt tasks and a diminished performance of unfamiliar ones. These theories havebeen criticised on the grounds that no differentiation is made between the mere passive presence of others and active spectators in the theatrical sense. In relation to driving this clearly is a beguilingly complex subject.

Ebbesen and Haney (1973) examined driving behaviour when turning at intersections. They attempted to measure the effects of various types of audiences on risk-taking action. If forced to wait in a line of cars before being allowed to turn, drivers substantially increased the risks they were willing to take, but the presence of other cars behind or beside the subject driver induced no additional risk-taking behaviour. No general theory however appears to be available that can be tested in the context of seat belt use and the audience effect.

Table 4 shows the correlations between driver seat belt wearing rates and passenger presence, sex and belt use. A number of conclusions follow from these data. Drivers with passengers present are more likely to use seat belts than when alone (39% versus 34%). Belt use by front seat occupants goes together in that on 83% of the occasions on which a driver was belted, the passenger was also belted.

In contrast the sex of the passenger, regardless of belt use, had no significant influence on drivers' wearing rates. The presence of a passenger appears to have a reinforcing effect on the driver in terms of increasing his belt use and this is in accord with the general social theory mentioned above. An observational study such as this however, cannot specify what is the "dominant response", but it seems clear that some audience effect may well be present which reinforces the general proposition that seat belts should be worn.

Female drivers showed higher usage rates than males by 5% (40% versus 35%). There is some suggestion in the data that if a female passenger is present and unbelted, the chances are greater that the driver will be unbelted (at 7% belt usage rate) if he is male, than if he is female (at 14% belt usage rate). Sex in general is not a dominant influence on belt use however.

Vehicle speeds were considered in relation to the presence of a passenger (Table 5). These results show that mean speeds are significantly less if a passenger is present. It might be concluded from this that risk-taking behaviour is diminished by the presence of a passenger, but clearly other explanations could be put forward.

Table 4 - Belt Use, Passenger Presence and Sex

Passenger Characteristics	Passenger Belt Worn	Driver Characteristics	Driver % Belt Use	% of total pop^n	Significance
regardless		all	36.4	100	
regardless		male	35	75	ρ<.01
regardless		female	40	25	
absent regardless		all	34	59	ρ<.01
present regardless		all	39	41	
none present		male	33	59	ρ<.025
none present		female	39		
all	yes	all	83	41	ρ<.005
all	no	all	10		
male	regardless	all	40	41	not significant
female	regardless	all	39		
female	yes	male	82	31	not significant
female	yes	female	80		
female	no	male	7		ρ<.05
female	no	female	14		
male	yes	male	90	10	ρ<.1
male	yes	female	77		
male	no	male	13		not significant
male	no	female	14		

Table 5 - Speed and Passenger Presence

	No Passenger	Passenger Present	
Mean speed	49 m.p.h.	45 m.p.h.	ρ<.001

CONCLUSIONS

This study has examined some aspects of voluntary seat belt use. The results suggest that an increase in risk-taking behaviour, as assessed by travelling speed, does not occur with seat belt use, contrary to the Peltzman hypothesis. Other aspects of belt use are investigated and vehicle class and age appear as important determinants of driver belt use. Vehicle speed is also influenced by these vehicle characteristics with newer, larger cars travelling faster than older, smaller ones. Belt use is strongly influenced by vehicle age. Finally the presence of a passenger appears to have an audience effect in that drivers' belt usage rates increase and speeds diminish if a passenger is present.

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