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Culpable versus non-culpable traffic accidents; what is wrong with this picture?

Abstract

It is often implicitly or explicitly assumed in traffic accident research that drivers with accidents designated as non-culpable are a random sample from the population. However, this assumption is very vulnerable to differences in the criterion used for culpability in previous research. The assumption of randomness leads to two predictions; firstly no correlation should exist between culpable and non-culpable crashes, and secondly the groups with such accidents should differ in their age and experience etc. These predictions were tested in two samples of bus drivers. It was found that in a sample with a harsh criterion for responsibility, the drivers with non-culpable accidents had the features expected, namely, they were more experienced for example, while in a sample with a lenient criterion, this was not so. It was concluded that similar studies to the present one would need to be undertaken to establish exactly what percentage of drivers in a given population should have culpable accidents and construct a criterion which yields this ratio. Otherwise, the theoretical assumptions of randomness and non-responsibility will probably be violated to some degree.

Key words: bus driver, accident, crash, culpability, responsibility, induced exposure

Introduction

Throughout the history of traffic accident research responsibility for being involved in a crash has received little attention. At one end, researchers have suggested that each person is fully responsible for every crash; many who conducted research into accident proneness seem to have held this belief (e.g. Shaw, 1961; Shaw & Sichel, 1965). At the other end, there are those who believe that all accidents are due to errors in 'the system', and prefer not to blame drivers (e.g. Dekker, 2002).

However, regardless of which theoretical stance is taken, it is a fact that very little research has been undertaken to actually study the relations between blameworthy and non blameworthy incidents. For example, none of the 100+ accident prediction studies reviewed in af Wåhlberg (2003) had any reference or discussion concerning how culpability should be handled or what effects different criterions could have.

Even the one source where culpability is an important subject and theoretical considerations made explicit, induced exposure methods (Carr, 1969; Haight, 1973; Stamatiadis & Deacon, 1995), there seems to be a similar lack of research into the concept itself, apart from Stamatiadis and Deacon (1997) as a notable exception.

But why is culpability important as a concept? In induced exposure methods, the reasoning is that it is possible to compare drivers in collisions on various variables, by turning culpable and non-culpable drivers into separate groups. If these groups differ, it is concluded that the difference tells us something about the causes of accidents. However, this method assumes that the non-culpable group's accidents are random happenings which they have not had any influence on, but are only due to their exposure. Therefore, the non-culpable drivers are a random sample of the driving population (Stamatiadis & Deacon, 1997).

In some accident prediction studies, the thinking is similar, but the method different; non-culpable accidents are seen as non-predictable from psychological variables, because they are not due to the behaviour of the driver, and should therefore be excluded as a dependent variable. In this tradition, a few studies have tested using ‘all accidents’ and ‘culpable only accidents’as criterion, mainly with the result that the latter had stronger associations with the predictors (e.g. Lajunen, Corry, Summala & Hartley, 1997b; Gully, Whitney & Vanosdall, 1995; Arthur & Graziano, 1996; Rajalin, 1994; but see also Dobson, Brown, Ball, Powers & McFadden, 1999; Quimby, Maycock, Carter, Dixon & Wall, 1986; Arthur, Strong & Williamson, 1994, for other results).

Having ascertained that some theoretical stances do assume that non-culpable accidents are random, we turn to the problem of what criterion is used to actually assign culpability. This kind of coding would most often seem to be regarded as unproblematic (most of the researchers analyzing culpability seem to accept the way police officers and companies have categorized their data, e.g. Gumpper & Smith, 1968; Carr, 1969; Gully, Whitney & Vanosdall, 1995; Chandraratna, Stamatiadis & Stromberg, 2006), but there is precious little research into the inter-rater reliability of coding (e.g. af Wåhlberg, 2002), not to mention how well the criterions actually capture the theoretical division of culpable versus non-culpable accidents.

However, apart from Stamatiadis and Deacon (1997)[1] no study has been found which has tested the characteristics of non-culpable accidents by themselves, although, given the theoretical considerations above, a number of predictions can be made concerning drivers with non-culpable accidents (af Wåhlberg, 2003). First, if non-culpable accidents happen randomly to drivers, there should be no correlation between the

[1] These authors did not use the driver as the unit of analysis.

number of culpable and non-culpable for each driver when exposure has been held constant. Second, neither should non-culpable accidents correlate with themselves in another time period when exposure has been held constant. Third, drivers with non-culpable crashes only should be very similar to drivers without accidents, and dissimilar from those with culpable crashes, on variables which have been shown to relate to crash involvement. Such a well-known parameter is for example experience[2]. The general thinking here was that if an effect has been found for a variable concerning accidents in general, this effect should reside mainly in the culpable category. Fourth, it should be possible to see differences in the size of these effects due to differences in the criterion for culpability used for a population.

Method

Samples and variables

The study was conducted using two different bus driver samples, one British and one Swedish. For the first, number of accidents for (each year of) a five-year period at three levels of culpability (none, some, sole), and number of years employed (experience) as a driver were available. The same data existed for the Swedish sample, plus exposure (hours of work per year) and ethnicity, crudely dichotomized as people with typical Swedish names versus others.

For the UK sample, culpability was assigned by the bus company in cooperation with an insurance team, while the Swedish data was retrieved from a research database (af Wåhlberg, 2002; 2004). For the present study, culpability was dichotomized.

Categories and statistical treatment

To test some of the hypotheses presented in the introduction, the drivers were sorted into three categories; those with no accidents, those with non-culpable only, and drivers with culpable accidents. If the criterion used to assign culpability is correct, it can be expected that the no accidents and non-culpable accidents groups will be very similar on all variables except exposure, and that both will differ from the culpable accidents group. Such differences can be tested using t-tests.

Data could also be arranged with number of accidents per driver for two variables; non-culpable and culpable.

Results

General

Descriptive data for both samples can be seen in Table 1. The most noteworthy features at this stage was the fifty-fifty distribution of responsibility for the British drivers, as compared to two to one for the Swedish drivers, and the large difference in mean number of accidents.

UK sample

First, the three groups of drivers were compared on the experience variable, as shown in Table 2. No differences were significant. However, it should be noted that the drivers with no accidents were closer to culpable than to non-culpable drivers in experience, which was unexpected. Thereafter, experience and the accident categories were correlated, with results that can be seen in Table 3. It is noticeable that not only

[2] Age (another variable which usually has an impact on safety) has not been shown to have any influence in these data (Dorn, af Wåhlberg & Muncie, submitted; af Wåhlberg, 2005).

are the accident variables fairly strongly associated, but experience does seem to have at least as much impact on non-culpable as culpable accidents. Finally, culpable accidents correlated .419, and the non-culpable .377 (N=464, p<.001) between the time periods 2001/2002 versus 2003/2005.

Swedish sample

As can be seen in Table 4, experience was significantly different between the drivers with culpable accidents and those without, whether they had had non-culpable accidents or not. The latter two groups were very similar. These effects may have been due to different numbers of hours worked. However, although those with no accidents did work significantly fewer hours as compared to those with culpable accidents, drivers with non-culpable crashes only worked longer hours than those with no accidents (as can be seen in Table 5).

Similar results surfaced for the ethnicity variable, despite its crudeness. In Table 5 it can be seen that drivers with Swedish names were more common in the no accident and non-culpable groups, despite that the latter worked even more than those with culpable incidents.

Thereafter, the variables were correlated. The results can be seen in Table 6and show that the association between the two categories of accidents is not significant, and that experience has the strongest effect on culpable accidents. Finally, accidents were correlated between time periods, and it was found that culpable accidents had .317 correlation, while the association for non-culpable was close to zero. Holding constant the number of hours worked (accidents/hour) during these years had little impact on any of the correlations.

Discussion

The present results would seem to indicate that so-called non-culpable accidents are not always a random sample of the population, as the UK sample clearly did not conform to the theoretical expectations for such a group. The Swedish sample, on the other hand, fulfilled these expectations, even before exposure had been held constant. The explanation for this difference lies obviously with the difference in culpability criterion (if it is assumed that UK and Swedish drivers are in fact equally often culpable for their accidents); the UK criterion would appear to be somewhat too generous.

The question of whether a criterion is correct, i.e. actually sort drivers' accidents into the right categories have rarely been researched. Moreover, the level of culpable drivers differ strongly between studies; 62 percent for police officers (Cation, Mount & Brenner, 1951), 35-39 percent for bus drivers (Brandaleone & Flamm, 1955), 50 percent for motorcyclists (Quimby, Maycock, Carter, Dixon & Wall, 1986), 52-62 percent for car drivers in self-report (Dobson, Brown, Ball, Powers & McFadden, 1999) and 39-52 percent for police-recorded crashes (Munden, 1967[3]).

From the present results and theoretical considerations, it could be suggested that for research purposes, for example in induced exposure analysis, the ratio of culpable to non-culpable accidents in a population should be empirically determined, using methods like the ones in this study, and the criterion thereafter set to achieve this balance. If not, assumptions, explicit or implicit, may be violated, and the results misleading. For example, Chandraratna, Stamatiadis and Stromberg (2006) used state

[3] This study used the term 'primary vehicle', which has been interpreted as akin to culpability.

records on culpability for crashes, trying to predict whether a driver will be culpable for a crash given their previous record of accidents etc. However, these authors also reported that culpable and non-culpable crashes correlated .49 (for an eight-year period), and that about half of the drivers were at fault. Given the results in the present study, it can be suspected that the criterion used was too mild, and that a serious amount of error was introduced into the study due to misclassification of incidents. Unfortunately, the Chandraratna et al study is also one of the few to actually report a correlation between accident categories. Turning back to the problem of the ratio of at fault to not at fault, it can be guessed from the present results and the study of Chandraratna et al, that 50 percent at fault is too low.

It can be noted that the present results are similar to those of Stamatiadis and Deacon (1997), but the conclusions different. They did find shared variance between culpable and non-culpable accidents that they could not explain by reference to exposure alone, which they discussed in the following terms; "To the extent, however, that similar types of drivers/vehicles tend to travel on similar types of facilities and at similar times, some correlation between responsible and not-responsible parties would be expected. *Moreover, less capable drivers would seem to be more likely to be the not-responsible driver due to their less effective defensive driving techniques*." (p. 41. italics added). Indirectly, these authors seem to accept that some 'non-responsible' drivers actually do have a part in causing the accidents. Anyway, in the end they concluded that this effect was too small to have any significant impact.

Furthermore, it may also be noticed that the present results do support the theoretical division of accidents by culpability, not only when induced exposure techniques are used, but also when accidents are to be predicted. Such a split has so far been uncommon in individual accident record prediction studies (af Wåhlberg, 2003), but the present results again underscore the importance of being clear about what categories of culpability is being predicted. Also, apart from the induced exposure method research, a number of studies of a traffic engineering flavour would seem to use the culpability split without much consideration of whether the theoretical division is actually mirrored by an empirical one (e.g. Ragland, Hundenski, Holman & Fisher, 1992). The results of such reports may therefore be questioned based on the present study.

Regarding methodology, it can be argued that the correlations for the UK sample are easier to interpret, as both accident categories are equally large. In the Swedish sample, the non-culpable accidents are fewer than their culpable counterparts, and these correlations are therefore probably somewhat underestimated, due to lower variance.

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Table 1: Descriptive data for the samples: Percentage of drivers with Swedish names. Means and standard deviations for age, experience (years employed), and accidents for the whole time period (all, and sub-divided into the two culpability categories). Age and experience calculated at the beginning of the period. Last, the number of hours worked for the whole period.

Sample	N	Ethnicity	Age	Experience	Accidents			
					All	Culpable	Non-culpable	Hours
UK (five years)	464		46.2/9.1 (N=407)	9.9/9.0	4.74/3.78	2.35/2.26	2.39/2.35	-
Swedish (five years)	255	57%	45.0/9.7	10.3/10.2	1.45/1.62	1.05/1.40	0.40/0.67	7193

Table 2: Comparisons of experience between the three groups of drivers in the UK sample; those with no accidents, those with non-culpable only, and those with culpable ones. Independent t-tests between means. Some comparisons for age were not possible to calculate, due to missing cases.

Groups	Variable	Means		N	t	p
Non-culpable/No accidents	Experience	11.6	9.9	58/60	1.0	ns
Non-culpable/Culpable	Experience	11.6	9.6	58/346	1.6	ns
No accidents/Culpable	Experience	9.9	9.6	60/346	0.3	ns

Table 3: The correlations between experience and accidents for the UK sample. N=464.

Variable	Experience	Culpable
Non-culpable	-.109*	.338***
Culpable	-.093*	

* p<.05, ***p<.001

Table 4: Comparisons of experience between the three groups of drivers in the Swedish sample; those with no accidents, those with non-culpable only, and those with culpable ones. Independent t-tests between means.

Groups	Means		N	t	p
Non-culpable/No accidents	13.1	12.9	32/83	0.1	ns
Non-culpable/Culpable	13.1	8.2	32/138	2.6	<.05
No accidents/Culpable	12.9	8.2	83/138	3.3	<.001

Table 5: The percentage of drivers with Swedish names in each of the groups; those with no accidents, those with non-culpable only, and those with culpable accidents.

	All drivers	No accidents	Non-culpable	Culpable
N	255	83	32	140
Percentage Swedish	57	67.5	62.5	50.0
Hours worked 2001-2005	7193	6701	7504	7414

Table 6: The correlations between culpable and non-culpable accidents, hours worked, experience and age for bus drivers in the Swedish sample. N= 253.

Variable	Non-culpable	Culpable	Hours worked
Culpable accidents	.102		
Hours worked	.153*	.145*	
Experience	-.046	-.276***	-.066

* p<.05, *** p<.001

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