RADIO 4 TODAY PROGRAMME SPEED TRIBUNAL

Report of M. Stone, emeritus professor of statistics at University College London.

Though all men are in error, they are not all in the same error, nor at the same time...each therefore may possibly heal the other...even as two or more physicians, all diseased in their general health, yet under the immediate action of the disease on di erent days, may remove or alleviate the complaints of each other. (Coleridge)

PREFACE

This report weighs the evidence and arguments that Mr Paul Smith and Mr Robert Gi ord have presented for and against the propositions that were put to them | that speed cameras should be scrapped and that road humps should be attened. I give my reasons for downweighting some of the evidence (from both sides) and for lending weight (to both sides) when the evidence merits support. Beyond that, my conclusion is that there can be no formal adjudication of such complex issues. There is a continuum between complete removal of cameras or humps and an increase in their number to a level that would satisfy the most risk-averse person in the land. One's position on that continuum has to be a matter of personal judgement (preferably well-informed). How, for example, should one weigh in the balance the death of a child in a road accident against the statistically determined fraction of the motorists' \freedom of the road" that might be held responsible for that death?

The Today tribunal was intended to bring into public focus and to throw some light on the con ict on our roads between responsible and irresponsible speed | and on the role that the three Es (Engineering, Education and Enforcement) can play in Society's determination of what is responsible and what is not. The main aim of the tribunal, however, was to generate interest in two more Es | those for the Evaluation of Evidence that is often either completely missing in public debate or treated with insu cient attention to important detail.

Not all of the items and ideas associated with the issue of speed could be touched on or adequately explored in one day's discussion or in the position statements that Messrs Gi ord & Mr Smith will lodge on the Today website. So I have taken the opportunity here to cover some of the omitted ones and develop others, in order to extend the evidence base on which others will then be free to determine their own position.

A DAY IN CONVERSATION AND CONTROVERSY

\There's been an accident!" they said,
\Your servant's cut in half; he's dead!"
\Indeed!" said Mr Jones, \and please"
\Send me the half that's got my keys." (Harry Graham)

The bene t of humps that has quite naturally received most attention is the dramatic reduction in the overall number of recorded accidents on humped roads | with fewer deaths and personal injuries, especially among children. Mr Gi ord makes reference to the experience of the cities of Hull and York as extensive examples of such records. To that can be added the study by Transport Research Laboratory Ltd commissioned by Transport for London for the GLA hump \scrutiny"[1], which I have not yet been able to get a sight of. It should be noted that data recorded in such `before/after' studies may be in uenced strongly by the statistical artefact of *selection bias* (Appendix A).

A secondary bene t of humps (some may place it rst) is their \tra c-calming" e ect. Humps undoubtedly create a more pleasant environment for pedestrians, and one that should encourage outdoor physical activity (children's play, cycling etc) with further long-term health bene ts. There is a striking photograph on the rst page of the Webster & Mackie paper[2]. It shows a narrow humped street in a 20mph zone with parked vehicles on both sides and the front

response times. The bet would be a `cert' in favour of humps if, as a society, we could get our act together and make good use of paramedics on motorbikes. On the issue as a whole, I have seen no case for wholesale removal of humps. However there is a strong case, before any extensive \roll out" of humps on residential roads, for (a) safeguarding key routes for emergency vehicles, (b) collating and evaluating data about their response times and (c) getting to grips with the problem of selection bias.

MY JUDGEMENT ON SPEED CAMERAS

There is a clarity about the road hump question that is in short supply when we turn to the issues that surround the use of speed cameras. Although there are many sorts of humps and the like, it is clear what they are all intended to do | force tra c to go slowly on residential roads. Humps are very successful in doing this compared with all other methods.

The DfT report[7] just published sets out clearly the \site selection guidlines" that have to be followed by police forces before a camera can be used at any location where a need is felt to do so. For xed cameras one of the criteria is that there should have been \at least 4 KSI [killed or seriously injured] per km (not per annum) in the last three years". For mobile cameras, only 2 KSI are required instead of 4. All cameras have to be clearly visible to a motorist with eyes on the road. Currently speed cameras have only two forms. They can remain in xed positions for long periods or move up and down long stretches of road. But whereas, in the case of humps, this variety is concerted towards a common measurable outcome (such as a reduction in average speed to below 20mph), there is no common measurable outcome in the case of cameras. The public is therefore uncertain about what exactly highly visible speed cameras are intended to achieve | beyond getting people to observe the speed limit for a while. The government may claim that xed cameras, at least, are there to deal with recognised accident \hot spots" whose risk cannot be engineered away. At these locations, they play a role much like that of red-light cameras at dangerous intersections. For cameras in general there is an implicit claim to some higher level purpose that would make sense of Mr Spellar's remark, when he painted cameras yellow in 2001, that he hoped \motorists will realise that road safety is our main concern". But everyone can see that the measurable outcome of cameras is a very localised reduction in speeds. Any technically-minded reader interested in what the outcome may be for accidents can go to a well-designed study[4] from South Wales of which I give a brief account in Appendix B. It appears that the measurable e ect on accidents may extend no more than a few hundred yards down the road. In e ect, the passing of speed cameras has become an exercise in \gaming" for those eager to exceed the speed limit | a sport that would be frustrated by deployment of hidden cameras at randomly changing locations in the whole road network.

Thus far, I have been giving my own view of the issue, not those of Messrs Gi ord & Smith. That is because the multifaceted incoherence of the issue led to a fascinating and wide-ranging discussion of the whole area which is not easily brought into focus. So I will now try to extract some of the arguments in their *written* statements to see where the declared division of opinion really lies.

Start with speed cameras as we now have them | all clearly visible whether xed or mobile | or as they have been in the last decade. One division between Mr Gi ord and Mr Smith is in how willing they are to question the published

evidence. Mr Gi ord takes the robust view, shared by most of us, that researchers whose job is to analyse and evaluate data can be reasonably assumed to have done so to the highest available scienti c standards, and that those in government whose job is to inform (by condensation of complex documents into executive summaries or press releases) will observe high standards too. If good people cannot assume that, where are we as a society? Mr Smith in contrast will not accept anything that he has not subjected to his own intense scrutiny. Since trust and appeal to authority are anti-scienti c virtues, my judgement will have to be made from a stance similar to that of Mr Smith | which is not to suggest that on any particular point one party is more likely to be correct than the other. For evidence about the e ect of speed cameras on accidents, Mr Gi ord refers to the 1996 Home O ce study[5], the 1997 West London study[6], surveys from OECD and the European Commission, and to the widely publicised DfT study of which the report[7] on the rst three years of the associated trial was released from its embargo just one day before our tribunal. Mr Gi ord expressed his trust in the latter, as Executive Director of the Parliamentary Advisory Council for Transport Safety, within hours of its publication:

> \This report thf0re63(thfy)83()-33rthf95hI wid1ed78-385(We386(wiihe)-)s3(o1(-)28261(to)-4f95hutting)-4f95death

Mr Gi ord does not refer to the South Wales study[4] to which I have already referred or to the paper[8] by Rune Elvik (see Appendix C). Each of these38418(do)-27(es)-418(cop)-28(e,)-439(in)-416(di eren)28(t)-417(w)27(a)28(ys,)-438(with)-4
hI The paper puts this nding nicely into ihe

> \In 2000 only 2.9% of all c386hes [PIAs]in South Wales occurred within a 500 metoiroute of [101] mobile speed hI tites included in the present analysi6. Thus the e ect across the entire eoia would be expected to be a 1.5% overall reduc - a guoit that is well within year-to-year variability. To have a much greater e ect, iameras need to be employed much more widely, and perhaps randomly."

questions with admirable forensic skill and logic. He is a gad y *par excellence* whose bite must have already irritated many in the road safety world who prefer a quieter way of dealing with issues.

His piece is a powerful polemic attacking the interpretation that others have placed on the body of evidence about the relationship between speed cameras and accidents. I need to discover, here and now, how much I accept of what Mr Smith is claiming. To do this in a reasonably coherent way, I will set out a *hypothetical stance* about the extent and nature of the speed camera nexus | as it is now and as it might be with di erent management. I will then use that viewpoint (which might be my own) as a baseline for argument, but will be more than ready to change it when I go through Mr Smith's piece looking for anything that could change it. I hope Mr Smith will accept that this way of getting to a nal judgement is simply a device for the preservation of mental hygiene.

The assumed stance is a very straightforward one. It is that the present growing multiplicity of highly visible speed cameras, whether xed or mobile, may be more of an irritant than a serious contribution to road safety. It is possible

necessary remoulding of the national character | now seemingly approaching cut-throat competition | be too onerous for Gordon Brown to consider? The feasibility of government intervention (who else would do it?) has to be taken into account. In the end, perhaps sophisticated speed limit enforcement | which is what the hypothetical stance envisages as a replacement for the current practice | is the price that the \normal motorist" has to pay for peace of mind on the roads. This trade-o would be another example of Bunte's \competition of two public goods" | where peace of mind about road safety is one good and the \freedom of the road" is the other.

There is much in Mr Smith's piece that is o ered in support of his claim that speed in itself is not the cause of accidents. One way of testing the sense of that claim is to ask whether we can imagine any scenario in which \speed" could ever be said to be the sole cause of an accident. Perhaps my imagination or my powers of lateral thinking are weakening with the years, but I have been unable to do that with any degree of realism. I nd that my \speed" has to be combined with a precipitating factor for anything to materialise. I have to accept then that \speed" must always work in combination with some other factor. Speed can then be truly said to be a causal element if we can maintain the following: that the accident would probably not have happened if the speed had been so-and-so many miles per hour less, other factors remaining constant. If I accept this line of reasoning, I cannot accept the relevance of Mr Smith's treatment of the matter as grounds for rejecting the hypothetical stance.

A second strand of Mr Smith's case rests on his questioning, verging on the censorious, of the propriety of attributing causality to the role of speed in empirically established relationships between speed-based measures (such as its mean and coe cient of variation) and accident numbers. In this, I think he has a valid point. But it is one whose proper

I am therefore left with an acceptance of the hypothetical stance, which I will complement with the following comment on the DfT program. The \roll out" of safety cameras by separate Safety Partnerships was initiated by DoT. Its management was placed in the hands of the private sector company PA Consulting Group. This \cost recovery" program has failed except for the HMT requirement that it should be self- nancing. There has been a failure to design the program so that it would provide the information needed to evaluate alternative ways of getting the bene ts of speed camera enforcement. The emphasis on political acceptability has led the program down a *cul de sac* in which essential public trust has been lost. The mistakes already made should be openly recognised, and the program should be subjected to a root-and-branch rethink.

THE WIDER FRAMEWORK

> *18 September 1939: I set o slowly on the Great North Road. At Ferrybridge, a cyclist shot out of a side road straight across the major road. I swerved and just managed to miss him by inches. He pedalled on furiously and went head rst into iron railings on the far side verge...*
> *22 September: The old cyclist from Ferrybridge is going to survive...His son had been killed on that crossroads quite recently and the old man had sworn never to stop for a car again in his life.* (Countess of Ranfurly)

The present cacophony and confusion about cameras and humps was entirely predictable, given the record of government activity concerning road safety over the last twenty years. With no coherent longterm policy free from day-to-day political interference, we now run the risk that the issues will be decided by soundbite and snappy editorial. The pity is that, underneath the obvious discord, there are many good people doing good work that could be put together to reach a reasonable compromise between the two Ss of Safety and Speed. Even good people may nd themselves disagreeing strongly, as do Mr Gi ord and Mr Smith, but for sixty million people unevenly distributed on one small island compromise is surely better than con ict.

There are two ways of writing the recent history of government activity as it a ects England and Wales. The rst would be a bland list of legislative steps and their Green or White Papers. The second would be an \inside story" | of how the justi cations or excuses for these steps have been made or obtained from a variety of sources. Both ways of writing the history are necessary, but the latter is the more essential if we are to understand the context and shape of the current debate.

For most of the 20th Century government departments relied, for the research they needed for decision-making, on a variety of \o cial" scienti c workers, from in-house civil servants to others working in universities, research council groups such as the MRC Applied Psychology Unit (APU) and government-funded organizations such as the Road Research Laboratory (RRL). The work of these scientists was routinely subject to wide, often public, peer review. For example, the in uential study in the 1950s on the e ect of alcohol on driving skill was the work of individuals from APU, RRL and UCL.

By the 1990s the emphasis had shifted signi cantly towards a wider range of research inputs to the processes of government decision-making. Greater reliance was placed on the \wisdom of the private sector" and on the contractual arrangements that dealing with the private sector required. By the 1990s universities had embraced, either willingly or under the nancial pressures of their dictated expansion, much of the ethos of the private sector and saw themselves as competing in the market place for what might be described as \market research" contracts with government

1995: The Home O ce engages Price Waterhouse to make a cost bene t analysis of safety cameras.

1996: The Transport Research Laboratory (TRL) reports on a study of physical tra c-calming measures | humps and the like. (TRL is here still an executive agency of DoT, but by 1997 it will be a private company.)

1997: DoT pays TRL Ltd for its study of the e ect of tra c-calming on vehicle emissions.

2000: TRL Ltd reports for DoT on the e ect on accidents of tra c-calming measures in 56 villages throughout Great Britain.

2000: DoT publishes its in-house exhortation *Tomorrow's roads | safer for everyone*.

2001:

2000:

The Today tribunal concentrated on PIAs and on speed as a *necessary* causal factor | no-one is injured unless there is movement in one vehicle or another. However one element in the more general debate is the \injury" to lifestyle that moving vehicles can collectively generate for pedestrians and cyclists in cities and country lanes. \Measuring" that injury in category (iv) is straightaway to enter the political debate about \tra c-calming' and cameras'.

Any police o cers who lled in the STATS19 record for an accident, during the decade following its inception in 1949, was required to look for its causes | speci cally to identify what were called \contributory factors" from a prescribed list. When the requirement was dropped in 1959, many police forces continued to do this seeing it to be in the public interest. At this time, when a causal analysis of road accidents appears even more necessary than it was in the Fifties, we are still without a coherent system of national records of \contributory factors" that would throw light on the relationship between \excessive" or \inappropriate" speed and accident rates.

There is another evidential matter that bears heavily on some of the controversies in our debate. When they \attend" an accident, police have some discretion about whether or not to treat it as an accident involving personal injury (PIA) thereby initiating the time-consuming STATS19 recording prcedure. Even greater discretion can be exercised as to whether the injury is classi ed as \slight" or \serious". \Fatality" (death within 30 days) is less ambiguous except in very rare circumstances!

PUBLIC MOOD AND OPINION

What academic papers say is one thing | what \the papers" say is another, and what you nd on the Internet is ynd 0 -17.93

The editor was writing about the handling of the \o cial statistics" that (unthinking) statisticians have to collect as carefully as possible so that others | mandarin economists and the like | can think about them at the level of public policy. But I think her comments apply to the matter in hand too. Many of us appear to have lost con dence that our political masters can reliably sort out complex issues without resorting to some level of subterfuge and concealment destructive of trust. If Lord Hutton had written this he might have interpolated an \unconscious" before the \subterfuge".

How DfT ascertains how favourable the public is towards speed cameras, and what percentage are in favour, are matters that may be as important as technical studies of their e ects. Many of the judgements of individuals claiming a louder voice on the basis of their technical expertise in road safety matters are simply value judgements. The crude expression of public opinion is also a value judgement made up of a large number of less weighty contributions which in aggregate do have a signi cant combined weight.

The design of the DfT questionnaire that elicits the targeted opinion \South of the Border" is a sorry tale best half-concealed. Those willing to read it should go now to Appendix D. \North of the Border", the 2003 study[12] by Stradling *et al* commissioned by the Scottish Executive has a more straightforward de nition of favourability than the one used by DfT. (Does the wind on the grouse moors clear away academic cobwebs and the spinning that goes with them?) The Scottish question was (I trust) something non-prejudicial like \Are you in favour of or are you against speed cameras?". Those either \Strongly in favour" or \In favour" were counted as favourable. Of over a thousand Scottish car drivers, 68% of males were favourable, 82 % of females. Only for 17-24 year-old males did the percentage fall below 50.

There are very few studies that pay proper attention to the opinions of other road-users such as cyclists, pedestrians, and those dependent on or making use of public transport. The evidence of London boroughs to the GLA hump scrutiny reveals both the super ciality and the di culty of ascertainments of public opinion in such matters. For example, drivers will want humps in their own residential road but not elsewhere.

APPENDIX A

Selection bias: Regression to the mean

This is a statistical phenomenon that has for many years haunted researchers in before/after studies of accidents. It is a statistical artefact pointed out by Francis Galton over 100 years ago, which he illustrated by thinking about the heights of fathers and sons:

> *Tall fathers and short fathers tend to have sons closer in height to the average than they were.*

It looks, super cially, as if the heights of a population should be getting closer to the average with time | clearly an

declare this reduction statistically signi cant at a miserly 5% level | another misuse of Karl Pearson's legacy, I fear. All that was needed was the observation that, when we compare the more justi able `before' and `after' annual rates for the 72 individual schemes, there were 63 decreases, 7 increases and 2 no changes. Did you ever toss a fair coin 70 times and get 63 heads?

An alternative to accepting W&M's reassurance about rttm might be to look at the accident number in the `before' months between the time when the local authority decided on the scheme and the time of its implementation. My experience of local authority decision-making is that this interval could be a year or longer. The rttm phenomenon would not a ect a before/after comparison based on such numbers. However even if we could get an estimate of the reduction that we could be sure was una ected by rttm, further adjustments would be needed to take account of the general downward trend in PIAs and of the reductions in tra c ow that averaged 27% for the 19 schemes where `before and after' ows were measured.

Finally, a comment on the striking conclusion in the Executive Summary that \there was a 6.2% reduction in accidents for each 1mph reduction in vehicle speed". Such summaries of otherwise credit-worthy reports are the bane of government science just as executive houses are an architectural blight in England: the frequent misrepresentation of the content of o cial technical reports leads one to wonder whether authors are free to control what their Executive Summaries tell us and how the say it. All of us, not just executive summary writers, are prone to accept single statistics divorced from the serious or playful work that generated them | statistics that require e ort in order to be properly appreciated. (Questioning them is such a chore!)

The 6.2% reduction was the ratio of 58% (the average of 32 percentage reductions in accident rates) to 9.3mph (the average reduction in speed for the 32 schemes). The Figure in the text that playfully supports the 6.2% (as the slope 6.1 of the tted regression line) shows that *there is no progressive relationship between speed and reduction in accident frequency* (as the wording of the Executive Summary suggests) if Brighton and Preston are excluded. These two schemes were anomalous in roughly doubling their accident rates but with smaller speed reductions. They might well have been treated as outliers from an otherwise zero-slope relationship or as unreliable \due to random uctuations

size of the reduction will have to be estimated | and for this the picture is murkier. Covering many separate sources of evidence, Mackie could give few details, but he did note that German researchers may have been in uenced by Galton's rttm artefact! This may have infected a simple table of annual rates of personal injury accidents (PIAs) or fatality and serious injury (KSI) accidents | the `before' and `after' data for the installation of *either* only 30kph signs in 36 zones *or* signs plus \physical calming" in 24 zones.

	Signs only in 36 zones			Signs + calming in 24 zones		
	Before	After	% change	Before	After	% change
PIA accidents	45.6	41.5	-9	115.9	80.2	-31
KSI accidents	9.5	12.8	+35	36.8	23.3	-37

Did Herr Pfundt claim that these and similar data showed that signs are ine ective in reducing accidents whereas physical calming is? It is a pity that the study did not somehow let signs show what they could have done with the high `before' levels of accidents and physical calming what it would have done with the low `before' levels. The \somehow" would have been achievable by allocating zones to signs or calming at random. This would at the same time have resolved the rttm problem, which is perhaps manifesting itself in the 35% *increase* for the KSI signs-only accidents. If, as is likely, the 24 tra c-calmed zones were selected for their high KSI rates then the complementary selection will make the signs-only zones an analogue of Galton's short fathers.

Bowman's 1997 mathematical analysis[14] of emergency response delay

The air, especially the air of London, is full of unresolved claims about how humps a ect the response times of

> \...LAS is not aware of any signi cant UK-based report that has made any scientic study into the overall e ects of speed humps, including their impact on ambulance response times, the potential consequences of delayed responses by emergency vehicles to `life threatening' situations, and their e ect on the comfort of patients being conveyed to hospital. We would welcome the opportunity to be involved in any such research if it were to be commissioned."

and then

> \This Service believes that it could probably save more lives if the overall tra c ow were to be improved. Just among the 5000 cardiac care victims that we try to resuscitate this could possibly save about 500 lives. In addition a minute gained in reaching other life threatening cases could potentially save hundreds of lives."

Bowman's paper is a prototype of the scienti c analysis that Peter Bradley called for. It was devised in response to a Boulder City Councillor's request for data that would \allow a comparison of the impacts of delayed emergency response time and the putative increases in neighbourhood safety":

> \His question can be answered well enough by considering cardiac arrest emergencies, for which reasonably good data exists, and then making a crude estimate to allow for the other critical emergencies. Data on the following are required: tra c accident deaths, cardiac arrest emergencies and survivals, emergency response times, and delays from tra c mitigation devices. Fairly accurate numbers exist for all of these items. They are certainly accurate enough for reasonable `risk assessment', which often involves far worse vagaries and rough estimates than in the present case."[14]

In this country, getting reliable enough data may be more of a problem than it seemingly was for Mr Bowman. However, the mathematics needed to elicit what the data could tell us is hardly intimidating. The probability of surviving a cardiac arrest is the expectation (over the distribution of response times) of the probability of survival when resuscitation gets under way at those times. Bowman used a mixture of local and medical textbook data to

The GLA \scrutiny"[1]

The Foreword to the London Assembly Transport Committee's \scrutiny"[1]

about the heights of fathers and sons. Tall fathers and short fathers tend to have sons closer in height to the average than they were. The standard criteria for a speed camera installation are that there must be at least 4 accidents per km involving fatality or serious injury and at least 8 PIAs per km, over a site length of 400-1500 metres (that is what the \at" means). In other words, cameras are put where they appear to be needed in terms of a highly variable number of accidents from year to year | which is the precise analogue of looking only at tall fathers! We have to expect some reduction, on the average, when we go from the period before the installation of a camera to the period after | and no cost/bene t analysis is sensible unless we can make a reasonable estimate of the size of that reduction. The authors of the report ignored the possible in uence of Galton's regression to the mean (Appendix A) and accepted the numbers they were given with the comment:

> \It should be noted that the sites covered within Table 10 were not randomly selected, but were chosen because the local authority responsible had already collated some `before and after' data in relation to them."

The neglect of Galton was then compounded:

> \Time restrictions also meant that it was not feasible to undertake precise matching exercises to determine whether any reductions identi ed formed part of a more general underlying trend, rather than re ecting the impact of tra c cameras. Careful consideration was given to whether other factors could have accounted for the identi ed reductions. No evidence was found to suggest that this was the case or that the conclusions reached were unduly optimistic."

by over-computerized signi cance testing. The latter produced a particularly memorable line in the table for fatality accidents:

Old Western Avenue	0	0.0	0	0.0	*0.0*	*0.0*	Highly signi cant (1% level)

where the rst and third zeros are the `before' and `after' accident numbers and the others are derived from them. The high signi cance is probably the result of the computer trying to deal with an illegal division by zero.
Homage to chisquare also had the debilitating consequence that the project felt unable to compare casualty numbers from the camera roads with the comparison (\control") casualty numbers. The grounds for this were that

> \Only accident categories are subject to rigorous statistical testing. Casualty categories are not appropriate for such testing because they are the outcome of random events and not the events themselves."

The quotation shows an admirable awareness that chi-square cannot be used for everything. In fact, the conditions for its valid use are so restricted that misuse is much more common than proper application. That was not what its inventor Karl Pearson (the rst professor in my department at UCL) intended over 100 years ago. But we all err from time to time. Even Homer nods, and Pearson himself started by getting the \degrees of freedom" for his invention wrong and had to be corrected by another UCL man, the illustrious R.A.Fisher. Incidentally, Pearson made something else that bears heavily on the present debate | the observation, well before government became a signi cant contractor in scienti c research, that

> \To endow research is merely to encourage the research of endowment."

If we discount the misuse of chi-square, it is still di cult not to be strongly convinced, by that dramatic 69% reduction in the number of fatalities, that the cameras did what they were intended to do. But that may be because we are not told enough about the design of the project to know that Galton's rttm has struck again. We are once again left with uncertainty about how much of the 69% is real camera e ect and how much is statistical artefact. Did the Highways Agency or some other body point the project to West London and those particular stretches of trunk road because it was observed, during the three years before the trial started, that they were su ering exceptionally high levels of fatality accidents? Were the lengths of the trial stretches just long enough to include some known accident \hot spots" for camera locations? How does their total length compare with that of all A-class trunk roads in \West London"? The report might have given readers some reassurance or information on these questions. It was also remiss in other matters. We are not given the accident numbers on the so-called \control" roads with which the trial stretch numbers are compared. The same numbers are used in each of the applications of Chi-square to individual stretches of road: their reliability (determined in part by whether the numbers are large or small) bears heavily on the extent to which these separate signi cance tests can be treated as independently informative.
From 1992 onwards, cameras were introduced all over London, and the project was therefore without any scienti cally

respectable control data. The project researchers had to be content with comparing the 69% reduction with a smaller decrease of 14% on non-trunk A-roads in other Boroughs (I was able to deduce the 14% by a reverse calculation that I should have not had to make). Logic excluded using the non-trunk A-roads in the *same* Borough for such comparison, since any di erence favourable to cameras could have been attributed to a displacement of accidents to those roads from the roads with cameras.

On the negative side, the study found one worrying feature of the data | an overall 28% increase in rear-end collisions on the camera stretches over and above their percentage increase on the comparison roads. In this case, where the data were saying something against camera advocacy, we *are* given some information about accident numbers on the \control" roads!

It is a pity that the informativeness of this study is less than it would have been if the \roll out" of safety cameras over London had had at least an element of experimental randomization | akin to that routinely used in medical research to nd out whether a new drug really works. (A staged introduction of cameras could have incorporated this, and a full \roll-out" could have been made as soon as the evidence showed that the cameras were saving lives.)

Evading the rttm artefact.....with Hauer and Elvik

Thinking of Galton's tall fathers, there would be no rttm in the heights of their sons if we could estimate the parts of the fathers' heights due to chancy environmental non-genetic factors. These parts could then be subtracted leaving adjusted heights that (discounting any tendency for heights to increase with the elimination of poverty) would be unbiased expectations of the sons' heights. We can replace the heights in this argument by accident rates, and the fathers and sons by the `befores' and `afters' of speed camera installations.

Working in the Safety Studies Group of the University of Toronto, E.Hauer[16] has shown how the chancy potions of the `before' rates can be estimated and removed, provided there is enough reliable information about the accident

self- nancing. I will comment later on the commissioned reports on this trial that have been made every year since then | the latest was released from its embargo just one day before the Today tribunal. The Christie *et al* paper[4] was not commissioned by DfT and is therefore a strictly scienti c report without any political colouring.

> \I *hope* that by instructing local authorities to make them more visible, motorists will *realise* that road safety is our main *concern*. ...These instructions emphasize the Government's commitment to using safety cameras as a deterrent against excessive speeding, and not as a means of raising money." [my italics]

Had the Minister's advisors told him about the 1999 New Zealand study that purports to show that hidden cameras are a better deterrent against excessive speeding than overt and visible ones? Mr Gi ord has elsewhere adduced the study as evidence in favour of cameras in general as agents for accident reduction. However, what the New Zealand study really shows is that a hidden camera has a greater potentiality for speed and accident reduction than a camera that is clearly visible to the motorist.

The study set out to be a \scienti cally designed trial" of the e ectiveness of hidden, as opposed to visible, cameras. But, no doubt for good reasons, it ended up with no element of experimental randomization. As far as injury accidents (PIAs) are concerned, its informativeness is essentially based on a change in the slope of a single time-series. The change of slope is in the graph against time of the seasonally-adjusted logarithm of the ratio of monthly numbers observed on open roads of two areas covering New Zealand: the Midland Region police force area of North Island (the *trial area* where hidden cameras were introduced and exclusively deployed from July 1997) and the rest of New Zealand (the *control area* using visible cameras throughout). There are six accident or casualty variables and six associated \percentage reductions" in this study[18]:

Accident/casualty category	\Percentage reduction"
All open road PIAs	11%
All open road casualties	19%
All open road casualties per PIA	9%
Camera area PIAs	17%
Camera area casualties	31%
Camera area casualties per PIA	11%

These \percentage reductions" are in quotes because they can be easily misinterpreted. They are percentage changes in the ratio (no. per site in trial area)/(no. per site in control area), where that ratio has been estimated by a sophisticated mathematical model of the apparent e ect of the hidden camera programme on seasonally adjusted numbers over and above a steady straight-line trend in the ratio of numbers for the two areas. Any single time-series has to be regarded as a fragile thing in uenceable by factors that come and go. There was a revealing graph in the earlier 1999 report[17] for the New Zealand National Road Safety Committee. It showed how the monthly number of casualties in the *control* area varied over the years | a downward trend until two months after the introduction of hidden cameras in the trial area, followed by a much larger increase above that trend than in the trial area. How did things go in the next two years? The 2002 report[18] does not give us the extended graph, but gives one that removes the trend from the pre-trial logarithmic series making it reassuringly at before a downward trend is revealed when the trial gets under way. If you get to see it, tilt your head to the right to see that the series can also be described

as a random excursion with a peak a bit before the trial begins.

This interesting study was carefully conducted and nicely reported. But the estimated e ects should be treated only as strong indications that will usefully contribute to any meta-analysis of similar studies | not studies of the value of cameras themselves but of the *relative* value of keeping them hidden. Accident numbers may have gone up in both trial and control areas but that would not be revealed by the \percentage reduction".

The rolling 2004 DfT study

The three-year DfT report[7] was released from a politically-dictated embargo on June 15th. As I implied in my speed camera judgement, its analysis of the data from the 24 police force areas makes no quantitative allowance for rttm. Section G3 of the report gives reasons for thinking that \the established statistical phenomenon of regression to the mean [rttm] will not apply in full measure". I interpret this to mean that the authors acknowledge that the estimates of savings of casualties and accidents in the Executive Summary should be taken as upper bound estimates. Will the public be made su ciently aware of this quali cation? Was the minister?

APPENDIX D

That government has long been interested in public opinion about the camera roll-out is shown by the DoT investment in a series of 12 surveys of drivers, 6879 in total, between 1993 and 1996. The eleventh report[11] on the ndings can be found on the National Safety Camera Liaison website. Mr Gi ord has already noted that the study classi ed drivers as \conformers", \deterred", \manipulators" and \de ers" in their response to speed cameras. The researchers got \the impression" from all their data that \everyone has a price" and that \provided the threat of cameras remains a potent one, the proportion who ignore them will reduce sooner rather than later [?? sooner or later]". They found that \most drivers in each survey were *favourable* to cameras, although those who had been caught approved less" [my italics]. They devised 10 ways of using cameras to get drivers to comply with speed limits. I think that \sooner or later" may have been intended because the Executive Summary (in this case surely not DfT-speak) ended rather pessimistically (menacingly, some might think):

> \...although we conclude that the proliferation of speed cameras is an important means by which to raise drivers' awareness of the dangers of speed and of inadvertent speeding, ultimately more than this and other forms of speed limit enforcement will be required in order to modify drivers' *views* on speed [my italics]."

How did the researchers determine whether or not a driver was \favourable" to speed cameras? Drivers were asked to respond to eight statements about speed cameras, each answer scorable -1, 0 or +1 on a favourable-to-cameras scale. Guessing a little, I think a driver would have been classi ed as \favourable" if his/her total score was positive. For four of the eight statements, agreement was interpreted as favourable to cameras, disgreement for the other four | a sort of neutrality. Currently, only four of Corbett & Simon's statements appear in the seven that are now in use by

Safety Camera Partnerships at the dictation of DfT. The four that were dropped were

\Cameras mean that the government is gaining too much power over drivers."
\Cameras are a new way to harass drivers."
\On roads with cameras the enjoyment is taken out of driving."
\Cameras are an accurate way of detecting drivers' speeds."

replaced by

\The primary aim of safety cameras is to save lives."
\The use of safety cameras should be supported as a method of reducing casualties."
\There are too many cameras in our local areas."

10. Royal Statistical Society (2004) Legislating for trust. *Signi cance* 1 51.

11. Corbett, Claire and Simon, Frances (1999) The e ects of speed cameras: How drivers respond. DfT Safety Research Report No.11. www.nationalsafetycameras.co.uk .

12. Stradling, S. G., Campbell, M., Allan, I. A., Gorell, R. S. J., Hill, J. P., Winter, M. G. and Hope, S. (2003) The Speeding driver: who, how and why. Edinburgh, Scottish Executive Social Research.

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14. Bowman, R. R. (1997) Deaths expected from delayed emergency response due to neighbourhood tra c mitigation. Colorado, Boulder City Council. http://members.aol.com/raybowman/risk97/eval1.html

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