2 Active Transport: Cycling

Chapter contents

2.0 Summary

A comprehensive section on cycling has been developed for the forthcoming *Health on the Move 2*. Cycling has great potential to assist public health programmes and reduce road danger. Fair comparison proves that the risks of cycling are within the range to which drivers and pedestrians are exposed, neither of which groups use helmets. Segregation in most circumstances does not improve safety but compromises it, due to increased danger at junctions. The Hierarchy of Provision is available to guide the development of cycle-friendly infrastructure. A most effective measure does improve cyclists' safety: more cyclists. More cycling means safer cycling, in accordance with the 'safety in numbers' effect. Since an increase in cycling is in any case desired to improve public health, the objective analysis provides a distinct conclusion: promote cycling. As regards cycle helmet effectiveness, there is a diversity of evidence. In this report, the diversity is explained in terms of confounding factors and confusion with secular injury trends. The most careful long-term studies do not reveal evidence of noticeable prevention of serious head injuries with rising helmet use. Calls for helmet legislation, and extant helmet laws in other countries, and indeed, even the promotion of cycle helmets, must be discredited from the evidence. Similarly, conflict between the desire by novice or non-cyclists for segregation and the poor safety record of these facilities needs to be resolved, ideally through wider appreciation of the Hierarchy of Provision. Local Authority support is critical for cycling programmes to succeed. Cycling can be a major factor in public health programmes.

2.1 Main Reasons to Encourage Cycling

2.1.1 Benefits of cycling to society and individuals

Cycling is highly relevant in the 21st century to address major burdens and threats. In health terms, cycling is physical exercise that addresses the trend to obesity and consequent disease. In ecological terms, the bicycle is a low-carbon form of transport, both in its construction and its use. In economic terms, Britain's increasing reliance on imported oil is a national risk that would be at least ameliorated by a cycling revival. In transport terms, Britain's road network is

amongst the most congested in the world; it is necessary to use it more efficiently by reducing car use for short trips. At the individual level, cycling confers additional benefits:

a) Cycling readily incorporates physical activity into daily life.

b) Cycling can be undertaken by virtually all age groups, of many different abilities.

c) Cycling is affordable once a bike is owned, and bicycles can be inexpensive to purchase.

d) Cycling is a means of reaching employment, training and other opportunities to those without car access.

e) Replacing motorised transport by cycling for a proportion of trips reduces pollution, benefits local air quality, and reduces cardio-respiratory illness.

f) A widespread cycling culture increases the safety of cycling and walking.

g) Cycling can improve mental health and feelings of well-being.

h) Cycling enhances local environments and sense of community.

i) Cyclists generally live longer than non-cyclists.[1]

j) Those who cycle to work report fewer days sickness leave compared with those who do not cycle.[2]

k) The combination of the cycle with public transport creates the only transport mode that can currently (pending further technological development of the people-mover) compete with the car for flexibility.

Considering the need to address the disease burden due to physical inactivity, the Chief Medical Officer noted in his 2004 report on physical activity that:

> *"For most people, the easiest and most acceptable forms of physical activity are those that can be incorporated into everyday life. Examples include walking or cycling instead of driving..."*[3]

Moreover, Cycling England have noted that:

> *"It's vital for the health of the nation – and the health of the planet – that health and transport professionals focus on positive actions to encourage cycling, especially where a cycle journey will replace a car journey. Local transport and health authorities need to recognise the potential of cycling to improve many aspects of public health, and place it at the heart of a healthy transport strategy, devising safe cycling policies and promoting the use of cycling – by children and adults alike – on a daily basis."*[4]

2.1.2 Evidence for the health benefits of cycling

There is a strong and growing body of evidence that cycling confers multiple health benefits.[5] More extensive information is also available on-line from Sustrans[6] and Cycling England.[7]

All-cause mortality

The strongest and clearest evidence exists for the association between physical inactivity and an increased risk of death, which has been shown in numerous studies.[3 8 9] In particular, the Copenhagen Centre for Prospective Population studies found a substantial decrease in the risk of death among those who spent three hours per week commuting to work by bicycle compared to those who did not commute by bicycle.[10] This is supported by a recent Chinese study reporting similar results in women.[11] A Swedish 35 year follow-up cohort study[12] concluded that:

"Increased physical activity in middle age is eventually followed by a reduction in mortality to the same level as seen amongst men with constantly high physical activity. The reduction is comparable with smoking cessation."

These studies confirm earlier work in the UK, showing that the life-extending health benefits of cycling were about an order of magnitude greater than the life years lost in road crashes[13.] In summary, cyclists live longer.

Cardiovascular disease

Strong evidence exists for the relationship between physical activity and a reduction of risk of mortality and morbidity from cardiovascular disease.[9 14 15] There is an inverse relation between physical activity and cardiovascular disease incidence and mortality.

Stroke

The evidence for an association between physical activity and ischemic stroke has been deemed equivocal[16] but evidence from case-control and prospective studies has suggested that physical activity reduces the incidence of stroke independent of other stroke risk factors in men[17]; this was confirmed in a recent review.[18] People who were highly active were found to have a 27% lower risk of stroke incidence or mortality than less active people.[19] Similar results were seen in moderately active people compared with inactive people[3] and for habitual activity,[20] especially if lifelong.[21]

Cancer

Physical activity is associated with a reduction in the overall risk of cancer.[14] A review of 41 studies observed a crude graded inverse dose-response association between physical activity and colon cancer[22] and an inverse association with a dose-response relationship between physical activity and breast cancer. Evidence for other types of cancer such as colorectal or prostate cancer is less conclusive.

Type 2 diabetes

There is strong evidence for the role of physical activity in the prevention of type 2 diabetes.[9 14] Regular physical activity is also an important component for the treatment of type 2 diabetes.

Obesity

As noted in chapter 2, the rise in obesity is largely due to a significant decline in energy expenditure over the past 30 years or so,[23] rather than an increase in calories consumed. Cycling is a more vigorous activity than walking. Expending ≥ 2,000kcal/wk (equivalent to daily cycling for 30-40 minutes[24]) compared with <500kcal/wk adds 2.15 years of life up to age 80.[25] 2,000kcalories is roughly equivalent to half a pound of fat. As a regular habit, sustained over the years, cycling has significant potential to control weight.

Other health outcomes

Lack of physical activity also has a negative influence on many aspects of health including mental health, bone health, muscular health and quality of life

2.2 Long term trends in cycle use and casualties

2.2.1 The Use of Hospital Statistics on Road Casualties

It is accepted that fatalities in road accidents are accurately reported. Concerning serious injuries, however, there is long-standing confusion in the medical world. This has major

relevance in the misperception of risk in cycling.

In the UK there are two datasets for recording fatalities and injuries in road traffic accidents: STATS19 and Hospital Episode Statistics (HES). The STATS19 dataset is maintained by the Department for Transport (DfT). It is based on reports by police attending road accidents. The police are mainly interested in crashes involving motor vehicles, as these are most likely to result in charges. The STATS19 database is the basis of the annual report *Road Casualties Great Britain*,[26] the record of deaths, serious injuries and slight injuries in road accidents and a prime element of road safety policy. The HES dataset is maintained by the NHS Information Centre. It is based on hospital records of those admitted as in-patients.

One might expect the HES to be the more accurate record of road traffic injuries. However, a serious complication arises, because the definition of 'transport accident[i]' in HES is defined differently for cyclists compared with pedestrians. This has long caused confusion. It has also given rise to the view that the police under-report cycling injuries; this view is not correct, as shown below.

Serious injuries in collisions with motor vehicles are accurately reported by the police for cyclists, but are under-reported for pedestrians. Table 2.1 shows data are taken from the 2006 and 2007 editions of *Road Casualties Great Britain*.[26,27]

Table 2-1. Serious injuries after collision with motor vehicle: STATS19 and HES compared

	Cyclists	**Pedestrians**
HES	2,186	7688
STATS19	2,092	5525
(difference)	4%	28%
Source	RCGB 2006[27] Chap 6 Table 6a	RCGB 2007[26] Chapter 6 Table 6e and p75

The under-reporting of pedestrian serious injuries is not appreciated in the road safety debate. The accurate reporting of cyclist injuries in STATS19 is likewise not recognised.

The major differences between STATS19 and HES arise for injuries not involving a motor vehicle. The definition of 'transport accident' in HES is not consistent. This is summarised in Table 2.2.

[i] In common with many other organisations, we recommend avoiding the term 'accident' when dealing with traffic collisions and casualties, as it is often taken to mean 'unavoidable' instead of its actual meaning of 'unintended'. However, 'Transport accident' is the term used in the International Classification of Disease; we therefore use it in this report when referring to data sources based on specific definitions but otherwise avoid the term.

Table 2-2. Comparison of inclusion / exclusion criteria for 'transport accident' in Stats 19 and HES

	Cyclists		Pedestrians	
	STATS19	HES	STATS19	HES
Collision with M.V.	yes	yes	yes	yes
Fall in highway	some	yes	no	no
Fall in unspecified place	no	yes	no	no

(see Chapter 6 of *RCGB* 2006 Edition[27] for detailed comparison of HES and STATS19)

Needless to say, the HES figure for cycling serious 'transport accidents' is greatly inflated by the inclusion of falls that are excluded from the pedestrian definition. The inflation factor is about 3.25. The situation is of course exacerbated by the HES cycling definition being a 'dustbin code' to catch incomplete data that do not fit anywhere else. Children playing off-road will be classed as transport accidents if the place of injury is unspecified at admission.

If we are to be informed, we must compare like with like. Table 2.3 presents the data for cyclists and pedestrians compared directly: collision with a vehicle, fall in the highway and fall in an unspecified place. The data for pedestrians are for casualties ≤ 65 years. only, as there are very few cyclist casualties older than 65 years.

Table 2-3. Serious injuries in fair comparison 2004/5 (C) and 2005/6 (P), HES data

	Cyclists	Pedestrians (<=65y.o)
Collision with motor vehicle	2,186	7,688
Fall (in highway or unspecified place)	4,880	63,500
Source	RCGB 2006 Chapter 6 Table 6a	RCGB 2007 Chapter 6 Table 6f

It may be observed that the inclusion of pedestrian falls (in the highway and in unspecified places) has inflated the original traffic injury figure by a factor of nearly ten. For cyclists, the comparable factor is approx. 3.2. It is in fact pedestrian falls that are the 'great unreported' and unrecognised as a serious injury issue.

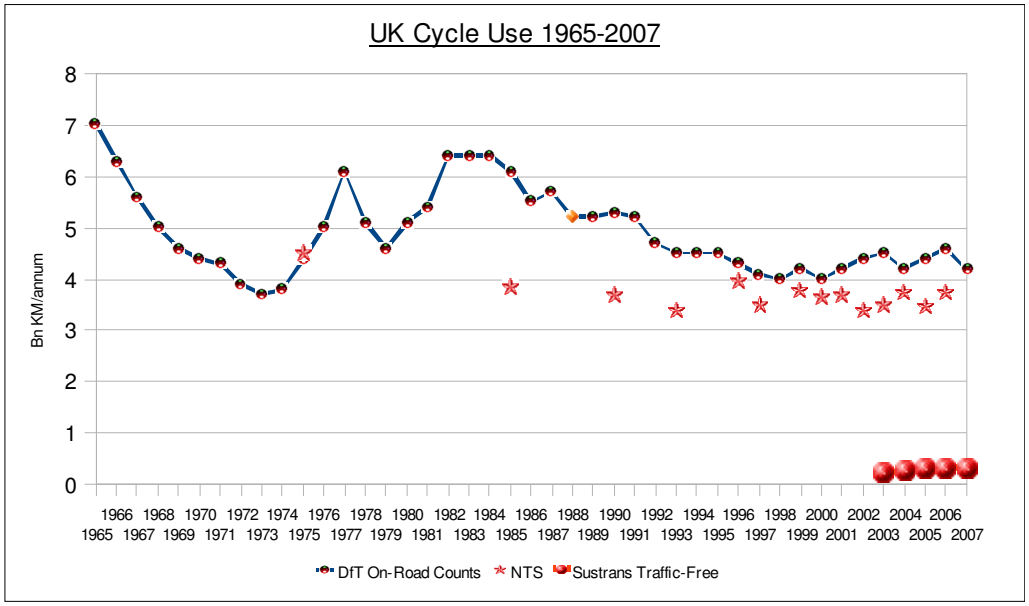
If HES were being used in a manner that respected the varying definition of 'transport accident', there would be no problem. However, the raw HES data are being misinterpreted by the DfT and some researchers to build a case that cyclist casualties are under-reported by the police, by a large factor, and hence that cycling incurs much higher risks than previously thought. This argument is false, as we have seen, but it has appeared in some apparently authoritative places. For instance, the most recent report on risk factors for cycling[28] issued by the DfT in December 2009 presents precisely this argument. A paper[29] that appeared in the peer reviewed journal *Injury Prevention* also presents this argument, to build a flawed case that cycling is more dangerous than police records show. This latter paper attracted considerable media interest. The argument is also applied in a recent textbook[30] on road safety, to conclude that the risk to cyclists is "50 times higher than for drivers". In contrast, more careful risk

assessments[31] **Error! Bookmark not defined.** have appeared in the past and been ignored by the media. Competent analysis is not news in cycling.

2.2.2 Historical Trends 1965-2007

To affect the future, we must understand the past. Data are presented extending back more than 40 years into the mid 1960s. Such long term trends inform us of the general drift of change that influences the current situation (Figure 2-1).

Figure 2-1. UK Cycle use 1965 – 2007



Sources of data:

[26] The Department for Transport (DfT) carries out traffic monitoring by on-road traffic counts. Automatic Traffic Counters (ATCs, >10,000 in number) distributed in the national road network add to knowledge of all classes of traffic. Cyclist movements are less reliably recorded than for other vehicle types. Cyclists are more likely to use quiet roads, where less monitoring takes place. Because of this, the data are likely to be under-estimates. The methodology of counts has been fairly consistent in the survey period above.

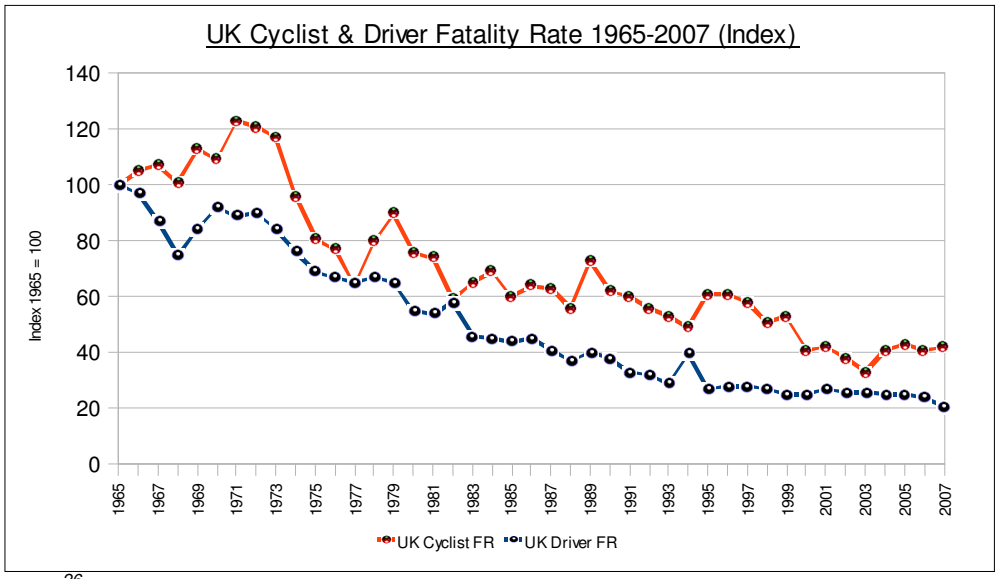
[32] The DfT also carries out the National Travel Survey. This involves distributing travel diaries to a random sample of approx. 8,000 households per year. There have always been difficulties with obtaining a high rate of completion of travel diaries. This has been especially so with cycling, which is mostly done by boys and young men. Since 1995, data have been weighted to account for incomplete responses. Previous data cannot be reliably compared to post 1995 data, although they have been included in the chart above. The NTS was carried out only intermittently prior to 1988. The 1978/79 NTS was withdrawn due to poor response rate.

[33] Sustrans collects its own data on use of the National Cycle Network. The Sustrans data presented here are for the traffic-free routes only of the National Cycling Network because in theory, use of On-Road sections of the National Cycling Network will duplicate data from the DfT above. Thus they complement the on-road data of the DfT. Sustrans and the DfT are developing the merging of their data, so the above data may be subject to revision (probably upwards relative to on-road cycle use).

Having declined through the 1950s and 1960s, cycling became more popular after the first Oil Crisis in 1973. The trend peaked in the mid 1980s. There followed about fifteen years of steady decline. In the last decade, the distance cycled nationally per year has been fairly constant. Against a background of rising population, this suggests continued slow decline in miles cycled per person. This is in fact reflected in the NTS data for 1996-2005, showing annual miles cycled per person falling by about 10% in that decade. The use of traffic-free routes of the National Cycling Network is growing, as the route is developed and marketed. Cycling on NCN traffic-free routes amounted to about 7.5% of all cycle trips by 2008.

Conclusion: a continuing trend of declining cycle use per person. The trend is long-established, although it is slower now than in the period 1985-2000.

Figure 2-2. UK Driver and Cyclist Fatality Rates 1965-2007



Sources of data[26]:

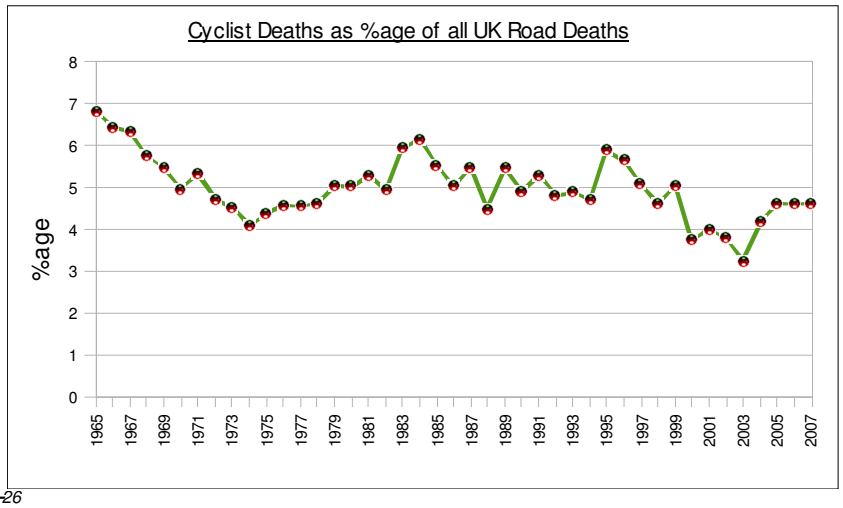
These trends are developed from fatality data as presented in Road Casualties Great Britain. This same source presents data on national mileage driven or cycled based on on-road monitoring.

Note: Fatality rates (deaths per billion km), have been indexed to 1965 values of 100. This does not mean that fatality rates for drivers and cyclists were equal in 1965. The fatality rates in that year for drivers and cyclists were respectively 11 and 78 deaths per billion km. The purpose of indexing is to allow easy comparison of long term trends.

One would naturally expect that the extensive improvement in protection for car occupants would be reflected in a relative advantage to drivers' safety. This happened briefly in the late 1960s when cycling fatality rates rose as driver fatality rates fell. However since 1970, cycling fatality rates have fallen by slightly more than driver fatality rates (Figure 2-2).

It is impressive that cyclist safety could have improved as much as driver safety over such a long period. It is beyond the scope of this review to analyse what underlies this result. Clearly there are consistent, powerful influences that have reduced driver and cyclist deaths almost equally over a 40 year period. A reduction in children cycling is probably not a factor here. The fatality rate for children and adults is very similar at around 35 deaths per billion kilometres in recent years (based on data from the *National Travel Survey*[32]).

Figure 2-3. Cyclist Deaths as percentage of all UK road deaths 1965 - 2007



Data source: DfT[26]

There has been some suggestion in recent years that cyclist deaths are rising as a percentage of all road deaths. In fact, review of the record back to 1965 shows that the current percentage is close to the long-term average of about 5%, although it is reverting to mean from a deep low (Figure 2-3).

2.2.3 Children and cycling

An overview of injuries to children when cycling is useful. Data presented in the National Travel Survey show that ownership of bicycles by British children is high, at around 80%.[34] This amounts to almost 10 million potential child cyclists. However, the vast majority of these children own either mountain bikes or BMX bikes. These are not designed as vehicles for transport: the NTS reports that the number of trips cycled per UK child is only 18 per year. The figure for a Dutch child is 530 trips annually.[39] The Dutch figure includes some off-highway trips which are excluded from the NTS. Even so, the contrast is a factor of around 25. The proportion of trips to school by bicycle in Britain in recent years was only 1-2%.[32]

In short, most British children own bicycles but they do not use them as a means of transport. In considering risk to children, the only data available concern on-road use from the NTS. By combining this with road casualty data, it may be shown that the risk per km travelled is higher for child cyclists than child pedestrians, although the risk turns out to be about equal once the dominance of boys in cycling is accounted for.[35] In recent years there have been 12 to 15 child cyclist deaths per year and 500 serious injuries in collision with motor vehicles. These figures represent 11% of fatalities and 17% of serious injuries of children in road accidents. These figures appear comparatively high but it must be recognised than 90% of child cyclist fatalities are male. This domination of male children in cycling inflates the overall casualty figures. Cycling road injuries account for only 6% of the annual total of 90-95,000 admissions of children for all causes of injury (taken from HES). Note that child cyclists and pedestrians together account for almost 80% of serious injuries to children from motor traffic. This reflects the relatively poor safety of children on the British road network.

2.3 Risk; the fundamental misperception of cycling

2.3.1 Risk of cycling for the individual

Is cycling a risky form of travel? If one states that the average risk of mortality amongst UK cyclists is about 0.4 fatalities per million hours' use (f/mhu), what does that really mean? It is in fact an exceedingly low risk. Imagine a cyclist who rides one hour per day for fifty years. This would amount to almost 160,000 miles of cycling. The risk accumulated in all that riding would be one chance in 140 of fatal injury. This analysis is pessimistic in that it assumes no learning with experience. Still, the lifetime risk is about the same as for the average European driver. The two big differences are that the cyclist would almost certainly not kill anybody else, and they could expect to live a longer, healthier life. That is why we encourage active travel.

What about risk of less severe injury? What is the risk of being injured in a collision and getting admitted to hospital? Taking the national average, each serious injury corresponds to two million km of cycling. Since a typical cyclist only rides about 1,500km per year, it is clear that the odds of being seriously injured, for the typical cyclist, are very low - less than one in a thousand annually. So, as an absolute risk, cycling is a low risk form of travel. An individual who completes the National Cycling Proficiency, uses a well-equipped bike, and has a conservative attitude faces very low risks. It should not be thought that cycling incurs risks that are unusual by the standards of daily life. It should further be noted that cycling in a city where the bicycle is popular is safer still, following the safety in numbers effect – as will be detailed in Section 2.4.

It must also be recognised that not all cycling is for transport. A sporting cyclist who rides 20,000 miles per year at 20mph is not 'typical' or anywhere near it. Likewise, off-road mountain biking and BMX riding are distinct from cycling as transport. Judgement of risks in these activities would require separate analyses.

2.3.2 Implications of more cycling on road casualties

From a policy perspective, it is necessary to study risk across populations in more detail. Cycling might be a low risk form of travel for the individual, but so is driving. It does not mean we can be indifferent to the implications of an increase in cycling. Would more cycling lead to an increase in road deaths and injuries?

There are two ways of approaching this question. One is to review cases where there in fact were substantial increases in cycling. This is dealt with in Section 2.4. The other approach is to compare the population level risks of cycling with other modes of travel, especially driving, since the purpose of active travel promotion is to replace driving with cycling.

In the 2007 edition of *Road Casualties Great Britain*,[26] the DfT presents a risk assessment of walking, cycling, driving and motorcycling, for the first time. It follows recent work by independent researchers in Britain and Denmark.[31] The risk per hour is taken to be the most significant measure because personal travel budgets are fixed at about one hour per person per day. [32] This result is consistent across time and even across wide ranges of human cultures, from pre-industrial to post-industrial.[36] The population spends the same amount of time travelling now that it did in the early 1970's; the reason for traffic congestion is because more of those hours are spent in cars and fewer on buses, trains, bicycles or walking. Overall distances travelled have increased. Modal shift to active travel means less time in cars; shorter distances; , more hours of public transport, walking and cycling; but no overall change in the time spent travelling. Time is fixed for all road users, but mobility varies greatly between drivers, cyclists and pedestrians. This is why risk per hour is significant, while risk per km travelled is of only limited relevance, mainly to compare walking and cycling.

Taken at face value, the results appear rather mixed. The risk per km travelled is lower for cyclists than for pedestrians. However relative to driving, the risk of fatality per hour is four times higher, and the risk of serious injury is six times higher for cyclists. These are formidable ratios, which appear to contradict Section 2.3.1, claiming that cycling is low risk travel. There is no contradiction. Driving is very safe in Britain, relative to most other industrialised countries. A small risk multiplied by a small factor remains a small risk. It must be emphasised that cycling is at least ten times safer than riding a motorbike. It is therefore inappropriate to lump cycling and motorcycling together as is sometimes done by agencies that do not consider the relative risks: even the World Health Organisation is capable of this error.[37]

Is the same individual really four times more at risk if they leave the car and get on their bike? The answer is no, they are not.

Comparison of cycling risk with other travel is fraught by a number of complicating factors.

1. Each travel mode involves a different sub-group of the population. In the UK, most cyclists are young and male, two factors that correspond to the highest injury and death rates from trauma in any population. In some other countries, the cycling sub-population is about the same as the national population, because most people are cyclists. This factor alone will account for at least some of the difference in average risk observed between the UK and cycling countries.

2. Cyclists spend less time travelling than drivers do (approximately 120hrs versus 300 hrs per year, respectively). This is at least partly because cycling is far more productive, losing little time in traffic jams and looking for parking spaces. The difference in annual risk between cyclists and drivers is thus negligible. Indeed, the annual risk even to a more than averagely active cyclist will be lower than the annual risk to drivers in many industrialised countries, notably Belgium and France.

3. The relative risk of driving is reduced by mileage on long-distance trunk roads and motorways, where risks are low. There are no comparable journeys for cyclists. It would be fair to consider the train and cycle combination as a veritable transport mode in which case figures would include the safe, long-distance miles travelled by cyclists in trains considerably reducing the risk result for cycling. Alternatively, the risks of travel by bike should be compared with the risks of urban and rural driving excluding motorways and 'A' roads.

What is the risk in driving? The average risk of the population is one number, but the risk experienced by individuals is a range. The risk in driving depends on driver age and sex, time of day, class of road, topography and country. Young male drivers face fatality risks ten times greater than middle aged male drivers.[38] Drivers on difficult rural roads may face risks ten times greater than on motorways.[26] Driving at night is, on average, about four times riskier than driving in daylight. If we extend this assessment to include the European Union, which would appear appropriate, then clearly the range increases further. The national average driving risk is about 2.5 times higher for France than for the UK. The UK has the best safety record in the world for driving. If UK cycling cannot yet match that, it is still doing well against driving in many industrialised countries.

For any valid comparison to be made, what is therefore required is age-, sex- and social class-standardised rates per mode per type of journey, which are not available. The small number of serious cyclist casualties in each sub-group would in any case make conclusions problematic, except perhaps for young males. Comparison of young males (sex and age only) does show about the same risk of fatality per hour for cyclists and drivers,[38] although this could be confounded either way by social class. Such data are not available by level of experience. On close inspection, therefore, it becomes clear we must be wary of drawing too literal conclusions from population-level risk assessments. The average risk per hour of riding a motorbike is more

than forty times greater than for driving. It is thus justified to conclude that motorbikes are a relatively risky mode of travel. But driving risk might easily vary by a factor of five or even ten for the same person, as they move from one class of road to another, from plain to mountain, from daylight to night time. So a factor varying from one to four difference in risk between cycling and driving in this country is not great enough to prove that cycling is riskier than driving, in a way that is meaningful to the individual. It is important to emphasise that this is a comparison of small risks. The health benefits of cycling far outweigh these small risks.

2.3.3 Superior overall safety of cycling versus driving: Risk in Use

Research at the Transport and Road Research Laboratory in the mid 1980s[38] showed that the risks per hour for young male drivers and cyclists specifically were not significantly different. Additionally, young male drivers impose significant risk on the population; young male cyclists generally do not. Cyclists and pedestrians almost never kill other road users. Cars are a major cause of deaths to pedestrians, cyclists and motorcyclists, as well as to other car users. 70% of car occupant deaths are due to collision with another vehicle. "Risk in Use" is the measure that combines the risk to the user with the risk imposed on others (Table 2-4). This exercise reveals why road deaths would not increase if there was an increase in cycling. In fact, it is much more likely that more cycling would be an effective road safety intervention. This conclusion is further supported by Section 2.4 Safety in Numbers.

Table 2-4. Risk of different modes of transport to all travellers by time spent travelling

Transport mode and duration	Fatalities to all road users per million hours of travel
Driver (300 hrs/annum)	0.45
Cyclist (120 hours/annum)	0.50

Source data[31]

As previously noted, drivers spend about three times longer driving per year than typical cyclists do cycling. On a Risk in use basis, there is nothing to suggest that cycling contributes more to road fatalities than driving. Some 60% of deaths associated with car use are to third parties other than the driver. By comparison, cyclists very rarely kill third parties. These results are true despite the loading on cycling due to "young male effect" and British drivers having the best safety record in the world. There are about three pedestrian deaths a year due to collision with cyclists, and there are about three cyclist deaths a year in collisions with pedestrians.[26]

2.3.4 Risk in Cycling in UK compared with the Netherlands

The difference in risk between cycling in Britain and in other countries is frequently exaggerated. Although the population average fatality rates for Dutch or Danish cyclists is about half that for British cyclists,[31] it is difficult to untangle the extent to which this reflects genuinely better safety, or just less of the 'young male' effect[ii]. The difference is less than that between French and

[ii] Casualty rates are available for sex and age groups in the Netherlands at least, because there are enough cyclist casualties in most age groups to make these feasible. In the UK, they are only available reliably for young men; other age and sex groups hold too few casualties to form reliable conclusions.

British drivers. Despite perceptions of different conditions for cyclists, the causes of fatalities are nearly identical in the two countries (Table 2-5).[39]

Table 2-5. Comparison of fatal traffic crashes in the Netherlands and the UK

Cause of fatality	Netherlands	UK
Fall, or collided with stationary object	8%	8%
Collision - with pedestrian	2%	2%
Collision - other cyclist	2%	n/a
Collision - car	53%	55%
Collision - commercial vehicle	35%	35%

As so often with perception of cycling risk, the popular image is a magnification of reality.

2.3.5 Conclusions regarding risk

The risk to the individual when cycling is very low. Cycling appears to compare poorly with driving in risk assessment based on national data, but the cycling figures are inflated by a number of important factors. It is fair to say that the risks of cycling are within the range of risks faced by drivers but cyclists clearly bear much lower risks than motorcyclists.

Cycling in the UK is disadvantaged by an exceedingly low modal share of trips. Even in a showcase example like London, the modal share of trips for cyclists was only 2% in 2008,[45] tiny by the standards of Northern Europe. Low modal shares are invariably associated with higher risks for cyclists. Risk falls with increase in cycling. Cyclists in London have seen no increase in the overall number of serious injuries, while the amount of cycling has increased by about 70% since 2000 (see Section 2.4 below). Also, the above data relate to traffic collisions alone. They do not include falls. As was noted in Section2.2.1 above, pedestrian falls are a large but not reliably quantified cause of serious injury.

It must be stressed that for the individual cyclist, the risk of serious injury is very low. One case of serious injury corresponds to almost 2 million km of cycling. Since cycling is under-measured, it actually corresponds to a lower risk than that.

This section began with a profile of risk in life-long cycling. It pointed out that the actual risk is exceedingly low. Messages from reputable agencies must respect this. At present they generally do not.

2.4 Safety in Numbers: More cycling means safer cycling

What actually happens when there is a resurgence of cycling? The question can be answered directly from experience, since there are now a number of examples of successful cycling programmes.

In Britain at least, there is no known case in the post-war era of an increase in cycling being followed by an increase in cyclist deaths, let alone road deaths overall, nor are the authors aware of any such case in another country.

Interest in “Safety in Numbers” (SiN) stirred during the 1990s. It was widely noted that the cycling programmes in the Netherlands had increased cycle use by 45% during the 20 years to 1997, yet deaths in those years declined by almost 40%[39] and the risk per cyclist declined by 60%. Wardlaw noted that in the UK, there had also been a similar revival of cycling after 1973, and cyclist deaths had also fallen during those years.[40] Jacobsen’s wider survey of data showed a power law rule: that if the amount of cycling doubled, the number of fatalities would increase by only about 40%.[41] Broughton et al studied cyclist safety in English counties and found a similar but slightly less pronounced effect: doubling cycle use would increase fatalities by only 60%.[42] These power-law effects turn out to be pessimistic since in practice it has been found that cyclist deaths do not increase at all, even with cycling levels doubling or more (see Portland, Oregon case study below). There appears to be a contradiction: SiN studies suggest some increase in casualties as cycle use rises, whereas the actual result is stable or falling numbers of casualties. This contradiction is resolved by acknowledging contributions from not just SiN, but also wider improvements, which reduced casualties amongst all groups of users.

There are now a number of case studies of cities that have revived cycling cultures. These are prominent in the proceedings of bi-annual VeloCity conferences.[43] Amsterdam, Copenhagen, Portland (Oregon USA), New York, London, Edinburgh, Brussels, Bordeaux and Paris are all cities that have achieved successful cycling programmes or are in the process of doing so. The 2009 VeloCity Conference launched the Charter of Brussels.[44] Cities can sign up to the Charter to declare their commitment to invest in active travel and achieve significant shifts to cycling and walking. Of the 26 cities that had signed it at the time of writing, only one is in the UK (Edinburgh).

In every case, rising levels of cycling and walking were accompanied by falling road deaths and serious injuries overall. Two notable examples are cited. In Portland, Oregon, all deaths due to traffic crashes declined from 46 to 28 per annum between 1997 and 2007, whilst bicycle counts in the centre of the city showed an approximate three-fold increase in ridership (see Slides 129 and 130 of Plenary Session 1 presentations in[43]). In London, England, Transport for London data show a 70% increase of cycling during the years 2000-2007, although cycle use overall remains low at 2% of trips.[45] The introduction of the Congestion Charge in February 2003 is thought to have had a significant influence in boosting cycling in central London. Cycle use in the more peripheral areas of London has grown less or not at all. During these years, cyclist fatalities fluctuated at about an average of 17 per year; serious injuries varied about an average of 400 annually. The erratic nature of cyclist casualties can be exploited by those wishing to sensationalise cycling risk. For instance, serious injuries increased by 34% between 2004 and 2007, but this followed a drop of 25% in the preceding three years. There are similar opportunities at the national level. Cyclist deaths in Britain increased 30% between 2003 and 2005. Figure 2.3 shows the long term perspective.

Safety in Numbers is a potent method to cut risk by creating an environment in which serious crashes are less likely to happen. The focus of cyclist safety should centre on programmes to boost the number of cyclists. Unfortunately the caricature that cycling is dangerous and “more cycling therefore means more danger” is ingrained in many public sector decision-makers.

2.5 Cycle helmets

The Transport and Health Study Group does not support legislation compelling the use of helmets. This is out of line with the current position of the British Medical Association, which supports helmet legislation. The BMA originally opposed helmet legislation, following a quite thorough 1999 study.[46] Then in 2005 it reversed its stance after a single study claimed that

compulsory cycle helmet wearing would not reduce cycling levels, therefore legislation should follow. However, in the study in question, the law was never enforced, so nothing was actually proved. The overwhelming weight of evidence is that enforced laws suppress cycling. The Public Health Committee of the BMA protested on this basis. The BMA changed its stance to conditional support for law, once voluntary helmet wearing levels were high.

The THSG is convinced the BMA was wrong to abandon opposition to helmet legislation. The current BMA stance of conditional support for legislation does not consider the consequences of the cultural factors required to achieve high levels of voluntary use. However, the BMA does at least recognise there is a dilemma; helmet promotion and laws deter cycling and damage public health. It is a matter of concern that some other medical organisations, such as the Association of Paediatric Emergency Medicine (APEM), are calling so vigorously for compulsory helmet-wearing for cycling.

If we are opposed to compulsory helmet wearing, would we therefore advise individuals to wear a helmet?

One author of the first draft of this chapter sees helmets as mainly relevant in off-road cycling and does not use one for road riding. One editor is a cycle helmet wearer. The other editor is a non-cyclist who has periodically considered taking up cycling and would wear a helmet if he did so. As these differences in personal choice imply, there is a range of evidence and experience on which to base one's view, and of course, most of us know someone who smashed a helmet in a crash. We may or may not be influenced by anecdote. The question is; which is the most reliable evidence? Appendix 2A at the end of this chapter presents a comprehensive review concerning cycle helmet effectiveness, acknowledges conflicts of evidence, and seeks to explain those conflicts.

To evaluate the effectiveness of cycle helmets was never going to be an easy task. The risk in cycling is low, so the number of injuries is low. Those who wear helmets are self-selected, therefore they do not represent a randomised sample. The early studies on cycle helmet use were case-control studies (explained in Appendix 2A). Case-control studies based on self-selected behaviour are vulnerable to confounding by socio-economic factors that are related to both helmet-wearing and to injury risk, which can lead to an association between helmet-wearing and injury risk that is spurious. Close inspection of the most highly cited helmet study shows ample evidence of serious confounding. The most careful population level studies, examining injury and fatality rates in relation to general level of helmet use, have not shown noticeable benefit. Population studies are not perfect either, but could hardly miss a consistently high level of protection. What population studies have demonstrated clearly, however, is the deterrent effect of compulsory helmet-wearing on cycling levels. (References for these statements are provided at the end of Appendix 2A to avoid duplication in the reference lists).

It is particularly notable that interest in cycle helmets has turned out to be a direct function of the popularity of cycling in a country. The issue began – and laws were first passed – in countries with the lowest levels of cycling. In the classic cycling countries (Denmark, Belgium and the Netherlands), interest in helmets has stirred only quite recently, and has attracted limited credibility. This is perverse: countries with the lowest proportionate number of cyclist casualties have the greatest interest in helmets. This pattern is revealing of the social and political inconsistencies driving helmet promotion. Evidence showing lack of effectiveness of helmets, or even harm, is ignored. Evidence of the low risks of cycling has also been ignored. Risk assessment prior to the introduction of helmet laws in Australia showed pedestrians faced higher risks than cyclists, and car occupants equal risk.[103] This did not stop the laws being passed, nor did it start the promotion of helmets for the other groups.

It is clearly unacceptable to present opposition to even the voluntary wearing of cycle helmets as wrong-headed and beyond the pale. There is evidence upon which such opposition can legitimately be founded. It is also wrong to present helmet wearing to the public as if it were undoubtedly a good thing. There are doubts of which they should be aware. It is important to recognise that the actual risks of cycling warrant helmet programmes to no greater extent than the risk of high speed crashes warrant the wearing of helmets by drivers or the risks of falling down steps warrant their wearing by pedestrians. The real harm of helmet promotion is that it exaggerates the risk of cycling. But when all that has been said, personal choice must be respected by all. The fact that many cyclists will choose to wear a helmet is not to be criticised any more than it is to be taken as evidence in support of legislation. Cycling is not a hazardous form of travel – that is the bottom line.

2.6 A Cycling Renaissance – how to unleash pent-up demand for cycling

2.6.1 Historical factors

Virtually every cyclist who visits European cities such as Copenhagen, Amsterdam or Groningen comes back with the nagging question: "how do they do it?" Levels of cycling are so much higher than in the UK, and cycling is an accepted part of daily travel. Is this a 'cultural issue'? Is the national culture the most important influence on the popularity of cycling?

We have to recognise starting points: the popularity of cycling is set, more than anything else, by heritage. Ironically, the United States was once the greatest bicycle manufacturer in the world,[47] accounting for nearly half of global production of 2.3 million units at the peak in 1896. The US "car culture" stems from the combination of enormous domestic oil resources and exceptionally innovative manufacturing industry. In contrast, the plains of northern Europe, largely devoid of oil and backward in manufacturing technique, naturally embraced and sustained the Victorian bicycle revolution to a far greater extent. This is obvious in data of car and bicycle ownership from 1928 (Table 2-6).[48]

Table 2-6. International comparison of travel modes in 1928[48]

	Inhabitants per car in 1928	Inhabitants per bicycle in 1928
The Netherlands	208	3.3
Germany	245	5.8
France	71	6.0
England	60	7.1
United States	6	70.0

So even as early as 1928, car ownership in the USA was already as high or higher than bicycle ownership was in many European countries.

After the Second World War, the 'car culture' spread throughout the industrialised world as an essential element of the 'showcase economies' of the West, along with consumerism and changing attitudes to personal debt. All countries experienced the same large move away from the bicycle that had happened in the USA 30 years earlier.

However, countries that had evolved a grand culture of cycling had further to fall. Thus both the UK and the Netherlands experienced up to 75% declines in cycling levels between 1945 and the first Oil Crisis in 1973. The big difference was that the Netherlands fell to a level that was still greater than it had ever been in the UK, on a per capita cycling basis,[39] so there was still a significant culture of utility cycling upon which a renaissance could be based. The pattern of transport during the last hundred years is thus a major determinant of the condition of cycling today in a given country. This is especially noticeable in France, where, despite decades of political indifference and the general absence of special facilities for cyclists, the bicycle still enjoys a healthy level of use and respect.

2.6.2 UK Public interest in cycling – evidence of pent-up demand

Figure 2.2 showed that there has been decline in cycling for the last twenty-five years. Might this be because the population has simply lost interest in cycling? Surveys show that this is not the case. A survey by MORI for the Commission for Integrated Transport found that 47% of people would cycle more if problems (as perceived) were addressed.[49] The principal barriers are expressed in terms of the percentage who said they would cycle more if the issue was addressed:

- Better / Safer cycle routes: 32%
- More cycle routes: 31%
- Better bicycle parking: 28%
- More considerate attitudes from drivers: 26%

Thus there is evidence of substantial pent-up demand for cycling. Achieving a cycling renaissance will involve releasing this pent-up demand through removing obstacles, as well as active measures like cycle-friendly infrastructure and the marketing of cycling as an appealing choice.

2.6.3 Public Policy – Continental model

It would be a grave error to underestimate the importance of public policy. In European cities that have growing numbers of cyclists, clear policy decisions have been taken to prioritise cycling as a mode of urban transport. This includes a few British cities; there *are* success stories in this country. Whether motivated primarily by environmental, health or transport considerations, successive city (and national) governments have decided that prioritisation of cycling – and associated restrictions on private car travel – offer the greatest potential for improving quality of life.

Dutch, Danish and German cities that have seen success in increasing cycling have a number of similarities[50] [51] [52]:

- the provision of separate cycling paths along busy roads and junctions;
- traffic calming of most residential areas;
- ample bicycle parking;
- full integration with public transport;
- comprehensive traffic education and training of both cyclists and motorists;

- a wide range of promotional events intended to generate enthusiasm and public support for cycling;
- policies that make driving expensive as well as inconvenient in central cities, through a host of taxes and restrictions on car ownership, use and parking; and
- strict land-use policies that foster compact, mixed-use developments that generate shorter trips.

There is a widespread belief, especially amongst non-cyclists, that the high levels of cycling in some European countries have followed installation of segregated facilities. This is a myth. As pointed out in Section 2.6.1, these have been cycling countries for nearly a century. What we see today results from factors of the 1920s and 1930s. However, it surely can be said that these old cycling cultures have been preserved, and to some extent enhanced, by modern support.

Previous European national cycling demonstration towns have established traffic planning models which re-prioritise cycling within traffic policy. This includes a recognition of the amount of short trips by bicycle, not reflected in traffic counts.[53] Best practice case studies highlight the degree to which cyclists can participate in traffic safely and without obstructions. This is epitomised in the phrase 'continuous and integral'. Of the top ten cycling cities in Europe, six have separate cycle facilities as standard and seven have bicycle parking as an important cycling policy theme.[51]

2.6.4 Cycle-friendly infrastructure for the UK

In Britain, the development of cycle-friendly infrastructure best practice has necessarily been tailored to the urban layout as built to date. The Cyclists' Touring Club and the Department for Transport have developed the *Cycle Infrastructure Design Guidance*.[54] This integrates with the development of the National Cycle Network by Sustrans.

The guidance is based around the 'Hierarchy of Provision':

- Traffic reduction
- Speed reduction
- Junction treatment, hazard site treatment, traffic management
- Reallocation of carriageway space: bus lanes, widened nearside lanes, cycle lanes
- Cycle tracks independent of road network
- Conversion of footways/footpaths to shared use cycle tracks for pedestrians and cyclists

This hierarchy recognises the inherent better safety of cyclists sharing urban road space with other traffic, rather than using shared pavements or road-side paths. It was developed after experience in the 1990's with the installation of cycle facilities of appallingly low standard.[55] Doubtless we all have seen the cycle lane sweeping across a footpath to collide with a telephone box. The British experience has been that, where segregated facilities are added to an established road system, they almost always create more problems than they solve.[56] [57]

Interestingly, the hardest evidence against the efficacy of roadside paths or pavement cycling comes from countries where these are common. Research in many European countries shows a surprising consistency of result: roadside cycle paths increase risk by three to four times relative to sharing space with traffic. A substantial literature of European experience is available.[58] Non-cyclists generally say they would start cycling if segregated infrastructure were available, but even this apparently simple promise turns out to be confounded by reality.

Experience in new towns like Stevenage and Milton Keynes, which were built with extensive segregated provision for cyclists, have not fostered cycling cultures. A study of the Milton Keynes Redways[59] found that cycle ownership was higher than the national average, yet the rate of cycle commuting was low at 3% of trips, lower than in nearby towns that had no infrastructure. It was noted that half of local cycling distance was still on the public roads, and further, that for adult cyclists the rate of injury accidents was almost twice as high on the Redways as it was on the public roads. During an eleven year period after 1987, there were six deaths on the Redways but only one on the public roads, for about the same amount of cycling on each. Despite this, surveys noted that the Redways were perceived to be safer.

It would be an error, though, to dismiss all segregation, or to suppose cycling infrastructure is a dispute about segregation versus sharing roadspace. *Any* effective infrastructure must:

- ***maximise*** speed, comfort and efficiency (i.e. reduce stop-starts to a minimum); and
- ***minimise*** delay, diversion and danger (perceived as well as actual).

These may be achieved on- and off-highway, but they must be achieved to draw the cyclists. Ideally, no obvious measures like cycle lanes are required. This is known as 'invisible infrastructure'. The requirements have been gathered into the '5 Core Principles'[60] [61] upon which the Hierarchy of Provision is based:

1. Convenient: Networks should allow people to go where they want. Routes should usually offer an advantage in terms of directness and/or reduced delay compared with existing provision. Cyclists should not face long detours or constant giving way along their route.

2. *Accessible:* Cycling routes should form a network linking key destinations including public transport access points. The routes should be continuous and as direct as possible. Routes should be provided into and through areas normally inaccessible to motor vehicles such as parks and shopping centres, as this may help to encourage modal shift.

3. *Safe:* Not only must infrastructure be safe, it must also be perceived to be safe. Traffic volumes and speeds should be reduced where possible in order to create the desired conditions. Opportunities for redistributing space within the highway should be fully explored. The potential for conflict between pedestrians and cyclists should be minimised.

4. *Comfortable:* Infrastructure should meet design standards for width, gradient, and surface quality etc, and cater for all types of user.

5. *Attractive:* The cycling environment should be attractive, interesting and free from litter, dog mess and broken glass.

The Hierarchy of Provision thus aims to thread a pragmatic course towards a cycle-friendly infrastructure that will draw new cyclists, making as full as possible use of existing roads. It has been applied in modest degrees in several British cities, notably Edinburgh, London, York, and more recently in Cycling Demonstration Towns in England (Aylesbury, Brighton and Hove, Darlington, Derby, Exeter and Lancaster with Morecambe). The Cycling Demonstration towns report an average 27% increase in cycling over five years, or about 4% growth per year. This may appear modest, but it compares favourably with growth recorded on the Continent in the 1980's and 1990's. For instance, cycle use in Netherlands grew 30% in the ten years 1980 to 1990, with slower growth since. There is ample evidence that even in the cycling demonstration towns, priority for cycling is still compromised.[62] This is the fundamental problem; lack of real

prioritisation of cycling by local authorities even when investing at ten times the national average rate per capita in 'showcases'.

Nevertheless a steady growth rate of 4% per year compounds to 50% growth in ten years. If this could be achieved at the national level, it would bring 1.5 million people the benefits of cycling. It is worth noting that to double cycle use in the UK would only require getting 5% of the population on their bikes. This does not appear overly ambitious, spread over, say, five to seven years.

Cycling infrastructure has a sizeable literature[56] and often provokes intense debate.[63] The priority for public health must be to attract non-cyclists onto the bicycle. A 2009 Sustrans survey of 1,000 women asked what would encourage women to cycle more, and suggested four answers. Two-thirds agreed that separate cycle lanes with vehicles excluded from using them at all would encourage women to cycle more, compared with one-third if cycle lanes were clear of all traffic except buses; one fifth a strictly enforced 20mph limit in local residential areas; and one-sixth cycle training locally.[64] Women who cycle several times a week but not every day were a little more positive about each suggestion. There was a marked social gradient: separate cycle lanes were desired by 72% of women in social classes I and II, falling to 54% in social class V. Women in manual groups thought locally available cycle training was more important (20% in classes IV and V) than other women did.[65] Thus there is a dilemma between measures that could attract non-cyclists onto bicycles while making cycling as safe as possible.

It is not clear whether cyclists who gain proficiency through training schemes like *Bikeability* are still as interested in separate paths. One presenter at the VeloCity 2007 conference summed up the solution to the conundrum:

> *"The best and safest cycle path is, ultimately, the one that is not needed because of the traffic structure and the traffic proficiency of the road users."*

Cycle routes may also be completely off-highway, using canal tow paths or former railway lines. These routes can offer both established and novice cyclists excellent alternatives to city streets, avoiding traffic lights and large junctions. Provided they are well surfaced and have good sight lines, these are a valued complement to the road network. These traffic-free sections of the National Cycle Network and the increasing local links to this may be the solution to the dilemma above between non-cyclists' wish for segregated cycle paths and experience cyclists' awareness of the disadvantages, particularly the greater hazards these pose at junctions. 6% of cyclists using the National Cycle Network are novice cyclists, or returning after many years of not cycling (a fifth of women cyclists surveyed nationally, and 22% of male or female cyclists at the Cutty Sark survey point).[64] Traffic-free sections of the Network account for about a third of its length, but 65% of its usage by cyclists.[33] This proportion is affected by low traffic levels on long distance routes, of course. It will be interesting to discover whether these new cyclists, once they have developed confidence in their cycling ability and enthusiasm for cycling as a transport mode, then transfer to on-road cycling.

The closure of rat runs to cars, leaving them open to cyclists, or the linking of quiet streets by cycle paths can also create continuous cycle routes attractive to established and novice cyclists alike.

The CTC (also known as the Cyclists' Touring Club) has further information and best practice case studies on its web site.[66] In addition, Cycling England presents a substantial range of advice on its web page *Infrastructure for Cyclists*.[67] The Scottish Executive guidance *Cycling by Design*[68] is also based on the Hierarchy of Provision and provides comprehensive guidance on the development of a cycling infrastructure, integrated with the National Cycle Network.

In summary, there is still a mismatch between what non-cyclists say they want and what experience shows is actually safer. As our objective is to increase cycle use amongst non-cyclists, the demand for a separate network is of fundamental importance. However, the new towns, and other examples, show that providing the segregation does not necessarily bring the cyclists. The demand for segregation follows the negative image of cycling in traffic. If that negative image were altered by enhanced status and role models, would there still be the same demand for segregation? Factually, cyclists, and especially beginner cyclists, are usually more at risk when using segregated facilities parallel to existing roads.

2.6.5 Guidelines on official promotion of cycling

It is vital that official promotion of cycling presents attractive images. These must acknowledge diversity amongst cyclists and support factual evidence regarding the low risk in cycling. Promotion must not exacerbate myths. Recent successful campaigns have shown the following styles:

- Use attractive models (aspirational but not intimidating);
- Present a range of bicycle types (folding, traditional roadster, fixed gear, town bikes, etc);
- Riders wearing normal everyday clothes, not high fashion but aspirational;
- Feature clothes that are non-seasonal, could be worn in most seasons;
- Present a range of settings (parks, on roads, urban);
- A mixture of riders with and without helmets, to reflect neutrality and individual choice.

2.6.6 Obstacles remedied by re-engineering[69 70 71 72]

Lack of secure cycle parking

- Theft is a major deterrent. Cycle stands are often badly designed or tucked away from public view, if installed at all. Parked bicycles need direct security supervision to inspire confidence. Indoor storage is ideal, or else at least in a secure, covered compound. Employers need guidance on minimum acceptable levels of storage.

Fear of Crime

- This is especially a perceived issue for female cyclists and older people, although in fact it is young males who are most likely to be the victims of crime.. It can to a degree be alleviated through good street lighting along cycle routes. It should also be noted that the problem diminishes as cycling rates increase, as the risk is greatest when no other person is around.

Better Integration of Cycling with Public Transport

- Surveys of cyclist behaviour show that few people are prepared to cycle much more than five miles. The average trip distance cycled is about 2.5 miles.[73] Clearly, the usefulness of both the bike and public transport is enhanced if the two can be combined (see Chapter 3).

2.6.7 'Factors of the Mind'

The obstacles in this section are inherent in the culture of Britain. They must be addressed by assertion of the facts and public relations work, and through enhanced status of cycling. Doctors, celebrity cyclists, politicians and utilitarian cyclists in their daily lives all have their role to play in addressing the following factors.

Fear of Motor Traffic

Perceived danger emerges as a major factor in reasons cited for not cycling, or for not cycling more. Active cyclists also often cite fear of traffic as a major issue. As discussed in Section 2.3, the fear is not justified by the actual risk of serious injury, but there is an important caveat. Some country roads become alarming commuter 'rat runs' in peak hours, whilst other roads carry so much heavy traffic as to practically exclude them for cycling. If there is no safe alternative to such routes then the network is broken at that point. The utility of a network is proportionate to the square of its size, so if three gaps of this kind break a local network into four they reduce its utility by 93%. It is in these situations that off-highway cycle routes are most relevant. However, in most urban settings, the low actual risk makes segregation superfluous and probably counter-productive, as discussed above. Experienced cyclists must be influential in securing the correct solutions for the circumstances. Cycling PR must foster an accurate perception of risk in the public mind.

National culture unsympathetic to cycling

It has long been observed that helmet use began earlier, and is today far higher, in countries with low levels of cycle use. This would tend to suggest a strong link between the amount of cycling in a country and the perceived danger in cycling. Efforts to promote cycling from low levels encounter cultural resistance. This point is well summed up by one study[71]

> *"Bicycling... is impeded by the lack of tradition of cycling for utilitarian purposes and by the marginal legal, cultural and infrastructural status of cyclists in automobile based transport systems."*

A fine example of this in the UK arises when insurance companies attempt to adjust their loss down by accusing injured cyclists of contributory negligence for not wearing a cycle helmet, or not using a sub-standard cycle path, or not wearing a high-visibility vest. These cases are never brought against pedestrians or drivers, despite the very similar levels of actual risks faced by these road users. These cases have not been successful, and informed legal opinion is that they should not be.[74] This does not stop insurance companies attempting to save money through accusations of contributory negligence.

Official documents like the Highway Code, and official policies such as helmet promotion programmes, confirm caricatures about cycling being 'dangerous', and separation from traffic being necessary to improve safety. The media also contribute heavily. Coroners' Court reports on deaths of cyclists get extensive coverage, especially concerning whether a helmet was worn or not. Deaths of pedestrians in falls, which are actually far more common, rarely get mentioned in the press.

Official Promotion of Misleading Perceptions

If official bodies perceive cycling to be unsafe then they may permit the issuing of messages which reinforce that view. That in turn may discourage people from cycling, and hence accept a serious reduction in life expectancy in order to avoid a risk that is well within the bounds of risks normally borne in everyday life. Two recent cases are worthy of mention.

The first is the case of Smith versus Finch (2008).[75] This was a contributory negligence counter-suit against a cyclist severely injured by a motorcyclist, on the grounds that the cyclist was not wearing a helmet. The case failed and full compensation was paid, but in his summing up, the judge opined *obiter dicta* that *"it must follow that a cyclist of ordinary prudence would wear one [a helmet]... I am satisfied on the balance of probabilities, that the cyclist who does not wear a helmet runs the risk of contributing to his/her injuries.."* Such a conclusion does not stand against evidence of the low risk in cycling and the problematic effectiveness of helmets. It was made by an official of the state having no known qualifications to make such a judgement, in the

absence of a process by which he could be called to account. It may have legal force in future cases. There is clearly a flaw in the judicial system, that individual arbitrariness can be magnified up to affect a national issue.

The second case is of a television advertisement in which the singer Duffy takes a quick ride to a supermarket on her bicycle (the advertisement can be viewed on YouTube). She did not wear a helmet or fluorescent visibility aid. Rather more to the point, her bike was not fitted with lights. Eighteen complaints were made to the Advertising Standards Authority (ASA), which proceeded to investigate. In the end, the complaints were not upheld.[76] Future advertisers however will be wary of portraying cyclists without helmets.

Of course, both of the above cases rest upon the ignorance about the actual risk in cycling. This ignorance is, unfortunately, fed by official discussions of cycling safety as a problem.

Lack of Utility Cycling Tradition

It is noted that the modal share of cycle use is high only in countries with high levels of utility cycling. 'Utility cycling' means using a bike in the course of the trips of daily life. This may include riding to work, to the shops, or to see friends in the evening. This is in contrast to leisure cycling, which is strictly a past time, not travel for economic purpose. Leisure cycling may actually increase car travel, if riders drive to an off-road or distant cycle route. This is a problem in some parts of Scotland, notably Callander. In contrast, utility cycling will most likely substitute for car use or public transport and therefore is the most desirable from the active travel perspective.

Utility cycling must be the backbone of any revival of cycling. Cycling programmes that ignore this will not succeed.

2.7 Conclusions: "Myth shall prevail if the wise remain silent"

The British government has long stated it would like to increase cycling. The National Cycling Strategy aimed to quadruple cycle use on 1996 levels by 2012. As this review has shown, the decline in per capita cycle use has been halted but not reversed.

The perception of cycling as unsafe is the central reason for the failure of this policy. Almost a third of non-cyclists are discouraged from cycling by this perception.

2.7.1 Summary of main conclusions

Cyclists using the roads bear everyday risks little different from walking or driving, and those risks fall as cycling gets more popular. This is known as the Safety in Numbers (SiN) effect. There is no known case in the post-war period when an increase in cycling caused an increase in serious casualties. Further, an increase in cyclists may be expected to reduce road deaths, due to the negligible harm cyclists impose on others. This would be especially so if more young men took up cycling. In most cases, the safest way to cycle is to share road space with other traffic, behaving in line with the principles of 'cyclecraft'.[77] Considerately driven cars pose very little risk for cyclists.

The health benefits of cycling are substantial, conferring a reduction in mortality similar to giving up cigarette smoking. The bicycle is judged to be amongst the most effective means to increase physical activity in daily routine. This is because it suits the sub-five-mile trips that make up the bulk of personal travel. When combined with the train, the bicycle could challenge the flexibility and convenience of car travel even for many longer trips.

It is evident that re-education of official, media and public attitudes must be a prerequisite to any renaissance in cycling, even back to the levels seen twenty years ago.

2.7.2 Conclusions on the safety of cycling

1. Considering the impact upon both users and third parties, cycling is comparable to car use in its overall safety.

2. As the figures for driving are diminished by the inclusion of motorway journeys, which are much safer than all purpose roads, and as the figures for cyclists are increased by the greater proportion of cyclists who are inexperienced, young males, or untrained, it can safely be concluded that for the kinds of journeys which will in fact be made by cycle, cyclists who have undergone proficiency training and ride regularly have an overall safety impact significantly less than that of comparable motorists on similar journeys.

3. As a much greater proportion of the safety burden of cycling falls on the user rather than on third parties, it is possible that the risk to the cyclist is slightly higher than the risk to a comparable motorist on a comparable journey. However direct comparison of the risks of driving and cycling is fraught by various confounding factors, including demographic factors, relative proportions of experienced and inexperienced users and types of journey. In addition, drivers travel much further than cyclists. This makes comparison of risk on a distance travelled basis misleading. It should be emphasised in any case that pedestrians face higher fatality rates per unit distance than cyclists The higher average risk of cycling at the population level in Britain, relative to driving, is not enough to indicate with certainty that a given individual would be exposed to meaningfully greater risk when cycling, compared with driving.

4. Even if there is an additional risk, it is small and is of an order comparable to many risks that are taken without thought in everyday life, such as driving on an all purpose road rather than a motorway, driving at night, or travelling by car rather than by train. The UK drivers' safety record is the best in the world. The UK cyclists' record is still better than drivers in some other industrialised countries.

5. Even if there is an additional risk, it is outweighed many times over by the health benefits so that overall cycling enhances life expectancy.[13] Any difference in risk between cycling and driving is fractional relative to the health benefits and some of this difference relates to not comparing like with like.

6. Not cycling therefore gives up a huge health benefit with considerable calculable impact on life expectancy in order to avoid a small risk, comparable to many risks that are taken without thought in everyday life, the impact of which on life expectancy will be negligible.

2.7.3 Conclusions regarding cycle helmets

Of particular concern is the prominence given to cycle helmets. This emphasis has for 30 years presented cycling as an especially risky mode of travel, akin to motorcycling. It is hardly surprising that UK bicycle use has declined by 30% in that time. In New Zealand, bicycle use collapsed by 55% following years of helmet promotion and enforced legislation.

A fair statement of the position regarding cycle helmets is as follows:-

1. The case for a cyclist to wear a helmet is no greater than that for a driver or pedestrian and certainly less than that for a footballer or rugby player.

2. It may be a rational decision for a driver, cyclist, or pedestrian to wear a helmet, but on the other hand individuals must keep a sense of perspective about how much effort they invest in avoiding small risks.

3. In the case of cycle helmets there is an added problem, which potential users should be made aware of, that there is scientific evidence suggestive of a possible negative effect which may even outweigh the benefits, although the nature and extent of that effect is ill understood and the evidence is not conclusive.

4.The wearing of cycle helmets should not be made compulsory, for three reasons. The most important is that -it has been shown in a number of different jurisdictions that compulsory (and enforced) helmet-wearing reduces cycle use and therefore has a negative effect on the population's health. Secondly, the risk which is being averted is sufficiently small that compulsion is disproportionate. Thirdly mass helmet use has not reduced serious head injuries to a noticeable degree relative to general improvements in road safety seen for other road users (i.e. secular trends).

5. It is a plausible argument that vigorous promotion of cycle helmet wearing does more harm than good by presenting cycling, wrongly, as a dangerous activity. As a related point, contributory negligence cases, brought by insurers against cyclists injured when not wearing a helmet, should be banned by appropriate legislation. It is also urged that Highway Code Rule 59 be amended to remove reference to cycle helmets and reflective clothing. The latter point conflicts with emphasising the duty of other road users to see cyclists, which in daylight are in fact adequately visible in lightly-coloured, ordinary clothing.

Discouraging healthy travel is much like cigarette advertising in the harm it inflicts. Public health professionals must recognise the hazard of unintended consequences from well meaning helmet campaigners, and be prepared to speak out against exaggerations of risk and distortions of data. *"Myth shall prevail if the wise remain silent."* This should in no way be intended to undermine the principle that individuals may choose for themselves to use helmets, following realistic advice about the protective value, as is also the case with helmets for drivers and pedestrians.

It may seem strange for public health professionals to express reservations about safety campaigns, but public health is always concerned with priorities. A risk-averse society is different from a safe society. In a safe society, those who climb mountains take the right equipment, check the weather, ensure that people know their route and expected time of return, know their limitations, and contribute to the funding of mountain rescue teams. In a risk-averse society, people do not climb mountains. Ultimately, a risk-averse society is an unsafe society because people lose the capacity to handle risk sensibly.

2.7.4 Conclusions regarding cycle-friendly infrastructure

The issue of cycle-friendly infrastructure presents a significant dilemma. The following is a fair statement of the position.

1. There are strong grounds for arguing that segregated provision is not the best way to make provision for cyclists in the UK road system.

2. In particular, there is concern that badly designed segregated provision will make cycling inconvenient and unsafe, especially by loss of priority at junctions. Past experience shows that this does not encourage new cyclists but it discourages existing cyclists. The current wording of Rule 61 of the Highway Code is in this regard unhelpful, implying that cyclists must use facilities "unless at the time it is unsafe to do so". Cycle facilities are rarely safer than the road, and badly designed ones are never safer. It is thus recommended that Rule 61 be omitted.

3. However, segregated provision is wanted by a large proportion of those who are open to persuasion to take up cycling, but have little, if any, personal experience of cycling. This

presents a fundamental dilemma. Should public health professionals accept that it is easier to work with the myth and develop segregated facilities in order to encourage people to cycle and hence gain the health benefits? Or should they correct the myth through favourable messages about cycle training, well-equipped road bikes and the directness of the existing road network?

4. Good quality off-road cycle paths, such as those that can be established on old railways or canal tow paths; cycle paths linking quiet streets into through cycle routes; and long continuous quiet routes formed by closing rat runs are popular with established and novice cyclists alike and should be a high priority for cycling investment.

5. There are some roads – generally major rural routes - which are inadvisable to cycle on and where segregated provision is necessary either on the road or avoiding it. It is particularly important that such provision is then funded and implemented to enable cycling. Where such routes would provide direct links between nearby towns or suburbs, they should be a priority.

6. Where the above measures bring into being significant cycle-friendly networks , it would be foolish not to create segregated links to fill gaps in the network (in line with Point 5). These must be of acceptable quality, as advised by experienced cyclists, or they will not be used.

7. The present Hierarchy of Provision should continue to apply. It is the most pragmatic guideline, and has achieved significant increases in cycling levels where it has been applied. The main problem is that too few local authorities have active cycling programmes.

8. It must be stressed that investment in cycling infrastructure will be largely wasted if it is not supported by official endorsement of cycling as a priority mode of transport.

It can be seen that this list places the emphasis on measures that would be seen as positive by novice cyclists and established cyclists alike. This is crucial, since badly designed cycle facilities will discourage existing cyclists, rather than encourage novices. Adequate priority for cyclists must be achieved in all cases. This recognises the concerns of experienced cyclists by clarifying the settings in which segregation is appropriate. The priority must be to get people onto bikes. The competent provision of cycle-friendly infrastructure is vital to this objective. We cannot ignore the views of that one- third of the population who want quieter streets or cycle paths so that they can take up cycling.

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Appendix 2A Cycle Helmet Evidence

A significant body of literature is available on cycle helmet effectiveness. This has been reviewed from time to time[78] [79] and these reviews have been subject to criticism.[80] [81] [82] In December 2009, the Department for Transport issued a further review of cycle helmet effectiveness[83]. This has already been subject to criticism for claiming helmets have life-saving benefit on the basis of the authors' assumptions, not on the basis of scientific evidence.[84]

The published literature falls into two main types of study: case-control studies and population-level time-trends analyses. Case-control studies report high levels of protection from wearing a cycle helmet, up to 88% protection from brain injury. Some population level studies have reported injury reductions from helmets, but in every case the effect was actually due to secular falling trends across all road users. Population-level studies that account for secular trends show no noticeable prevention of serious head injuries, either in traffic collisions or falls in the highway. The case-control studies were conducted while helmet use was still at a low level (3-10%), whereas the population-level studies had to wait until there were high levels of helmet use. The debate thus opened in the mid to late 1980s with apparently strong reasons to promote helmets and make them a legal requirement. The later population level studies have attracted less notice, and have been ignored by official reviews. For instance, the 2002 UK government review,[79] the Cochrane Review[78] and a recent review by NICE[85] all omit mention of population-level studies. The latest (2009) DfT helmet review did consider population level studies, but denied their relevance to judging helmet effectiveness. Ignoring conflicts of evidence is bad science. An explanation is required for the disparity between case-control studies and population-level studies.

In case control studies, people with a particular outcome (such as head injury when cycling, the ‘cases’) are compared with ‘controls’ (such as, non-head injuries when cycling). The ‘cases’ and ‘controls’ are asked about previous ‘exposure’ (i.e. whether or not they were wearing a helmet at the time of injury). Case control studies are very useful for generating theories but are less good at confirming cause and effect, both because of difficulties with time sequences and recall bias and also because of confounding: there may be systematic differences between the cases and the controls that affects both the outcome (head injury) and the exposure (wearing a helmet).

The case-control studies were conducted on a best endeavours' basis, but nonetheless can aptly be criticised for serious flaws. For instance, it is now known, from directly observed helmet surveys, that social class has a strong influence on helmet use by children.[86] Recent experience has taught the perils of relying on case-control studies when personal choice is involved[87] because of confounding.

The largest case-control study ever conducted[88] gathered data on cyclists' injuries in Seattle during a 2.5 year period from 1992. There were c.3,900 cyclists treated in Emergency Rooms, with adequate data being captured for c.3,400 cases. However, only c.300 (9.4%) required admission. The low number of serious injuries, despite the prolonged data gathering period, underlines that cycling is not in fact a significant cause of serious injury even in a city of (at the time) 2.5 million. The study's conclusions regarding prevention of serious injuries thus rest upon a fairly small dataset. The results show a mysterious pattern, as displayed in Table 2A.1 below:

Table 2A.1 Case-control study of helmet use and injury in Seattle

Outcome	No. with helmet	No. without helmet	Odds Ratio
Fatality	1	13	0.07
Severe brain injury	15	47	0.24
Brain injury	62	141	0.33
Any head injury	222	535	0.32

Note: Odds Ratios are the measure that can be obtained from a case control study. In this case it is the ratio of the odds that someone wearing a helmet had that outcome compared with the odds that someone not wearing a helmet had that outcome. An odds ratio below 1.0 means the 'exposure' (helmet wearing) is protective.

The data show that, apparently, the protective effect of a helmet increases with increasing severity of injury. It is extremely difficult to accept such a result, and indeed, it is the opposite of what is seen in population level studies, which return the more sensible outcome of declining protection with increasing severity of injury. It must be the case that confounding factors systematically caused non-helmeted cyclists to be in more severe traffic accidents. This is consistent with the observation that helmet use is a function of social class.

The Seattle study dataset forms the core of the Cochrane Review of bicycle helmet effectiveness. Its small dataset of serious injuries and the above noted implausibility of the results are not widely recognised. On the contrary, the results are still widely cited in the literature and media as proven fact. The other main case-control study[89] cited in the Cochrane Review took place in Cambridge, England and is likewise based on a small dataset of serious head injuries (104 cases). None of the studies considered socio-economic differences between helmet and non-helmet users.

Note should be taken that the latest BMA briefing in support of helmet legislation specifically excludes prevention of death from the benefit. A fuller discussion of the problems with case-control studies of cycle helmets is available.[90]

In contrast, population studies are much harder to challenge. A number have appeared, two of which stand out as being particularly rich in terms of the time period covered and a control group being presented. Hendrie et al[91] studied the effect of the state helmet law of Western Australia, concerning serious head injuries to cyclists in traffic accidents (collisions or falls in the highway). This was based on study of the proportion of serious casualties with head injuries, when set against a control group. It thus examines the prevention of head injury when crashes happen, not the number of crashes or the risk of being in a crash. They concluded the law prevented 10-20% of head injuries. However, as the authors point out, the result rests upon one step change in the year prior to the law, not upon reductions as the law was enforced, nor upon any reduction with rising voluntary use pre-law.

Scuffham et al[92] studied the same injury class for New Zealand, using a similar technique. They concluded 19% prevention of serious head injuries (mainly scalp lacerations) due to enforced legislation. However, the authors did not model the helmet law as a step change in helmet use. Surveys showed a step increase in helmet use as the law was enforced, but this was not reflected as a step change in head injury trends. The base data show that serious head injuries continued a smooth secular decline through the law enforcement, while serious non-head injuries markedly increased. Other data show that cycle use (in time spent nationally) declined

by 33% between 1989/90 and 1997/98[93], the period of helmet promotion and law enforcement. This would imply an increase in risk post-law.

Because there was scope for further analysis as per above, these data, and others from Victoria, Australia *inter alia*, were gathered and published[94] with a conclusion of "no clear benefit". The failure of mass helmet use to affect serious head injuries, be it in falls or collisions, has been ignored by the medical world, by civil servants, by the media, and by cyclists themselves. There is a collective willingness to believe, in defiance of reality. This appears to explain why the population-level studies are so little appreciated. Let it be stressed that the definition of head injury applied in these population level studies was not especially exclusive – for instance, scalp lacerations were included. In both the Hendrie and Scuffham studies, 70% of the head injuries occurred in simple falls, not traffic collisions. Despite this, no reduction of head injuries relative to non-head injuries could be linked to increasing helmet use in the populations concerned. In the absence of any easy rationale, these studies are simply dismissed by those who wish to believe otherwise.

Confirmation of the population-level studies comes from physical evidence. One leading engineer has reported: *Another source of field experience is our experience with damaged helmets returned to customer service... I collected damaged infant/toddler helmets for several months in 1995. Not only did I not see bottomed out helmets, I didn't see any helmet showing signs of crushing on the inside*[95]. The significance of this is that crushing of the liner is evidence of significant energy absorption and therefore impact alleviation. Even earlier, in 1987, the Australian Federal Office of Road Safety found that in real accidents: *very little crushing of the foam liner was usually evident... What in fact happens in a road crash impact is that the human head deforms elastically on impact. The standard impact attenuation test making use of a solid head form does not consider the effect of human head deformation, with the result that all acceleration attenuation occurs in the compression of the liner. Since the solid head form is more capable of crushing helmet padding, manufacturers have to provide a relatively stiff foam in the helmet so that it would pass the impact attenuation test... cracks developing partly or fully through the thickness of the foam renders it useless in crushing and absorbing impact forces*[96].

Risk compensation: risk compensation is the human tendency to alter behaviour when expected consequence changes. For instance, the expected benefits of seatbelt use failed to materialise following legislation.[97] Analysis of car wrecks makes it clear that seatbelts can confer life-saving benefit in a given crash. The only explanation for the failure is a change in behaviour by some drivers forced to wear a seatbelt. Seat belts became law for drivers and front seat passengers in the UK on 1st January 1983, with compliance rising to 90% (from about 30% use) within a few weeks. It has been concluded that one in eight cyclist deaths and one in 12 pedestrian deaths in that year were due to seatbelt legislation.[98] This transfer of danger from those in cars to those hit by them is euphemised as "migration hypothesis". Figure 2.3 confirms that 1983 marked no noticeable change in the fatality rate of drivers. The UK government had commissioned research into seatbelt legislation prior to the final Parliamentary debate in 1981. The report by JE Isles of the Department for Transport concluded that seatbelt laws had not detectably reduced road deaths.[99] This was suppressed and only became known when *New Scientist* magazine revealed its existence in February 1985. Thus the 1981 debate that passed legislation was never informed. Claims for success of seatbelt legislation rest upon the long term declining trend that dates back to the 1960s and continues to this day. The lesson of seatbelt laws is: do not ignore risk compensation.

With respect to cycle helmets, risk compensation has not been much studied. The most definite, and disturbing, result concerns helmet use altering driver behaviour. One study[100] found that some drivers passed faster and closer to a helmeted cyclist. Hedlund has proposed a general model[101] of behaviour, in which cycle helmets score highly in likelihood of causing risk

compensatory behaviour in riders. A study of children running around an obstacle course with and without helmets (and other protective equipment) showed strong risk compensation, with children going faster and being more reckless when using the protective equipment.[102] Surveys of US cyclists in the late 1980s found that helmet users were more than seven times more likely to say they had struck their head in the last 18 months than non-users.[103] At this time the rate of helmet use was c.10%. But is this self-reporting bias? Or bias due to self-selection by higher risk cyclists to wear helmets? If risk compensation was a serious problem, one would expect to see an increase in road traffic casualties as helmets become popular. This can happen, but not in a consistent way. One may easily note from Figure 2.3 that cyclist deaths sharply increased after 1994, in the years when helmets first became popular in Britain, although the effect has faded. A US study[104] found a statistically significant association between helmet use and risk of death to US cyclists in the period 1973 to 1985. On the other hand, analysis of Edinburgh road casualties[105] found no evidence that adult cyclist injuries in traffic crashes had worsened since 1990, relative to the control group (pedestrians). Research into cyclists' attitudes has found that the more a person believes a helmet to be effective against serious or fatal injury, the more likely they are to wear one.[106] In summary, on the balance of probability, risk compensation by helmet wearing cyclists is highly likely, but the evidence is not conclusive. The evidence that drivers impose more risk on helmet wearing cyclists is disturbing and certainly warrants further research.

Rotational Injury: brain injuries may be caused by linear impact or rotation of the head, or a combination. There is no definitive research on whether cycle helmets increase the risk of rotational injury. Laboratory tests show that rotational accelerations in helmeted head forms can exceed levels likely to cause debilitating injury or death. However, laboratory conditions are not real conditions, as has already been noted above. On the basis of biomechanical test results, one would expect helmets to prevent serious and possibly even fatal head injuries, although probably increase the risk of rotational injury. The absence of noticeable reduction in serious head injuries with mass helmet use is a real world result that cannot sensibly be ignored. An interesting commentary is available that discusses possible reasons for the failure of laboratory results to carry into the real world.[107]

The failings of biomechanical studies do not prevent these results being cited in favour of helmet promotion, in the absence of any positive real world result. Some advocates of cycle helmets dismiss all results from the real world in favour of the assertion that cycle helmets must work because they would be expected to work from laboratory tests. The latest (2009) helmet review[83] by the DfT is an example of this. While concluding that no clear evidence of helmet effectiveness emerges from a review of the literature, it then claims life-saving protection from helmets, but on the basis of the authors' biomechanical assumptions, not scientific fact.

Helmet standards must be mentioned in brief. These have changed since the first ANSI standard for a bicycle helmet in 1966, and vary today around the world. The helmet standard prevailing in Australia and New Zealand at the time the helmet laws came into force (AS/NZS 2063.2) was a tougher specification than the EN1078 standard for helmets in Europe today.[46] Contrary to what one might expect, the robustness of cycle helmets has declined since the 1970s, with the progressive loss of the hard outer shell, increase in venting, and reduction in mass. This has made popular acceptance possible. The most stringent helmet standard in the world today is the Snell B95. Such a helmet is hard to obtain in Europe.

The British Medical Association was persuaded to support helmet legislation on the basis of one study concluding that the Ontario child cyclist helmet law of 1996 had not deterred children from cycling and that therefore previous experience with enforced legislation was no longer relevant.[108] However, the paper's authors never mentioned that the Ontario law was not enforced; helmet use returned to pre-law levels after about three years.[109] This paper has been widely

misinterpreted as applying to enforced legislation. Another paper[110] claimed that the Ontario law had cut child cyclist deaths by half in the following ten years, and quoted data selectively to suggest that helmet use was maintained at a high level in this period when in fact it was not. The decline in deaths was seen in pedestrians too and was clearly an environmental effect.[111]

It is not widely appreciated that there is now a significant literature of studies casting doubt on the wisdom of helmet programmes.[112] These studies typically do not receive media attention and remain little known. Jurisdictions that have introduced mandatory helmet use have suffered a pronounced reduction in the number of cyclists and cycle trips made. For instance, cycle use in New Zealand has dropped 55% since 1989/90[93]. Analysis of census data shows permanent reductions of utility cycling in Australia too.[113] Helmet promotion also hinders cycling programmes[114]. Reducing active travel has a significant, negative impact on the public's health by reducing physical activity levels.[115]

The disconnect between medical opinion and the facts is stark.

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