Chapter 2

Peak Travel, Peak Car and the Future of Mobility:
Evidence, unresolved issues, policy implications and a research agenda

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Abstract

In many advanced economies, car use per head, and sometimes total car traffic, has shown low growth. In some countries (and especially cities) it has declined. In a few countries, there have been similar studies of the distance travelled by all modes added together, which has shown a similar trend though with some doubts about how international air travel should be handled. It is generally agreed that the trends in the last few years must be influenced by world economic problems, but some of the possible changes in trends seem to go back ten or twenty years, with signs detectable even further back.

Although there are differences of emphasis, the statistical facts of a reduction in historic growth, low growth or stability at national level, and reductions in specific locations, especially some larger urban areas, seem broadly agreed by most analyses. This evidence is sometimes ignored, but it is not contested.

There is great interest in the appearance of some common features in many countries, notably including changes in the propensity to get driving licences among young adults (especially teenage men), an apparent weakening of the association between income and mobility, a greater influence of public transport, walking and cycling to economic prosperity in some of the most successful cities, and the development of e-commerce, telecommuting and social networks.

There are currently differences in judgement on how influential these factors are, and on whether the observed trends are temporary or reflect structural shifts which could be long-lived. These differences especially focus on the relative importance of economic issues (particularly prices and incomes) and wider social and cultural changes, such as mobile internet access, demographic, gender, attitudinal and cultural trends, the effects of transport policies and the possibilities of deeper concepts of "saturation" of mobility when further increases bring little extra benefit. There is at the moment no strongly-established common view about future growth in car use to the extent that was taken for granted in earlier decades.

The paper discusses research needs, and some emerging issues for future transport policies, including the appraisal of large-scale transport infrastructure projects, service provision, pricing, the allocation of risk and initiatives to reduce car dependence, in the context where forecasts are problematic and contested.

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1. Introduction

This paper seeks to summarise the current state of play of discussion about reduced traffic growth in recent years. In a wide variety of different studies, using different methodologies and definitions, it has been observed that car use per head, or total car traffic, or road total traffic has shown little signs of growth for some years in advanced economies. In some countries, and especially cities, one or more of these indicators have declined in absolute terms. In a few countries, there have been similar studies of the distance travelled by all modes added together, which have shown a similar trend in terms of national travel, though with unresolved doubts about how international air travel should be handled.

Although different definitions of traffic have been used, in most cases it is car use which has formed the largest proportion both of the level and the growth, and the label "peak car"[8] has been widely used as the summary of a debate about whether the long dominant growth in car use specifically has come to an end, is nearing an end, is turning down or is only temporarily interrupted. Since a very large part of the policy and planning of transport has been based on forecasts of future growth, the possibilities that car use may grow significantly less, stabilise or reverse are of profound importance.

As a caveat, it should be said that a full analysis of this question really should be located in much wider methodological and empirical issues of travel demand analysis. Such a wider discussion would take on board the multi-disciplinary literature on demand elasticity, induced and suppressed traffic and the effects on travel choice, in the short and long run, of infrastructure provision and policy interventions. Of particular importance is the emerging empirical evidence on the impacts of policies aimed at reducing car use, such as pricing, pedestrianisation, public transport improvements, cycling and land-use planning. While incomplete, a number of reviews of reviews and some original sources establish that very much more evidence is available on circumstances in which people reduce car use than is often assumed in debates at national level, because the best evidence tends to be specific and local. This paper does not do full justice to all those potential sources of evidence: it seeks to record the way the argument has actually developed, noting differences of definition and approach but not fully resolving them.

There is currently much work which is in progress but has not yet reached the public domain. Apart from the work referred to in this paper, drafts and suggestions are circulated, not yet ready for citation but expected to emerge in coming months, from, among others, Armoogum, Bussière, Collet, Gargett, Glazebrook, Goodwin, Grimal, Hallworth, Headicar, Immers, Jones, Jorritsma, Kenworthy, Kuhnimhof, Le Vine, Madre, Meissonnier, Metz, Mitchell, Newman, Polak, Stokes, Van Dender, Van der Waard, Villareal and Zumkeller.

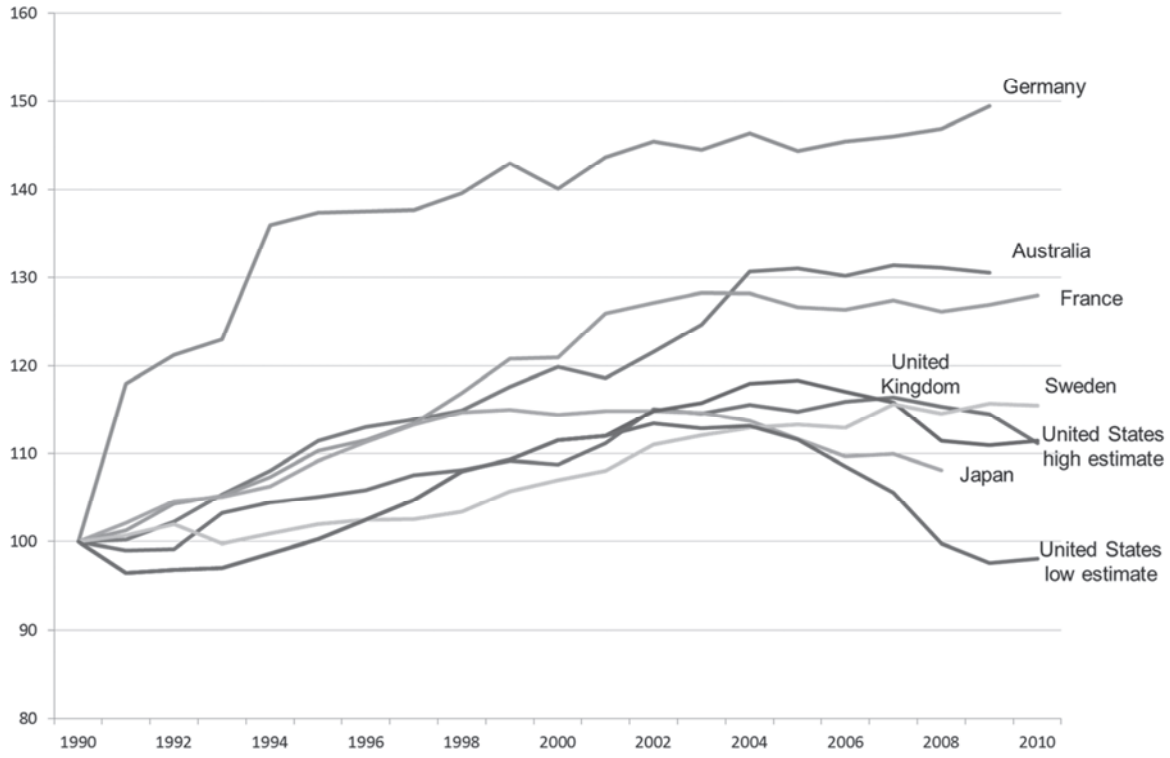
Thus, this is a rich and rapidly changing field of research, which is widely recognised as important, and is also recognised (by most if not all agencies) as having some unsolved questions which should be taken seriously. It has been put on the agenda for transport analysis by two main classes of evidence: (a) aggregate trends usually at national level, usually based on time series data within a context of traffic forecasting by national governments; and (b) the experience sustainable of specific local areas, especially cities, in the context of development of infrastructure plans and transport policies. Until now, there seems to have been little synthesis of these two, but a bridge has

been provided by studies using survey techniques, of the travel undertaken by individuals and households.

2. Aggregate observed trends at national level

An early piece of research to speculate that a levelling off of growth was occurring on an international scale was by Schipper and his colleagues (1993), and he continued this work until in 2010 Millard-Ball and Schipper published a paper with its hypothesis in the title: "Are we reaching peak travel?", which included some influential and often cited graphs on eight8 industrialised countries. In 2011, the International Transport Forum showed rather similar figures, in a discussion paper titled "Peak Car Travel in Advanced Economies?", and this was updated in 2012 as Figure 1.

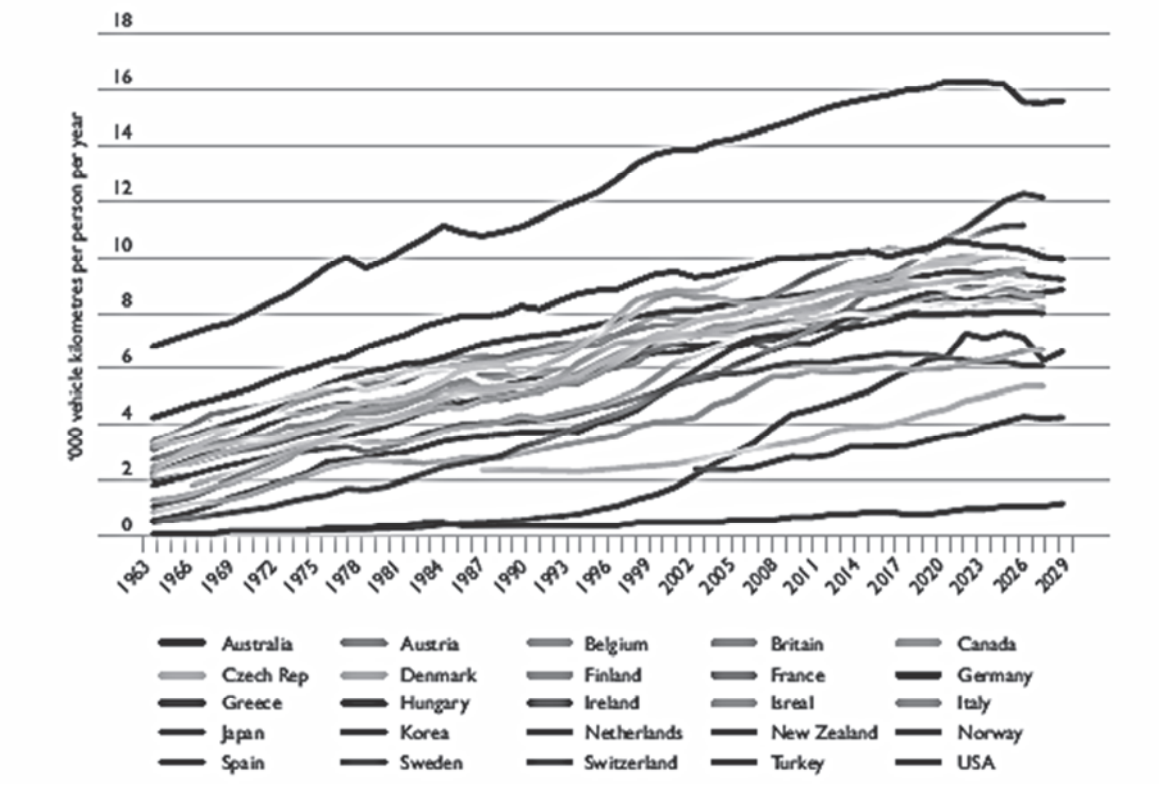
Figure 1. **Passenger kilometres by private car and light trucks, 1990-2009**
(Index 1990=100)



Source: International Transport Forum statistics.

A report by Gargett (BITRE, 2012) extended a similar database to some 25 countries, shown in Figure 2, though this relates to all traffic not just car use, and is per head.

Figure 2. **Patterns of traffic per person in Australia and 24 other countries**



Source: Gargett (BITRE, 2012).

In spite of the difference in definitions, both showed signs of what has variously been described as "levelling off" or "reduced growth". The international figures do show a substantial variation, but nevertheless there are some shifts in the aggregate trends which are not confined to a specific or very small number of countries, but seem to be a widespread phenomenon of advanced economies.

As far as the author is aware, there are no substantial suggestions that the reported trends are artefacts due to faulty measurement or misleading definitions, though some care is needed because as noted the definitions used by different authors vary. (For example, presentations on a total or per capita basis beg the question about whether it is valid to assume that growth is proportional to population, which seems not to be the case but is often assumed.) But the main thrust of the discussion has been about *why* such trends have happened, without (as yet) a full consensus but, broadly speaking, the fact of the observations is accepted with little challenge.

3. Explanations offered for the changes in trend

The range of different suggestions which have been made so far may be seen in Table 1 (next page), prepared by the author (Goodwin 2012), which is intended to be an overall summary of both formally stated research work and also intuitive and politically-driven suggestions. (The table has grown as a result of suggestions made in discussions at conferences and correspondence over the last year, and no doubt will continue to do so).

Within this seemingly endless list of possible explanations, there have been two broad schools of thought, which influence much of the research which has been carried out. These are as follows:

- The first school, often associated with governments, tends to suggest that all or most of the observed changes in per capita travel may be explained by "conventional" economic variables, notably fuel prices and measures of economic strength (such as income, national or regional GDP, unemployment). Examples of this are the analyses of the British and Australian governments in UK Department for Transport (2012), BITRE (2012). They do not come to the same conclusions about future growth, however, and even differ somewhat in the case of UK traffic growth, for which both make forecasts. Both assume that total traffic rises more or less in proportion to population growth[9], as modified by prices and economic indicators, but it seems that the role of a saturation level is much stronger in the Australian work than the British.

- The second school is much more diverse in character, but with a common emphasis on a wide variety of "other" cultural, social and policy factors, varying in importance, with a research question of whether there may have been long-lasting structural changes in the drivers and trajectory of traffic growth. While economic factors would be accepted as having some importance in all these cases, they are not seen as necessarily pivotal. It would also follow that total traffic growth may not be proportional to population growth, but be moderated by the structure and location of the population.

All such arguments can have shades of grey between one and the other, but distinguishing features tend to include the question of proportionality to population, the estimated strength of policy impacts, and the role attributed to social and cultural influences. It is interesting however that the notion of a saturation level, "natural" in some sense, can apply in both cases, so it is helpful to discuss that next.

Table 1. **Factors suggested to explain widespread reduced growth in car use, and some reduced absolute levels of car use in advanced countries**

Traditional "economic" factors of prices and incomes

- General economic conditions;
- Fuel prices, cost of learning to drive, acquire and run cars, congestion charging, insurance costs, parking costs;
- Fares subsidies on public transport;
- Changes in regulation, taxing and funding of company cars;
- Decoupling of income growth from travel growth.

Changes to the relative quality and reliability of travel

- Improvements in public transport, due to priority access to infrastructure and better operations;
- Congestion;
- Provision of cycle lanes and other support;
- Pedestrianisation of town centres and traffic calming in residential areas;
- Development of urban rail systems with consequential impacts on property values and attractiveness of locations well served by public transport;
- Reallocation of road capacity from car to wider pavements, priority lanes, etc.;
- Parking conditions and policy;
- Increased availability and lower (relative) prices of alternative long distance mode (rail, air) which may lead to substitution for given destinations but perhaps more importantly substitution of destinations and modes.

Developments in land use planning

- Redevelopment of brown-field sites and inner city areas with high densities;
- Retail and service development favouring urban localities rather than out-of-town sites;
- Inner city development of a type which becomes preferred by higher income groups and opinion formers, changing fashions away from suburbs;
- Better understanding of economic benefits of public realm improvements.

New social/technical patterns and preferences seen as influences on behaviour

- Travel time budgets, especially in the context of natural saturation level;
- Application of "smarter choices" programmes;
- Cultural and psychological shifts including a cooling or disappearance of the "love affair with the car";
- Concern with motivations less favourable to the car (notably environmental impacts and personal health);
- Various different forms of e-commerce (tele-commuting, on-line shopping, virtual conferences and meetings) and e-leisure (social networks, virtual worlds) especially associated with mobile commuting (which in turn is more favourable to public transport use than car driving);
- Social changes such that the driving license as a key rite of passage into adulthood no longer has the universality it had seemed to be acquiring, especially among young men whose propensity to learn to drive and buy a car has reduced in many countries;
- Decline of the status, fashion, social esteem, implicit sexuality and "buzz" of car ownership and use, and their replacement by other products and icons;
- Changing demographic structures and lifestyles, including those which affect the longevity of particular life-cycle stages and the locations where people prefer to spend them, for example shifts from inner cities to suburbs of young couples, returning to cities when their children leave home;
- Growth of immigrant numbers (in the broadest sense) who bring different cultural attitudes and habits of travel to their new homes, whose effects may go in either direction depending on the specific two cultures concerned;
- Shift in the direction of transmission of attitudes, i.e. from children to parents;

- Complex balance of aging and gender effects, such that women are catching up with the car access of men, men are catching up towards the longevity of women, both are living longer with a tendency to keep on with car use in the early years of retirement but then to have a longer period of life when it is less easy to sustain car use and the skills which go with it.

New patterns of work, shopping, entertainment and leisure

- Shift of certain categories of what has traditionally been considered as "personal" travel to "commercial" travel, notably in home delivery of some goods previously been transported by car;
- Telecommuting, high-technical versions of home working;
- Shifts of some travel from car to air, and from air to train;
- Reduction in traditional forms of car dependence, including by development of new patterns of car use moving away from traditional ownership to various sharing, leasing or renting schemes.

Direct and indirect effects of technologies providing mobile internet access

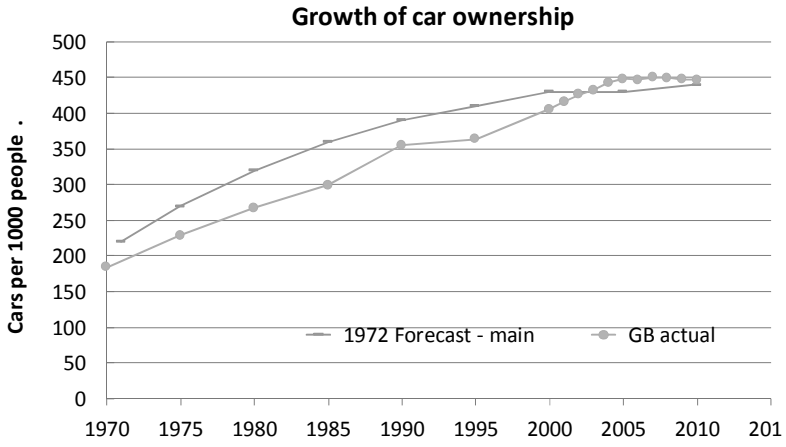
- Opportunities for entertainment, social contact and productive work during travel, tending to favour public transport more than car use;
- Better travel planning, including recovery from disruption.

4. Ideas of saturation

In the early years of traffic forecasting, it was taken for granted that at some point in the future the number of cars and the volume of traffic they would generate had an upper limit, known as the saturation level. In general this was taken as deriving from social and economic factors (sometimes described in terms such as "when everybody who wanted and needed a car would have one", *not* from the idea of a road network which would be "full up"). A generation of forecasting techniques were developed in the 1950s and 1960s, in which the most influential work was probably by J. Tanner at the UK Road Research Laboratory. The estimation of the saturation level was first done by looking at trend and cross section data, and then imposed as a parameter which gave a strong constraint or upper bound on future traffic levels. The speed at which car ownership and traffic approached the eventual saturation was thought to be influenced by incomes and (less so, at that stage) by prices. Empirical research suggested that the quality and price of public transport would have an influence, as would demographic and planning trends, but this work tended not to be incorporated directly in official forecasts, being subsumed in rather generic "external trends".

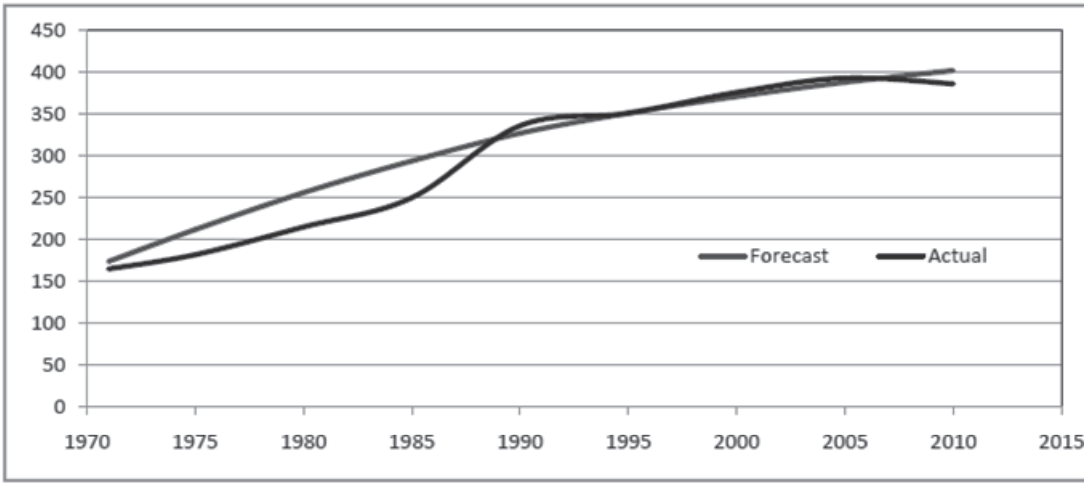
The high point of this form of forecasting was probably in the 1970s and, as it happened, a particularly characteristic application of Tanner's method, by Tulpule (1974), has recently come into view, as the timescale of its forecasts, from 1973 to 2010, enables the rare opportunity of testing the complete period of a long-term forecast against the observed outcome. This is shown, for car ownership and traffic, in Figures 3 and 4.

Figure 3. **TRRL forecasts, 1972 base**



Source: Mitchell, iammotoringfacts 2012, from Tulpule, 1974.

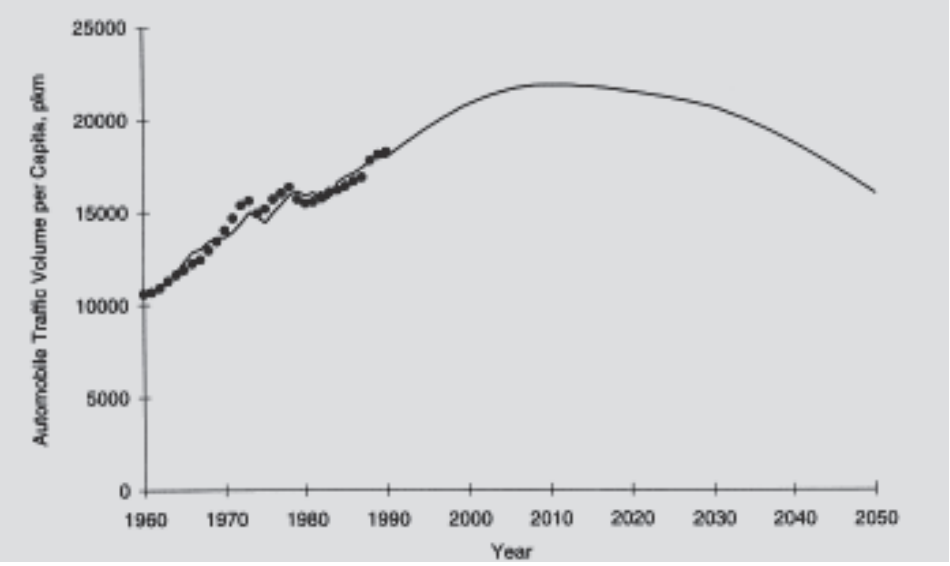
Figure 4. **Car traffic, 1970-2010, 1972 base forecast**



It is immediately obvious that the forecasts, considering they are made over such a long period with no retrospective "reinterpretation", are quite remarkably accurate. This does not indicate, of course, that the forecasting assumptions, methods, parameters and method were all justified – there are many ways in which offsetting errors can produce accurate forecasts, and indeed the method was officially abandoned as inaccurate within the first ten years its currency. An S-shaped curve including saturation can, when saturation is deemed to be far away, be quite sensitive to the effects of other factors such as prices and incomes, but as it is approached, the saturation level estimated will have an increasingly strong effect on constraining and limiting errors due to other factors. The main retrospective significance is that the forecasters of the time some 40 years ago did not think it was unlikely that an ultimate saturation level of around 400 cars per 1 000 population would occur in the first decade of the 21st century, which later forecasters (until recently) considered highly improbable.

Another forecast which suggested a peak per capita car use in North America by about 2010, and absolute decline in OECD countries as a whole, was by Schafer and Victor (2000, in calculations evidently carried out about 1996). The forecast is shown in Figure 5.

Figure 5. **Projections of peak and decline of car use by Schafer and Victor (2000)**

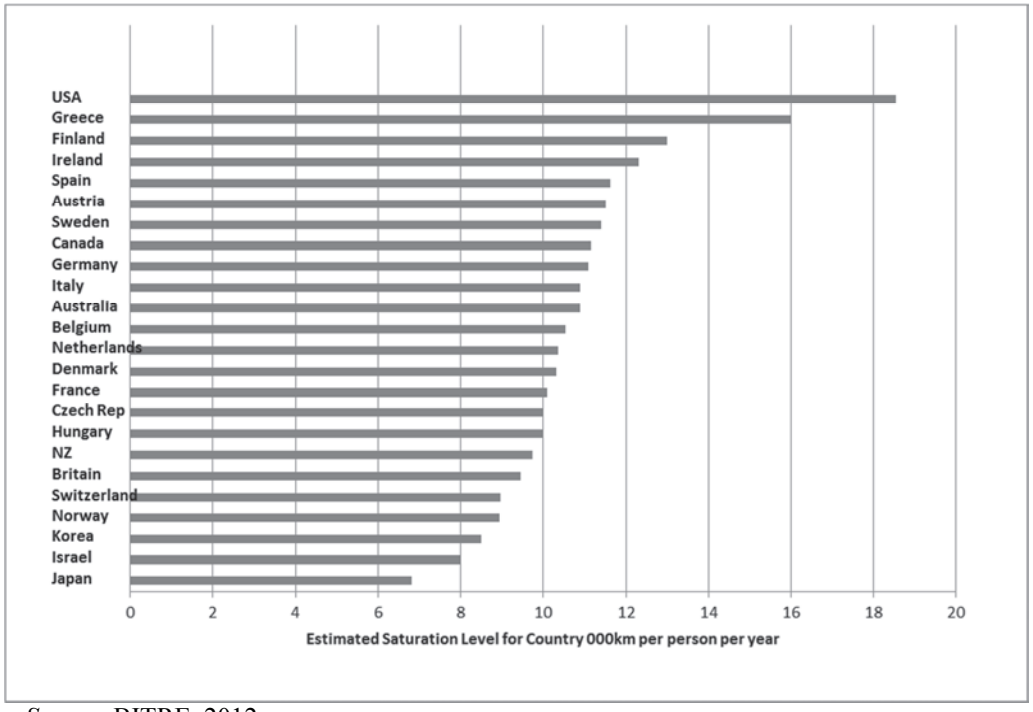


In their model, the driver of this decline was a transfer of demand from car to air, which they project would account for 36% of all global mobility by 2050, and still be growing at the expense of all other modes. The underpinning of this is discussed further below.

In Gargett's approach, the functional form chosen estimates a saturation level directly for each country studied. The saturation levels (estimated from time series data in which the specification includes separate consideration of fuel prices, a measure of economic success, and other variables) are shown in Figure 6.

The saturation estimates are generally higher than current levels, in the nature of the specification of the functions used, and in most cases sufficient evidence of a slowing down in the growth curve already enabled a definite saturation level to be estimated. There is a considerable cluster in the range 8-12 000 vehicle-km per person per year, in which the USA stands out as being exceptional (apart from Greece, which not everybody would take as credible). There is no indication that the American experience would be taken as a "target" towards which other countries are progressing, even ones which are sometimes described as similar: Canada sits between Sweden and Germany, and Australia between Italy and Belgium. The significance of these figures is not that such an approach is universally applicable, or that it will be better than locally specific estimations for each country, but that the visual impression of an approach to saturation among many countries is consistent with an econometric estimation, with around 20 out of the 25 countries showing somewhat similar values. (No saturation estimate was made for Turkey, the missing country in the figure).

Figure 6. **Saturation levels of total traffic per person redrawn from data estimated by Gargett**



Source: BITRE, 2012.

It should be noted that the functional form fitted does not allow recent declines in car use to appear as a downturn (they are explained by the other variables, or if this does not fit they somewhat depress the saturation level). They also do not allow consideration of the effects of other factors outside the model – for example, quality of public transport or other car-reducing policy measures – which are assumed to be zero or random.

The work by Tanner and Tulpule, Schafer and Victor and by Gargett, representing substantially different approaches, nevertheless indicates that current discussions of the idea of an upper limit on car use or traffic are not a radically new concept. There is a pedigree of many decades.

But the idea of saturation may be derived from quite different approaches. In the early 1970s, that the first attempts were made to build into forecasting an observed regularity[10] that the average amount of time spent travelling was remarkably stable, for reasons which were unclear but in some authors' view represented a fundamental aspect of human behaviour, the travel time budget. Tanner and Tulpule made no use of this in their saturation levels, but Zahavi (1974) built such a constraint into his proposed forecasting model, initially in relation to the time spent travelling by car, and later by all modes taken together. This hypothesis remained a magnetic idea to researchers looking for aspects of stability which could be used to give reasonable constraints to otherwise limitless trends. It is interesting to note that two researchers in particular have applied the idea of stable travel time budgets to the issue of saturation in mobility, namely, Schafer and Victor (2000) and, more recently, Metz (2010). Their analyses are radically different and incompatible, but both lead (via a different chain) to the conclusion that stable travel time budgets would be expected to lead to stable or reduced car use. The two arguments may be summarised as follows:

- **Schafer and Victor (2000):** there is a very strong elasticity of total distance travelled (by all modes) with respect to income, but the total amount of time spent on travel is stable. Therefore as income increases, this drives the transfer to faster modes. Some travel by slower modes is displaced by travel by faster modes. Air travel being faster than car, this will eventually replace a substantial proportion of car use, which having itself displaced much public transport and walking, will stabilise and then decline. (This prediction, though controversial, and focussed more on predicting a very large increase in air travel, was made before the stabilisation and reduction of car use was recognised).

- **Metz (2010)**: the number of destinations that can be reached within a given distance increases, on average, with the square of distance, but the additional utility to be gained from a more distant destination decreases the more nearer destinations are passed. Since total travel time is stable, there is increasing resistance to travelling further, and the positive income elasticity declines in importance compared with the travel time constraint. So total distance travelled tends to saturate, and total distance travelled by car (influenced by cost and land-use constraints) will saturate also.

Although both approaches rely heavily on the observation that constant travel time is rather, or completely, stable, the key difference between them is that Schafer and Victor would expect an income elasticity which continues to be high and a powerful driver, and Metz expects a declining income elasticity of reducing importance. This is in principle empirically testable, and is discussed below.

Although Metz states his argument in terms of a stable travel time budget, a closely similar result can be obtained without this constraint. A more general hypothesis, due to Van Dender, is that because the *total* amount of time available is always constrained, the opportunity cost of spending time in transport rises as income rises, except when time spent in transport can be combined with other activities such as working on public transport, which will give an incentive for modal shift from car to those forms of public transport where this is suitable. A different insight is provided by those forms of travel demand models which express money in the form of time rather than time in the form of money. Most of its results are symmetrical but the implication is that income increases lead to a declining marginal utility of money rather than an increasing marginal utility of time, this being intuitively a more sensible interpretation of the observed increase in "value" of time.

Thus the simplest hypothesis, and the one rooted in the longest history of transport analysis, to explain the observed trends is the proposition that the long term growth in car use would naturally be expected to saturate, and there is nothing special about "now" in terms of timing: it is happening now just because it has reached the relevant level. This was, indeed, forecast nearly 40 years ago. There would be a variation among countries about how close to saturation they are, some variation in the level of that saturation due to specific local circumstances, as yet undefined, and differences about whether that would also happen to all modes including aviation, but it would be a "natural" and not unexpected development.

However, just because a relatively simple econometric model including a saturation level can be consistent with observed trends does not, of itself, prove that the explanation is adequate, and this has become apparent because there are other phenomena, which have led researchers to look at deeper explanations.

5. Explanations based on wider social and cultural factors

While it would be expected that different specific circumstances and features would apply in every country or indeed region, there have been some common features widely noted in recent, which seem to apply in many countries, and which become apparent at a more disaggregate level than national trend data, for specific groups of people or places.

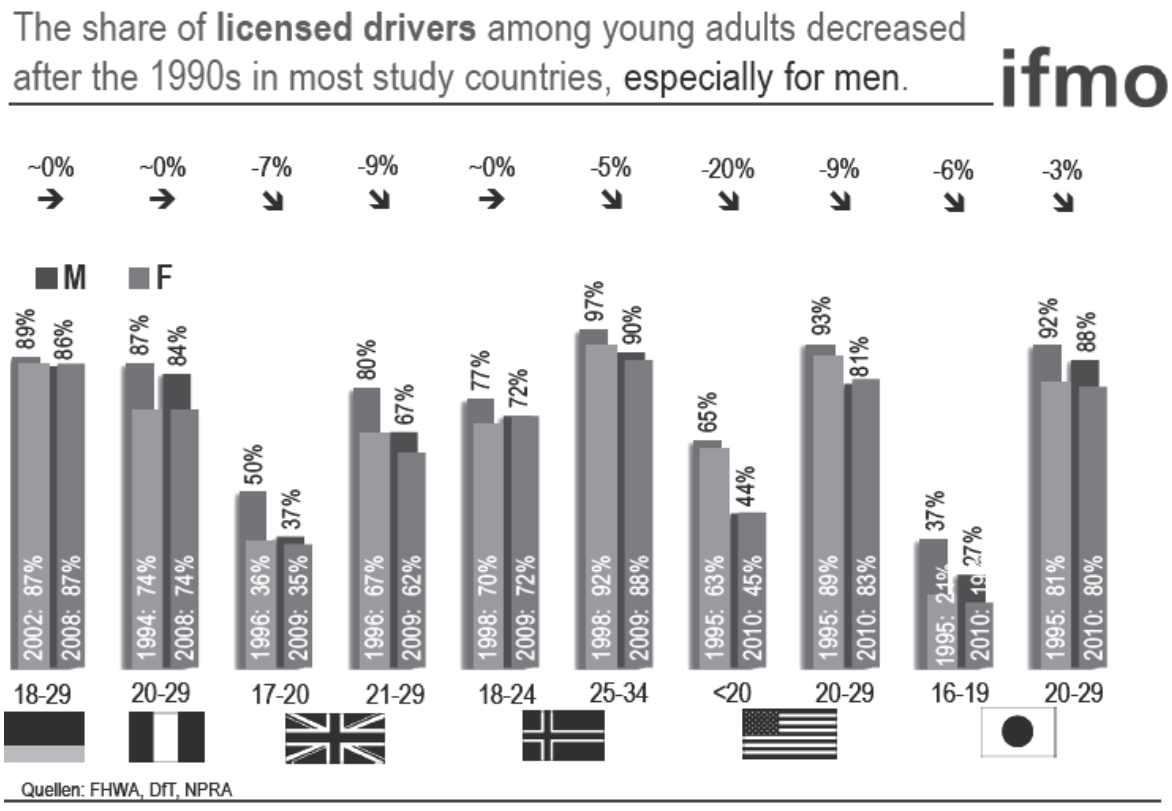
The common features which many commentators have recently found most illuminating include the following.

- A strong age relationship such that the first, or biggest, changes in travel behaviour are seen among the young, especially young men.
- An income relationship such that the long noticed importance of income growth as a strong driver of traffic growth is weakening, or in reverse.
- The existence of downward trends in traffic in certain cities which are growing in population, employment and wealth; this is usually associated with relationships with planning outcomes, development density, relative importance of "greenfield" and "brownfield" locations for new development, and policy initiatives including pedestrianisation, new tram systems, traffic calming, and in some countries very strong growth in cycle use.
- Observation of strong growth in social networking, mobile computing, and internet-related economic activity such as shopping, tele-commuting, teleconferencing.
- A summary of some of the main research findings in these areas is given in turn.

5.1 Age-related changes in trend

An international comparison by BMW in Germany (Kuhnimhof, 2012) has suggested that the share of licensed drivers among young adults decreased after the 1990s, especially for young men, as shown in Figure 7.

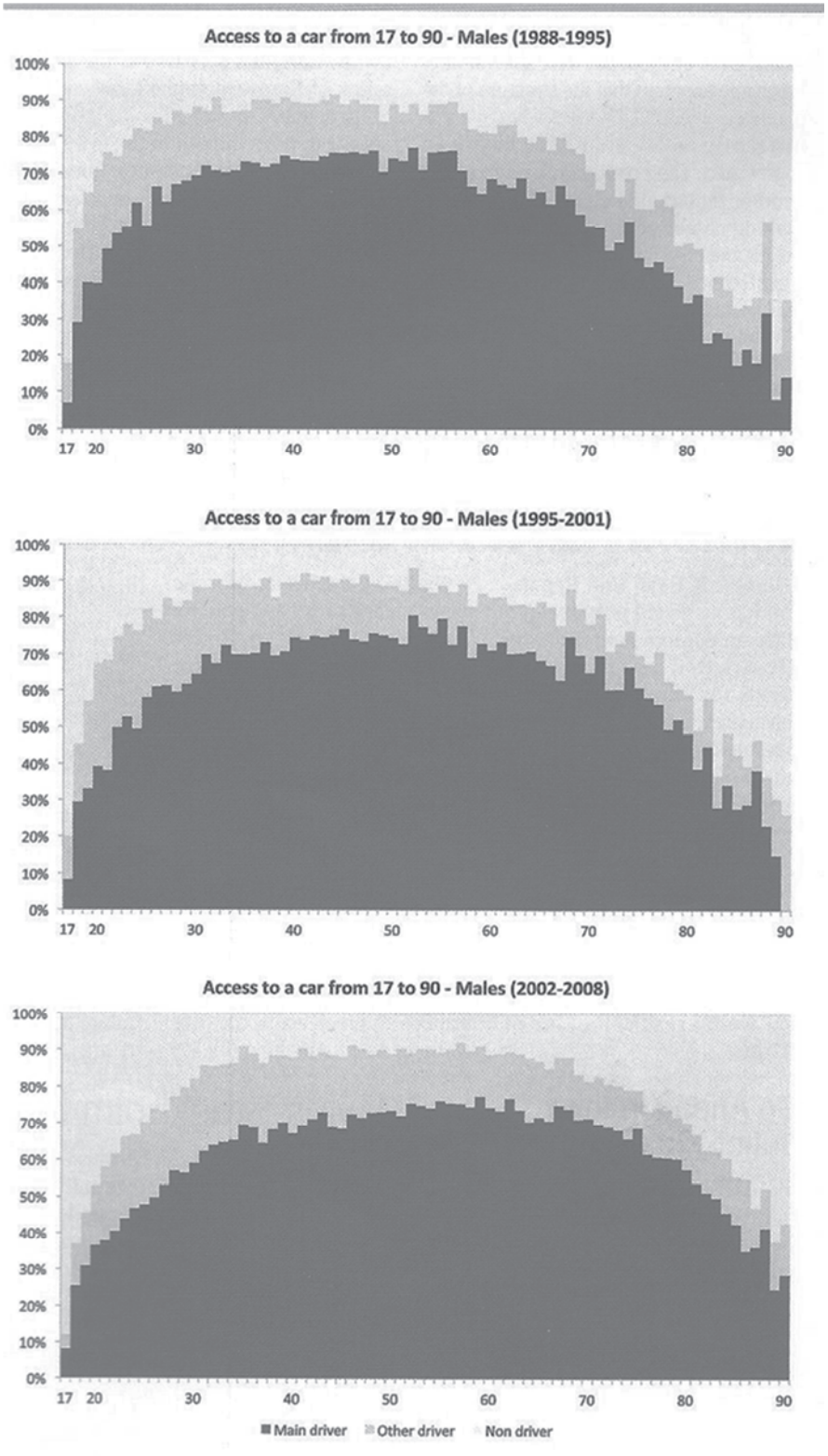
Figure 7. **The share of licensed drivers among young adults decreased after the 1990s in most study countries, *especially for men***



Sources: US Federal Highways Administration, UK Department for Transport, Norwegian Public Transport Administration.

The first person to have noticed this trend seems to have been Noble (2005) and detailed analysis of UK data has been carried out also by Mitchell, Le Vine and others, including Stokes (2012[11]) whose analysis has a particularly interesting presentation in the form of quasi-dynamic cohort movements, separately from men and women, over a twenty-year period, 1988-2008. His results are shown in Figures 8, 9 and 10 below.

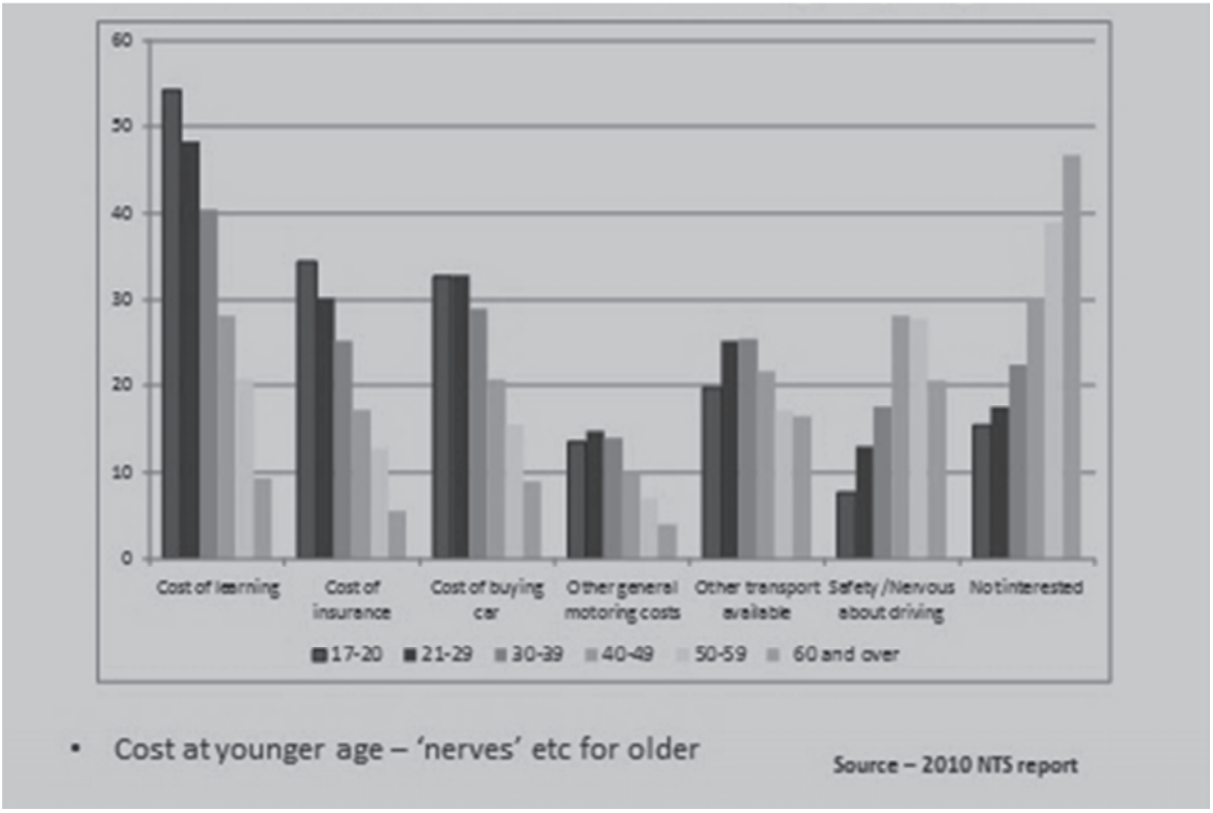
Figure 8. **Access to a car from 17 to 90 – Males (1988-1995)**
Figure 9. **Access to a car from 17 to 90 – Males (1995-2001)**
Figure 10. **Access to a car from 17 to 90 – Males (2002-2008)**



Stokes notes that what started as a reduction in the propensity of young men to learn to drive continued over the period. Even though many of the individuals announced their intentions to "delay" learning to drive rather than not to learn, the decision seems to be sticky, and a smaller proportion actually get licenses than plan to do so (and apparently the ones who do get licenses, late, then drive less). The reduction evolves through the population as people get older: at the same time, however, an increasing number of older people have cars as a result of their own decisions, when younger[12]. Car use among young women did not show the same features initially, but may have started to more recently.

Some surveys have asked people of different ages their own perceived reasons for not learning to drive. The results of a UK survey are shown in Figure 11. They indicate that cost-related factors are mentioned more frequently by the young, and other factors more frequently by the old, though it is interesting that "other transport available" is quoted by up to a quarter, and "not interested" by 15% to nearly half.

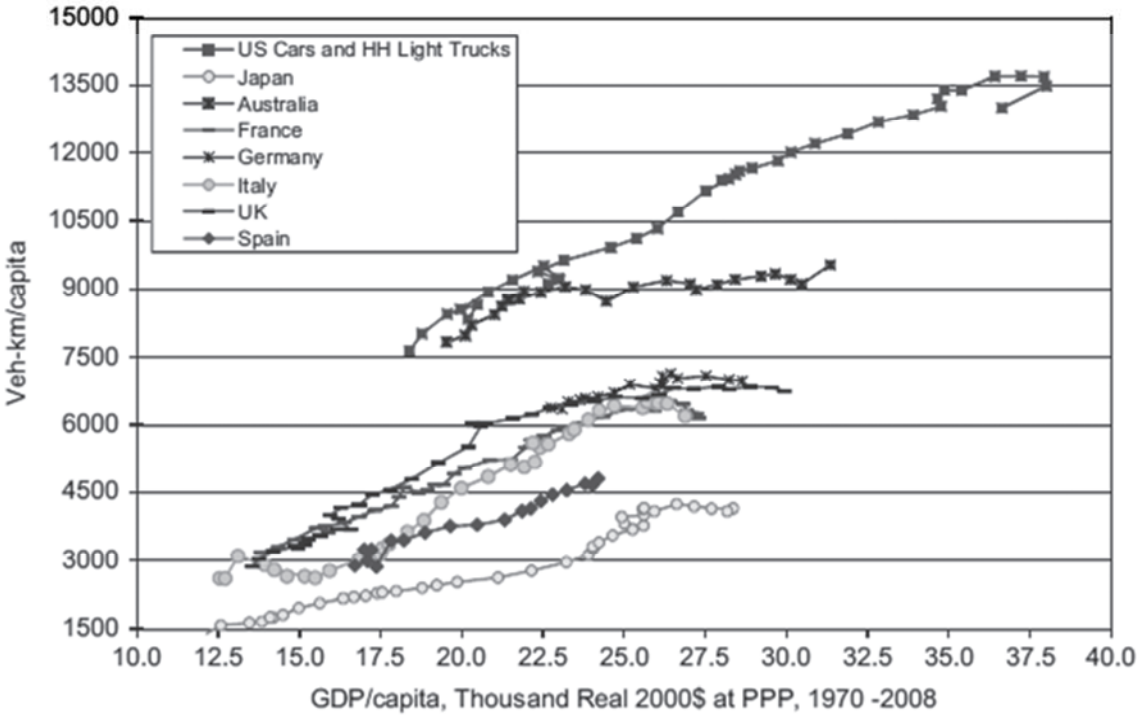
Figure 11. **Reason for not learning to drive, by age**



5.2 A weakening effect of income

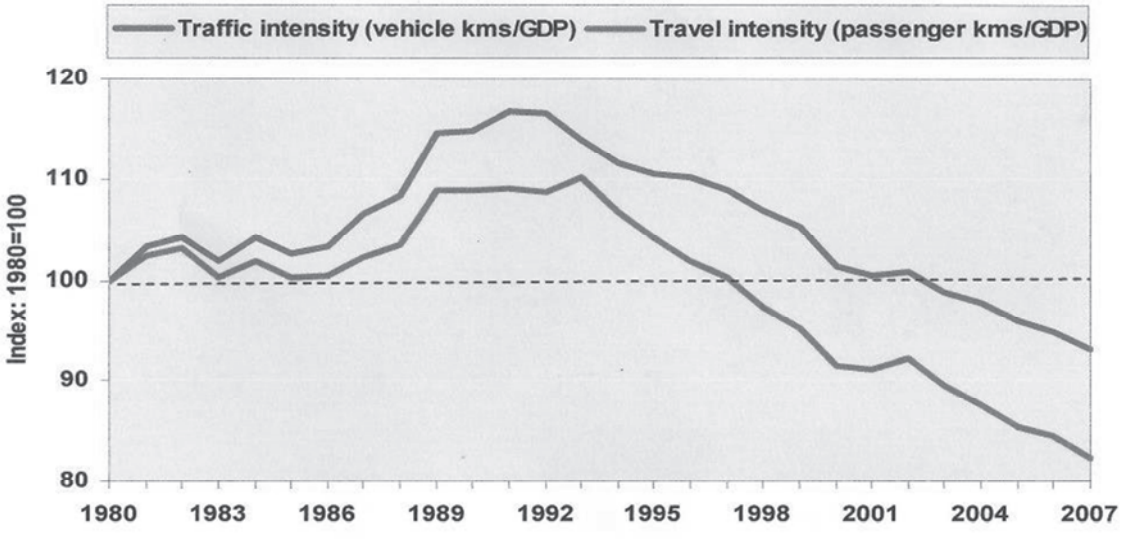
It is interesting to note that Schipper's last work focussed on income effects, with the results shown as Figure 12. He suggested that this showed a progressively weakening effect of income growth on travel, as saturation levels were approached.

Figure 12. **Vkt/capita for cars and household SUV or light trucks *vs.* GDP per capita in 2000 USD, converted at purchasing power parity**



Another indicator of a weakening relationship between income and traffic is shown in a shift of trend of the transport intensity of economic growth in GB, which was increasing in the period from 1980 up to the early 1990s, but then reversed and has been decreasing since (often called "decoupling" transport growth from economic growth). This is shown in Figure 13.

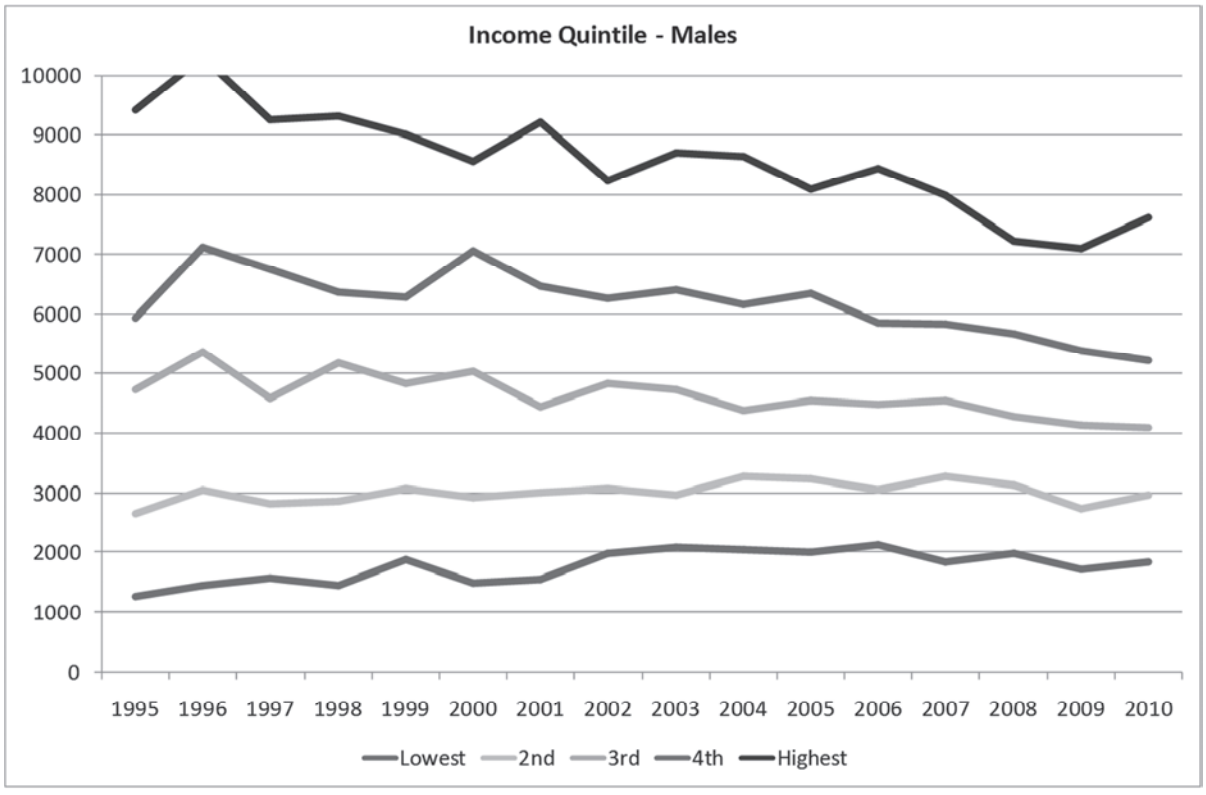
Figure 13. **Transport intensity in Great Britain** (kms per unit of GDP)



Source: Department for Transport (2010).

A particularly interesting result has been reported by Stokes (2012) which has not (as far as the author knows) been noted elsewhere, but raises an important question about the effects of income. This is the suggestion from UK National Travel Survey data that car use by men in the highest income group has reduced most, while the lowest is still increasing, shown in Figure 14.

Figure 14. **Reduction in car use by men in the highest income group**

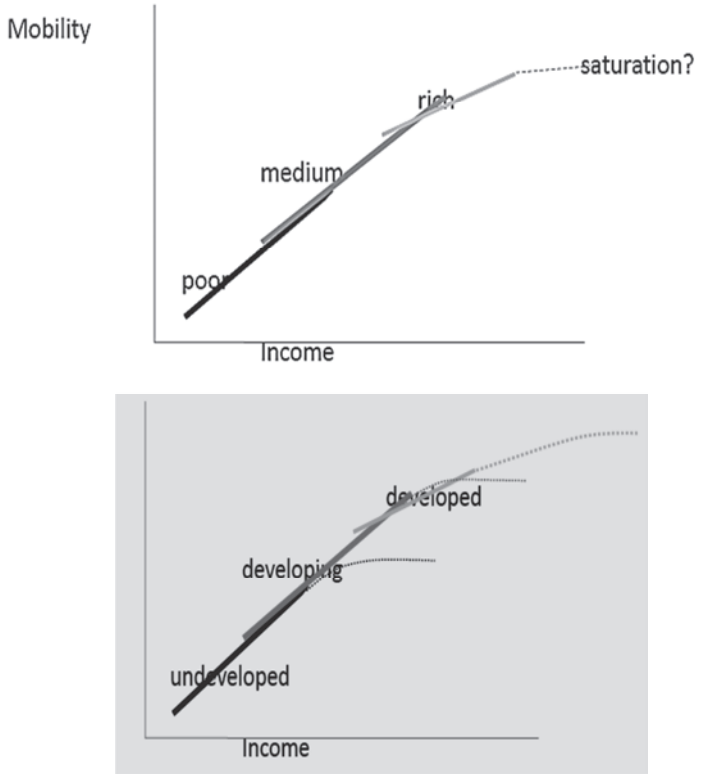


Source: Stokes (2012).

This is not a regression towards the mean effect, since in the period concerned men in the highest income group were getting richer, not poorer, and is not what one would expect at a time of economic difficulty and pressure. It is however consistent with (though does not prove) the idea that wealthier people have found it easier to develop a less car-dependent life style, which is plausible.

The possibility of a reducing role for income as the core driver of traffic growth has important implications for global trends in which there has often been a formal or informal presumption that the future for poor countries, as they become richer, is to be taken as following the same historical trajectory of the richer countries. In the limit, this would mean, for example, that Europe follows America, Asia follows Europe, Africa follows Asia, and so on, all ending up with American styles of car domination. Saturation, if it occurred, would be at some global level greater than the current US experience[13]. An alternative hypothesis would postulate that different groups of countries, or individual nations, would see their own reduction in historical growth rates.

Figure 15. **The hypotheses of a single pathway to saturation led by income, versus multiple saturations for different countries**



5.3 A possible effect of mobile computing and associated cultural changes

In a very early speculation, Hallett and Stokes (1990)[14] considered whether the influence of advertising on attitudes to car ownership could be modified or offset by new technology. They wrote:

> "*Another possibility is that some new product could hit the market which would make the car redundant in the psychological sense. It is hard to imagine what this could be. Computers seem to be the products which come closest to satisfying the kind of psychological desires which cars cater for. Some computing product (probably portable) could maybe be produced which would cater for power, or freedom desires, although it does not seem at all likely at the moment*."

However, the idea took off again in the early 2000s in studies which considered whether telecommuting and other information technology might reduce the demand for travel, a widespread view at the time being that there was little evidence that this was happening, and the argument that it might was ambivalent: internet contact might widen the geographical spread of personal networks, and therefore generate more travel rather than less.

It is intriguing that Hallett and Stokes' reference to "some computing product (probably portable)" has turned out to be one of the most important trends of the last two years, and there is much speculation that mobile information technology is having as big an effect on travel choices as it is manifestly having on activities undertaken during travel. There is much evidence on the exponential growth in use of mobile information technology for entertainment, social networking, and as potential

travel substitutes such as tele-commuting, tele-shopping, teleconferencing. This is not in doubt. It is also known that this has been a youth-oriented market albeit subsequently penetrating into all age groups. A frequent feature of professional discussions on the topic is anecdotes along the lines of: "For me, getting my licence and my first car was a very important part of growing up, but my son/daughter/nephew/niece doesn't seem bothered – they are more interested in their phones, tablets."

Prima facie, there is a very strong reason for expecting connections between observed reductions in travel and increased use of mobile information systems, but the author is not familiar with current empirical studies directly investigating this in the context of current technologies, and this remains a gap to be filled. In particular, not a single case is known where government transport agencies are funding current research on the impact of smartphones on travel, for example.

So are there effects on transport? Some have already been observed – the effect on the "value" of time, the nature of journey planning and especially the ease of changing plans to cope with unexpected incidents or just a change of mind, and so on. But underneath all that, there is a change in the nature of what we mean by a primary activity. A phone used to be something you might use while travelling; now travelling is something you might do while your attention is actually on a web connection. There is no consumer object so rich in status and symbols: it seems to be the icon of the age, just as cars used to be. Practically, the user does not need expensive lessons, a test, a licence or insurance, and it will not be confiscated by law for misuse.

Meanwhile one notes the ubiquitous iconography of advertising. (Slogans such as "I love my iPhone" are as prevalent as the use of "love affair with the car" images since the 1950s.) The images are there though the quantitative evidence is only now starting to emerge.

5.4 Traffic trends in cities and other urban areas

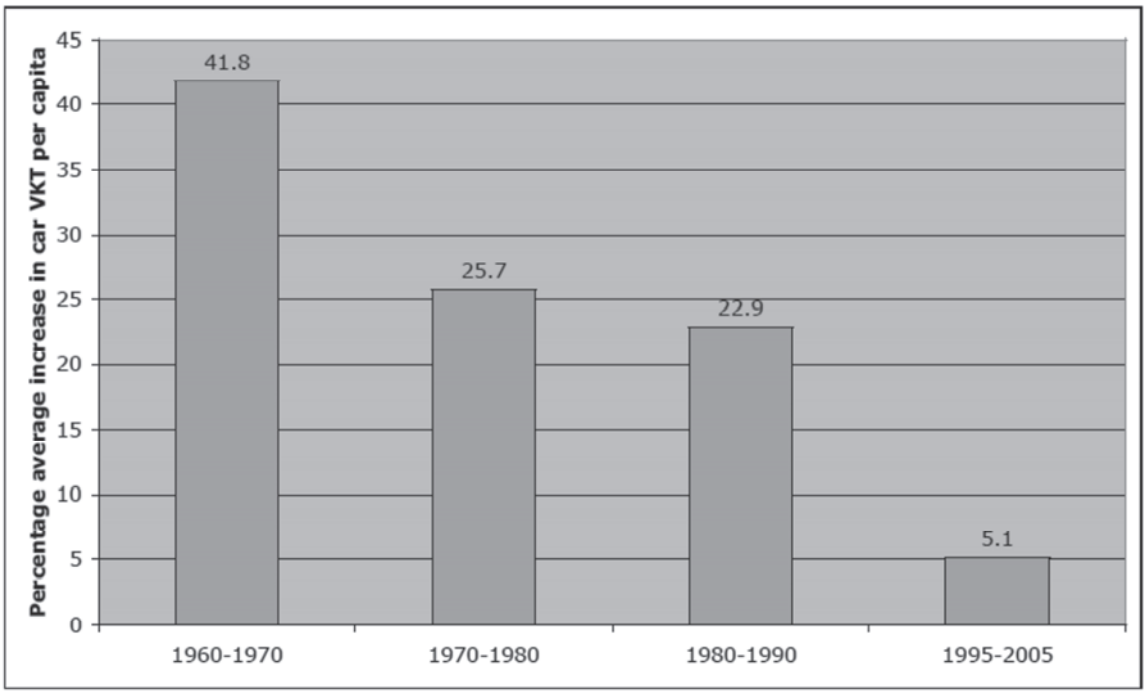
National travel statistics are composed of travel by different individuals in different places, and it is likely that the search for understanding and explanation will increasingly focus more on local trends than national ones. Within this, an important argument is widespread that it is in cities where the influence of policy, alternative modes to the car, and physical barriers to car use are most effective. The proposition is that the national trends cannot be understood without seeing what is happening in the cities.

Newman and Kenworthy (2011) showed that the growth of car vehicle-kilometres per person declined over a 40-year period up to 2005, when it was still positive on average, but low, as shown in Figure 16.

Puentes and Toner (2009) suggested that the growth of per capita car use in US cities was slowing throughout the 2000s, and declined from about 2005. More recent work suggests that car use in some large European cities has been declining for a decade or more, and this is discussed below.

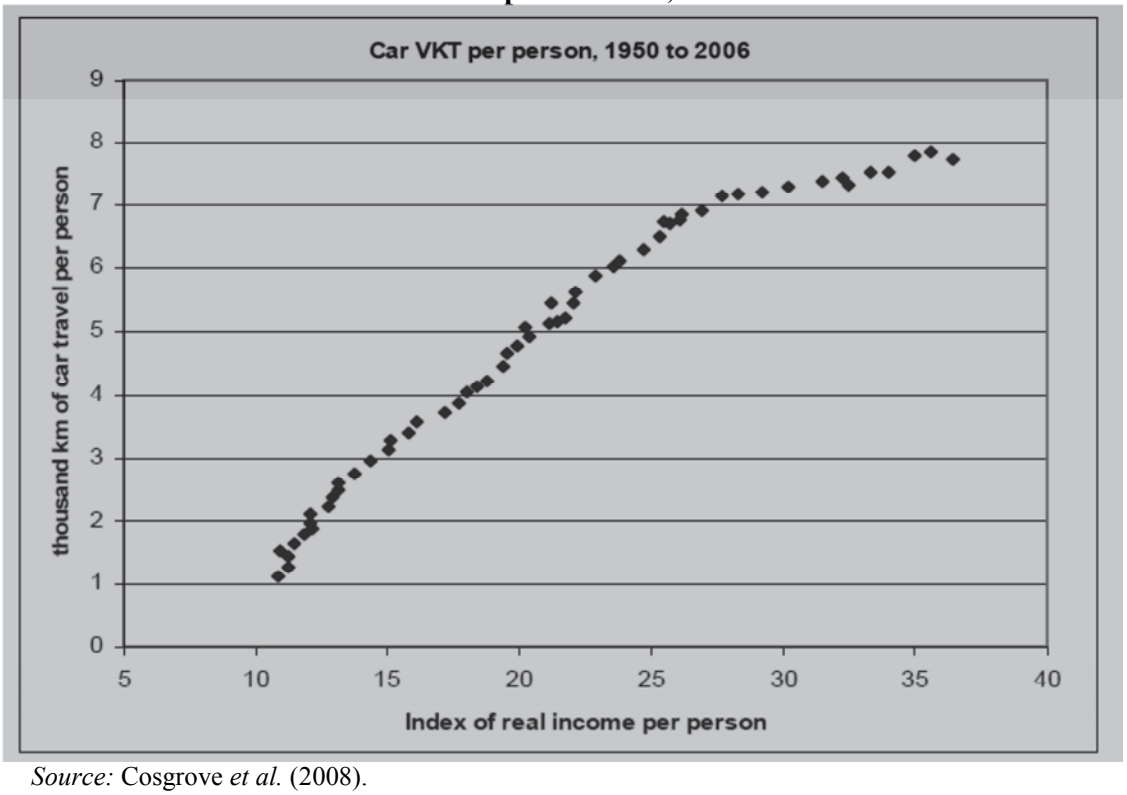
A study by Cosgrove *et al.* (2008) for the Australian Treasury particularly noted that the relationship between income and growth in car use in metropolitan urban areas had flattened substantially from the 1980s onwards, as indicated in Figure 17.

Figure 16. **Growth in car use per person per decade in 25 cities,**



Source: Newman and Kenworthy (2011).

Figure 17. **Per capita car travel related to per capita income in Australian metropolitan areas, 1950 to 2006**



Source: Cosgrove *et al.* (2008).

This discussion is continued with respect to policy influences which are focussed especially on urban conditions.

Wider evidence on policy impacts on car use

In terms of policy content, evidence available includes the following key studies (as well as more detailed case studies on a very wide variety of locally specific initiatives):

- The *pedestrianisation of large areas of city centre*. This may be counted as one of the great success stories of transport and land-use policy in recent decades, with many hundreds of cases, very well embedded in cities, with the UK experience supporting but mostly being somewhat less ambitious than the best European examples. There is good (and bad) practice on how public transport and parking policies can strengthen or weaken the impacts, and it is possible to give well attested rules of thumb about orders of magnitude of impacts and the conditions and dynamics of public support, but there has been much less successful interest in detailed modelling, forecasts, and formal ex ante or ex post appraisal, using either classical or behavioural theories.
- The evolution of ideas about *traffic calming, shared space and quality design*, mostly in residential areas, ranging from entirely new principles of street layout and design in, for example, some Dutch suburban areas, to the cheapest and nastiest (but sometimes effective) retrofitting of speed humps in traditional local streets.
- A substantial body of experience about *public transport*, including high-speed, long-distance rail services, and local street-running metro systems with reserved or priority track access. (This evidence includes important classical analyses, such as effects on local property markets, which are usually positive and can be quite large, e.g. 10%-20% house price premiums); also effects of bus priorities, busways, bus marketing initiatives and other promotions.
- *Cycling* initiatives are now widely and long-enough established to identify cases of reversing a long-term downward trend and replacing it by very substantial growth.
- There are separate bodies of empirical study about *individual choices and behaviour*, of which the most widespread have been repeated cross-section studies before and after a policy intervention (e.g. ranging from studies of the effects of reducing *public transport fares* in the 1980s, studies of both increasing and reducing *road capacity* in the 1990s, monitoring *road pricing* in London and Stockholm, and the range of *smarter choices* initiatives, including workplace and school travel planning, personalised travel advice, marketing, car sharing or pooling or clubs.
- Qualitative and quantitative studies of attitudes about existing behaviour and intentions or aspirations about future changes in behaviour, usually finding quite large minorities declaring themselves willing to change their choices for a wide variety of reasons (including health as much as, sometimes more than, traditional transport objectives), and with more or less strongly expressed caveats and conditions about the quality of alternatives provided. (This body of work usually finds a minority, but significant numbers, of people who say they would like to drive less than they currently do, which is a potentially important section of the public in early responses). There are reservations about whether there is a gap between intention and actual behaviour, and very little evidence to test whether the people who say they would like to change their behaviour are actually the ones who do so. This critical evidence gap arises because there are no known longitudinal attitude studies of any scale, though there have been some small-scale pilot studies with helpful results.

- There is a very important but usually ignored evidence base of longitudinal studies of reported behaviour, including ten years or more of data of how commuting trips in particular change over time for specific individuals. This enables measurement of "churn" and the volatility of choice from day to day or from year to year. It is crucial in understanding the potential for future change, because of the axiom that analysis of change must proceed from evidence on change, not evidence on states. (Most of the received wisdom that "travel choices are too difficult to change" stems from this misinterpretation).
- In the Sustainable Travel Towns report, by Lynn Sloman and colleagues, car driver trips per person declined by 9%, and car driver distance per person by 5% to 7%, from 2004 to 2008. But interestingly, when Sally Cairns compared these results with the National Travel Survey results for other towns of similar size, she found that the car use had gone down there as well, though not as much: car driver trips per person by 1.2% and car driver distance per person by 0.9%. Studies by Carmen Hass-Klau of the impact of building new urban tram systems in European cities found that car ownership was reduced in the neighbourhood of the trams, by an average of 13%, even though these areas were also affected by gentrification and increased property values as a result of the same improvements: they became richer.
- It is worth mentioning also another type of greatly underused evidence, namely, the international pooling of data from local initiatives and schemes. Two sources stand out (though there are many more). These are (a) the ongoing Victoria Transport Policy Institute On-line TDM Encyclopaedia, at www.vtpi.org/tdm/index.php, led by Todd Littman, which is a portal to much of the world's literature on the subject (albeit rather North American in its practical orientation), and (b) ELTIS (European Local Transport Network Information Service) at www.eltis.org which, as at January 2011, contains summary descriptions of 1 275 transport initiatives in European cities. Updated frequently, though detailed information then needs to be gained from the contacts given there. Note that much of the German, French and Spanish experience is not reported in English and is therefore inaccessible to many monoglot English speakers. After a period in which Germany was widely recognised as the leading country for sustainable urban practice, that lead has probably now passed to France, whose policies are radical and effective, especially in the reallocation of road capacity from cars to sustainable modes and walking space, though little known in the UK apart from the Paris Velib' scheme, which was the model (though considerably bigger) for London's "Boris Bikes".

As an overview, this body of evidence suggests that responses of car use to policy initiatives are often rather small in the short run, but build up to very much more flexible life-style choices in the longer run, defined as the period of 5-10 years and in some cases longer, in which habits are eroded and new ones form, with a particular importance of life-cycle or other changes as being the triggers which enable responses to changed transport conditions. There is a very large volume of empirical and case study evidence about the effect of changes in price, speed of travel, quality, information, new infrastructure, better use of existing infrastructure, planning, and other factors which can be influenced by public or private interventions. The evidence available is rich concerning reductions in car use up to about 20%-30%, but very sparse, at the present time, for changes greater than that. A summary of useful references is given in Table 2 below.

Table 2. **Selected references with overviews and synthesis of empirical evidence on implemented transport initiatives and their effects**

Citation and date	Sources used	Coverage	Comments
European Conference of Ministers of Transport (2007) (Book, 263 pp)	63 references and a review of progress in 51 OECD and ECMT member countries.	All modes, including freight, shipping and aviation	Identifies 400 measures, with orientation to efficiency and supply-side measures.
Balcombe, R. *et al.* (eds.) (2004) (Book, 237 pp.)	About 600 references, including good coverage of grey literature.	Public transport fares elasticities by area, purpose, time of day and other dimensions; quality of service, income, car ownership, and various policy impacts.	Replaces an influential earlier work (Webster & Bly, editors, 1980). Good on short-term/long-term distinctions.
Cairns, S., C. Hass-Klau, P. Goodwin (1998) (Book, 259 pp.)	About 150 references, incl. many semi-published, some non-English (notably German), and original material from interviews with local authorities.	Effects of reducing road capacity by pedestrianisation, bus lanes, and evidence from accidents, disasters, maintenance, etc. (complement of SACTRA report on induced traffic).	Updated in a short paper by Cairns *et al.* (2002). Also contains useful summary of literature on dimensions and dynamics of changing behaviour. Demonstrated that volume of traffic often reduces by 25% or more following pedestrianisation and similar policies, though this can be reversed by inconsistent policies elsewhere.
Cairns *et al.* (2004) (Book, 676 pp.) www.dft.gov.uk/pgr/sustainable/smarterchoices/ctwwt	About 300 references plus citations from sets of interviews in 24 case study locations. Includes many sources in the public domain, but not easily accessible.	Workplace and school travel plans, personalised travel planning, public transport information and marketing, travel awareness campaigns, car clubs, car-sharing, teleworking, teleconferencing, home shopping.	(Sometimes called the "soft factors" report). Concluded that there is potential for Smarter Choices to reduce traffic volumes by 11% nationally, maybe 20% in peak period urban conditions, with a ten-year build-up and serious commitment.
Commission for Integrated Transport (2007) (Booklet, 105 pp)	About 120 references	Contribution of transport to carbon reduction.	UK statutory advisory body.
Goodwin (2007)	Shorter version of "Changing Travel Behaviour", produced by the ESRC Transport Studies Unit 2004.	Overview of potential for reducing car use.	This was a major research programme undertaken as the core theme of an ESRC "designated research centre", 1994-2004. Included analysis of the natural "churn" in choices, such that over a five to ten-year period such a high proportion of the population had experienced "life-events" that their travel behaviour was easier to change than in the short run.

Table 2. (continued) **Selected references with overviews and synthesis of empirical evidence on implemented transport initiatives and their effects**

Goodwin, Dargay and and Hanly (2004)	About 85 references in the last ten years. Source literature about 500 references).	Road traffic and fuel consumption (includes some freight indirectly, but mostly personal).	Companion paper to Graham and Glaister in same journal, updating earlier literature reviews by Goodwin (1992) and Oum *et al.* (1992). Other reviews by Espey, and Sterner & Dahl. Reinforced earlier conclusion that long-term effects are about twice as great as short-term (one-year) effects, from econometric evidence.
RAC (1995) (Book 153 pp.)	About 85 references.	Overview of factors causing car dependence and possibilities of reducing it.	Suggested that the proportion of truly car-dependent trips was significant, and growing, but 20% or more of car trips were relatively easily diverted.
Cairns, S., S. Atkins, P. Goodwin (2002)	18 references, mostly UK.	Updating extra information related to Cairns, Hass-Klau and Goodwin (1998), see above.	Broadly consistent with earlier report above.
Avineri, E. and P. Goodwin (eds.) 2010	122 references.	Comparison of experience, theory and evidence on behavioural change in two different sectors, health and transport. Includes discussion of "nudge" methods.	"*…an approach which recognises non-economic as well as economic motivations for behaviour must be able to give better insights into how change works; policy interventions can therefore be more successful as well as less intrusive. 'Nudge' approaches are advocated as a cheap and uncontroversial alternative to more challenging public initiatives; however, advantages sometimes claimed are almost certainly overstated; we judge it unlikely that there is a large latent body of easy, cheap, hardly noticed initiatives that will have big effects without the need to consider more substantial intervention. The real promise seems rather to help to design the bigger initiatives better, that is to add 'nudges' to improve or speed up the effects rather than as a replacement for other interventions."*
Sloman *et al.* (2010)	Empirical analysis of data, so references only as sources for analysis.	Impacts of initiatives in Darlington, Peterborough and Worcester.	Found car trip reductions of 9% and increases in walking, bus and cycle trips of up to 30% (different balance in each town), less than "Smarter Choices" report but for less expenditure over a shorter period, so broadly consistent.
Victoria Transport Policy Institute **On-line TDM Encyclopaedia**, at www.vtpi.org/tdm/index.php, and **ELTIS** (European Local Transport Network Information Service) at www.eltis.org			Two exceptionally useful on-line evidence resources. See text.

6. A research agenda

6.1 What is the research question to be addressed?

We have an expanding set of observations, in many countries, showing features of car ownership and use in recent years which are different from previous decades. These include at the aggregate level a long period of stable car use per head, and a shorter period of declining car use per head; and at the less aggregate level the appearance of different trends for different types of area and person. Forecasts of future levels of car use (and its consequences for congestion, environment, economy, mobility, etc.) depend on understanding why the current and recent trends have changed. Therefore the task is more fully to describe what has happened, in ways which can test the strength of different explanations.

6.2 What alternative hypotheses have been suggested?

Over the last few years, three main alternative explanations have evolved. They should all be treated as hypotheses to be assessed, not revealed truth. In summary:

a) **The "Interrupted Growth" hypothesis ("IG").** This states that the main reasons for recently observed changes in trends are the effects of three key drivers, namely, income measured as GDP per head, population and fuel cost of motoring. The strength of these factors is broadly known, and reasonable assumptions about the future changes in national income, population and fuel price combine to suggest that car traffic will continue to grow, albeit at a slowing rate, for several decades into the future.

b) **The "Saturation" hypothesis ("S").** This proposes that car use per head has broadly already reached, or is close to, the maximum level it ever will, because more car use does not give benefits greater than the cost in money, and especially time, of doing so. Future increases in income will not generate more car use. Future levels of car use will be influenced by population, but not proportionally because increases housed within urban areas will be served partly or mostly by public transport, walking and cycling. The future will show rather stable levels of car traffic.

c) **The "Peak Car" hypothesis ("PC").** This considers that car use per head is passing through a peak and the current downturn may be an early sign of a long-term decline in car use, due to a complex combination of drivers in which economic influences are modified by policy, attitudinal, social, technological and cultural changes.

The nice thing about these hypotheses is that they are quite distinct, and represent all three logical possibilities (increase, level, decrease). In reality, all institutions and individuals surely accept that there will be *some* effects of most or all of the available driving factors, the difference largely being about their relative strengths, so that there are grey areas of overlap: logical possibilities of one model being appropriate for one area and a different model being appropriate for a different area, or at a different time, for example.

Thus the question arises of how different the hypotheses are? In the very short run, they are identical: they all "fit" current experience. In the medium run (say 5-10 years), Saturation and Peak Car will look rather similar, but Interrupted Growth is distinct on its own. Intriguingly, in the longer run (say, 15-40 years), this changes: Interrupted Growth looks more and more like Saturation, albeit at a higher level of traffic, and it is Peak Car which becomes more distinctly different.

Subject to the research approach described below, it seems unlikely that any of the three hypotheses can be firmly ruled out with confidence *and consensus* over the next two or three years. So the question will need to be addressed about how to sustain efficient transport decisions in the context of continuing uncertainty, which is a quite different problem than the use of a rather narrow envelope of "high" and "low" forecasts, mostly depending on different assumptions about factors like income growth.

By definition, all three propositions make a plausible explanation of observed trends at the aggregate national level. Although further general exploration of the data will certainly be helpful, there seems to be a particular type of further research which will give the greatest dividends. This is to define specific hypotheses about trends which are already observable now, which would look *different* according to the three hypotheses. Then a test of the relative merits of the different approaches is to be sought, not just in whether they "fit" the aggregate totals, but which best accords with the other accessible information. The following table gives some example tests, to clarify the point, though expecting that there are many more, and that each can be more precisely and subtly defined.

Table 3. **Tests of evidence tending to discriminate among the three hypotheses, IG (Interrupted Growth); S (Saturation); PC (Peak Car)**

Phenomenon	Nature of Test	Inference	Notes
Timing (a general approach which should modify all the others, below**).**	Do the drivers reasonably closely **precede** the effects?	Contradictory evidence more powerful than supportive, because many of the contending drivers are roughly, but not exactly, collinear. More detailed examination would make use of what we know empirically about the time scale of effects following causes in travel behaviour – well documented in some variables e.g. transport prices, income: a long-term impact cannot happen in the same year as a change in driver, for example, but spread over some years after.	This test is more powerful at the less aggregate level, e.g. for specific cities, types of area, policy initiatives, categories of people – since there will be a wider range of timing experience, and hence more likelihood of picking up counter-hypothesis evidence**.**
Income	(a) Evidence of change in income elasticity over time (b) Evidence of changing car use of different income groups, particularly the highest and lowest (c) Locations with growing income compared with locations with declining income	a) S and PC suggest that elasticity of car use with income has declined towards, or to zero; IG sees continued substantial positive income elasticity as important driver. b) IG would indicate rich to show stable or increasing car use, poor to show (temporary) reductions. S might indicate more even responses (income being less important than relative status). PC might see opposite impact as richer have more potential to lead a new trend. c) IG would indicate locations with growing income to show more traffic growth than those with declining income. S and PC have not suggested a particular pattern – the test is more suggestive for/against IG.	(a) There are good published aggregate econometric studies on this, but less at household level over time. (b) Note that strictly test should relate to people with g*rowing* and *falling* income rather than high and low. However during a time of widening income distribution this will be a characteristic of the highest and lowest groups. (Also because of the dispersive part of regression to mean processes). So test on highest and lowest will be broadly valid.
Population	Is traffic growth proportional (less, more) to population growth?	IG has suggested nearly proportional. S has suggested strong dependence on brownfield/greenfield balance. PC would also imply this, but with stronger effect.	May be more useful to use *density* rather than population – NTS allows this
Congestion	Does rising congestion damp further traffic growth?	Historically, IG has put much emphasis on congestion effects, but currently the proposition is that effect is not strong enough to offset other effects. S sees it as a contribution to saturation. PC sees it as a possible divergent effect (see below).	Difficult to test because of inherent two-way effect – all agree that rising traffic increases congestion. Useful to explore but may not usefully discriminate.

Table 3. (continued) **Tests of evidence tending to discriminate among the three hypotheses, IG (Interrupted Growth); S (Saturation); PC (Peak Car)**

Phenomenon	Nature of Test	Inference	Notes
Other policies	Do other policies significantly affect traffic growth and levels? The two most discussed have been reallocation of road capacity and "smarter choices" (soft) initiatives.	All approaches accept there must be some effect, but IG has tended to say effect must be small or very small compared with population, fuel price and income, S has not depended on them either way, and PC has tended to say effects are large.	A great deal of evidence at the town/city level, because that is the level where policies have differed. Research would initially be revisiting and reviewing the published studies. (Note that an essential feature of any approach stating that selected variables are a "sufficient" explanation is the presumption that other variables, which may be collinear, are unimportant.) There is an active discussion on this, with detailed evidence already cited.
Non transport drivers	Are there apparent other major social/economic changes which have appreciable effects on travel choices?	IG has tended to say no, but if they exist will be reflected in model parameters. S has not depended on these. PC has tended to suggest social attitudes (health, environment, status) and technical changes, especially mobile computing. There are also other big social changes which might have an effect (e.g. gender changes, households, culture) but which are not *a priori* associated with one hypothesis or another.	Tests might be detecting particular groups who seem more influenced by these drivers, and seeing whether there is evidence that their travel choices differ. This would be exploratory rather than clear hypothesis testing (but no less useful in the longer run).
Equilibrating/damping processes	What do the hypotheses imply about robustness and reliability of their forecasts?	S sees achievement of a saturation level as an equilibrium and stable position. IG and PC are divergent – they get further apart over time, possibly reinforced by the policies each might adopt – i.e. S has more negative feedback, IG and PC might have more positive feedback. There are strong (but complex, and sometimes counter-intuitive) implications for robustness, processes of policy and project appraisal, and for strategic policy development.	Not clear that this can be tested empirically, but it is an essential part of the discussion about what policy conclusions might follow from each.

7. Some future policy issues

(Note: this section is drafted mostly with reference to policy discussions in the UK, each country having its own specific cultural and political constraints on the way policy is discussed and determined. But it may be that the underlying principles are common to other countries also.)

7.1 Robustness to uncertain futures

There have been many years, in some countries decades, of assuming that forecasts of future mobility are about as well determined as forecasts of the future economic variables which determine them. In this case there will be an envelope of uncertainty of travel forecasts, but it is quite likely to be a rather narrow envelope.

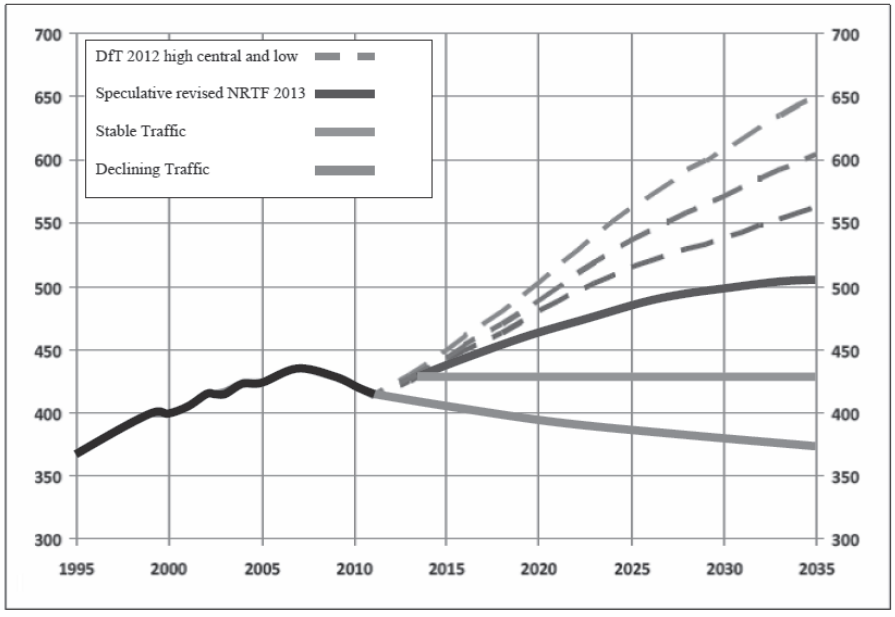
However, the situation now seems rather different. There is uncertainty of a different type, namely about the underlying relationships themselves, and it cannot be assumed that there is only one viable forecast of travel corresponding with any particular assumption of, say, economic growth or fuel prices. In that case, it is logically necessary consider the robustness of future policies and projects in terms of scenarios about the future, not forecasts of it. This will remain true until the big research issues about future mobility are resolved to the point of a reasonable degree of consensus, which does not yet exist. The policy issue is of appraisal under conditions of contested futures.

An example of such an approach is shown in Figure 18 in relation to UK conditions (though somewhat similar arguments could apply to many countries) by comparing the DfT's National Transport Model's outputs – a trajectory of aggregate traffic volumes year by year into the future – but reflecting the range of futures which now start to become credible. As a grey background three dotted lines are DfT's current (2012) assumptions about three futures for England – a "high demand", "low demand" and "central" projection, which differ (but not by very much) in relation to Government publicly expressed assumptions about economic growth, oil prices and fuel economy. The three coloured lines, however, are not simply an exploration of a wider range of possible scenarios, but are based on different interpretations of the evidence about the peak discussions. The red line, an expected return to growth (though less than previously forecast), is likely to be one where some road capacity expansion, though less necessary or good value for money in CBA terms, might actually start to become more useful in "making things better" rather than "slowing down the pace at which they get worse".

The blue line is simply a stable level of traffic continued at a suitably defined "current" level, somewhat increased to close to its 2005 peak. This is a simplified version of the idea of traffic saturation, ignoring the critical conversion from per capita saturation to population totals, which depends on the physical location of housing development, so itself requires a high and low envelope. For the scenario, simply choosing a stable volume of traffic has one decisive appraisal advantage: it unambiguously addresses the question "what would this policy or project do for the current problems that we see and experience"? It therefore does not depend on the elusive concept of "better than it otherwise would have been": it just relies on "better". For public discussion this represents a robust

and transparent idea with no trickery. (A reminder: this is about "base" demand, and it would still be necessary, as in all the scenarios, to calculate induced traffic).

Figure 18. **Suggested increasing, stable and reducing traffic scenarios for appraisal**



The green line approximately reflects, but simplifies, the idea that the stabilisation then traffic decline in recent years may be in part a structural change in trends, influenced by mobile computing, demographics, cultural expectations, costs and policy. For forecasts, this approach itself would need two branches, depending on whether the associated policies have a positive feedback effect ("virtuous circle") increasing the rate of decline, at least for a period, or a damping effect leading to a new, but lower, saturation level. That is, probably, too complicated to deal with for a scenario, but the simpler version shown, with a reduction of about 0.5% a year back to around the 1995 level, also makes a genuine contribution to understanding even in advance of confidence at the forecasting level. This is because it represents downside risk of expensive investments being unremunerated, in money or benefit, hence is crucial for negotiating risk as between the public and private sector, and testing the robustness of both capacity and demand management to different futures.

There will, of course, only be one future which actually happens, but we do not yet know what it is. In the meantime the three scenarios illuminate appraisal while not needing agreement on forecasts, only requiring a shared respect for the legitimacy of views that traffic could, possibly, increase, stay stable, or reduce.

Thus the essence of policy appraisal would shift. A key question – to be applied to major strategic trajectories and also to large scale specific projects, would be: does this policy stay a "good thing" under all the contending scenarios, or does it only make sense under one of them? This tackles the question of robustness, and helps positive decisions to be taken even before consensus is reached on the research.

A more ambitious approach would be to assign probabilities to the different scenarios, though in one sense that simply displaces the problem: if we were in a position to establish consensus probabilities, we would also be in a position where there was more agreement about the interpretation of the evidence than has yet been reached. Even so, there is an advantage in separating the established facts from the contested judgements, which would assist transparency in decision making.

7.2 A specific policy issue: the allocation of risk in the case of private investment into major transport infrastructure projects supported by public policy

An issue of interest in many countries is whether private funding sources can be found to finance major infrastructure projects which are desired by public policy. In the UK this takes the form of encouragement by the UK Treasury for bodies such as pension funds to encourage them to invest in the country's infrastructure.

However, pension funds – indeed, any private investment whether on behalf of pensioners, shareholders, or trust beneficiaries – have legal obligations to spend their stakeholders' money on sound financial principles. If they do not do so, their decisions can be challenged not just in political hurly-burley, but in the courts, with real money at stake. As with a share flotation, the key issue will be the Prospectus, the formal analysis of an offer which has sound expectations of financial return, and careful consideration of risks, especially downside risks – what are the chances of a worse return than expected, and who bears the risk if so? The prospectus methodologies may (or may not) be the same as those used for public sector forecasts, but the application, responsibility for error, focus, authority and implied power are different. In other words, due diligence means that some independent consideration of the validity of official forecasts is certain to happen, in one form or another, and with legal consequences.

The first thing such a review will need to do is consider the track record of the currently authorised forecasting procedures. They are not uniformly good. Then one can consider a role-playing game. Suppose you are the investment manager for XYZ Pension Fund, considering whether to invest in the M999 bridge and motorway widening programme, vitally necessary, you are told, because it is already operating to capacity and the traffic will increase by 50% over the next 25 years. This sounds like a good prospect, and the question arises about whether to opt for a real charging scheme, taking in an income stream from many individual motorists, or a shadow scheme, paid by the Government in relation to future traffic. So you look at the forecasts, and the forecasting record. Now the graph indicates a downside risk of the long term traffic flows being substantially less than the forecasts, as they have continually been for at least the last quarter of a century. In that case, an income depending on real charged prices is going to be less profitable than an income stream guaranteed by the Government based on the Government's own forecasts. So the investor will ask for a guarantee. But the downside risk for Government would be the danger of paying a lot of money, not underpinned by buoyant tax revenue, in respect of traffic flows which under-perform, for a project which for that reason turns out to be a lot less necessary anyway.

But consider the opposite outcome: suppose that the traffic forecasts do turn out to be accurate, or even underestimates. Then the cash flows are more robust but there is a danger of significant reputational damage, since congestion will actually be getting worse, not better, and the investing agency will be taking a substantial, highly visible, controversial income, in respect of a worsening quality of service.

These twin fault-lines – financial risk if the forecasts are overestimates, and reputational damage if they are correct or underestimates – suggest, it seems to me, that the ideas will evolve over the

period of negotiation to one of two pro-active forms. First, it could be a real road pricing scheme with a much greater public, rather than private, focus, for the traditional reasons of tax revenue and travel demand management, rather than road expansion. The second possibility would be to evolve into more and more extravagant guarantees, ending in a PFI-like scheme which risks paying substantially too much to the private providers. Both options are currently very unattractive politically. So a third, passive scenario could then emerge, suggesting that, since traffic is rather stable, maybe it is better just to let the issue lie for a while, while focussing on other improvements such as maintenance

7.3 Another example of policy implications: "smart" methods aimed at reducing car use

The main reason for the growth of implementation and experience on smarter choices (then called "soft measures") in the late 1990s and early 2000s, culminating in their breakthrough into the policy mainstream after 2004, was because they offered a (relatively) easy, cheap and politically attractive way of reducing the expected traffic growth to levels which were compatible with the amount of road capacity which was or could be made available. The main alternative approaches – a massive road building programme big enough to outpace forecast traffic growth, or system-wide road pricing to ensure economically efficient use of road capacity – each had their persistent champions, but neither ever came close top commanding majority support in the population in the UK. Opinion polls suggested a stable support level for either of around 30%, with at least as many vigorously opposing. Politically neither added up. By contrast, smarter choices had no natural opposition of any substance, and a lot of gentle goodwill, often up to 80-90%.

Currently there are great financial pressures on national and local government, as indeed on most of the public, and there is a need for reassurance that any substantial expenditure gives good value for money, and is in accord with the political and economic priorities of the time. There is substantial evidence that smarter choices give very good value for money indeed – better than most infrastructure projects – in line with a decade of discovery that small, local, cheap improvements to the quality and ease of transport (such as local safety schemes, area traffic management, reallocation of road capacity to walkers, cyclists and public transport, and improvements to the public realm in town centres and areas of concentrated shopping and leisure activity) typically give benefit cost ratios (BCRs) in double figures, with benefits that may be 10 or 20 times as large as costs, or more, compared with ratios in the range 1-6 of even the best infrastructure projects. It is true, however, that not everybody fully understands these results, and some even casually reject them. There is genuinely a need for refreshing the knowledge base and understanding of the great measured benefits, and the very positive political goodwill, which smarter choices bring.

In this context, there is great significance in the observation that in recent years traffic levels, and especially car use, has simply not grown as much as was being forecast from the late 1980s onwards. As discussed above, there is a lively debate about the reasons for this, with broadly two different views. The "official" view is that the phenomenon is essentially temporary, due to economic conditions, with the expectation that when the economy returns to "normal" functioning, so also will traffic growth. The alternative explanations suggest that the phenomenon preceded the current economic difficulties and therefore should not be attributed to them: rather, there are signs of a structural shift in attitudes to cars and the resulting travel choices, so the future will show a long-lasting stable level of car use, or even falls. Indeed, the previous implementation of policies intended to reduce car use, may have actually succeeded in doing so, and the policies have turned out more successful than is often thought. The question is – what effect does this unresolved debate have on the usefulness of further implementation of the same policies?

If the official view is right, then smarter choices will remain as an essential set of instruments of policy to cope with traffic growth which cannot be solved by other politically acceptable or affordable methods. If the alternative view is right, however, then the argument is not exactly symmetrical: if people are using cars less this does not of itself solve all the problems of mobility and access, and there will need to be a much wider application of other methods to assist people with efficient and high quality transport systems. Then, it seems likely that the balance among the different smarter choice methods is likely to shift, as "dealing with excessive traffic" becomes less of an issue but "providing good mobility solutions by means other than car use" is by no means less important.

The result of this seems to me to be that one needs a short-term smarter choices strategy which is suitable for either of the outcomes, but then with the expectation that it will be fine-tuned in different ways according to whether the official, or alternative, view turns out to be right. That is an excellent example of a robust and flexible policy.

This is an important example of interaction between research and policy, with a conflict shown in a deeply-rooted, and long-lasting, incompatibility between two arms of government, or two mind-sets of understanding, which give conflicting signals and threaten to weaken – or, at worst, paralyse – a most constructive and worthwhile instrument of policy.

One the one hand, smarter choices, formerly called "soft measures" provide a general but profound set of influences on travel behaviour, empirically demonstrated time and time again as able to alter choices with little or no opposition, no natural opposition, little offense, and excellent value for money. On the other hand, they provide a continual challenge to analytical orthodoxy. They do not fit easily into the longest-established set of forecasting tools, challenging either their behavioural assumptions or formal specification. Their benefits seem not to sit comfortably alongside the traditional ones of time and money saving. If the empirical results are taken at face value, they raise uncomfortable questions of whether the well-established modelling frameworks are as good as is claimed for them, and therefore raise questions about other policies also.

Notes

1. Not everybody is comfortable with the phrase, which is drawn from an analogy with "peak oil", because the correspondence is not exact in terms of physical limits or the nature of production costs. Nevertheless, it expresses a hypothesis very succinctly and there is not another short label offered.

2. The evidence that car use is different according to whether population growth is accommodated in dense urban areas, suburbs or rural areas seems to be very strong, and presumptions of proportionality to population are therefore very vulnerable.

3. The author has noticed that early discussion of a stable average travel time budget was often expressed as a stable 55 minutes, later a stable 60 minutes, and recently a stable 1.1 hours.

4. This can be seen in a particularly vivid "moving pictures" format on his website at: www.gordonstokes.co.uk/transport/peakcar.html

5. This is sometimes described as "an increase in car use among older drivers". That is misleading: they have not been increasing their car use, but driving more than previous generations of old people, which is an important distinction.

6. There is a curious dissonance between the quantitative models embodying this concept and the ideological, cultural and environmental presumptions which would, when made explicit, generally be found quite distasteful, and probably incompatible with respectable world views.

7. Stokes (2012) later wrote that this seemed to them so unlikely that they left it out of their subsequent work on the subject.

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