Evaluating Active Travel: a challenge to prevailing frameworks

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Abstract

Evaluation can be considered as a systematic attempt to determine the value, efficiency and effect of existing and/or potential policy interventions. Within the transport sector, the merits of the prevailing evaluation paradigm have cemented its position as the support mechanism of choice for transparent and justifiable decision-making. Recently, however, contributions to the transport literature have challenged some of the core assumptions present in current appraisal frameworks and this has raised important questions as to whether such frameworks, in their current form, are capable of yielding appropriate and informative outputs. This is especially pertinent in the United Kingdom, where cost-benefit analyses have traditionally emphasised travel time savings as the major benefit of infrastructural interventions, especially in the context of motorised road transport. Given that UK transport policy now explicitly encourages travel by non-motorised modes, this paper critically examines the extent to which current practice in cost-benefit analysis, as manifested in the Department for Transport's NATA framework, accurately encapsulates the multitude of societal benefits conferred by walking and cycling. Drawing on a brief numerical example, we explore potential adjustments to cost-benefit analysis that might improve the quality of future investment decisions made in relation to these modes.

Introduction

There is growing acknowledgement that the prevailing mobility paradigm in the advanced capitalist economies poses a significant challenge to sustainable development, a tripartite concept that seeks to harmonize the conventionally competing priorities of the economy, society and the environment (Banister, 2005). Alongside explicitly auto-orientated measures designed to ameliorate contemporary mobility problems (e.g. road pricing, development of alternative fuels, etc.), academic and policy attention in the transport field has increasingly been directed toward pro-auto-alternatives, such as walking and cycling (Department of Transport, 1996; Taylor, 2006; Parkin *et al*., 2007). Whilst these modes clearly do not represent a panacea to all transportation problems (Lucas and Jones, 2009), there is strong evidence to suggest that their inherent energy- and space-efficiency can make a valuable contribution to the project of sustainable urban mobility (see, for example, Pucher *et al*., 1999). Furthermore, such 'active travel' has proven health benefits at both the individual and societal scale (Cooper *et al*., 2006), prompting its conceptualisation as a 'multiple satisfier', capable of simultaneously realising several human needs (Horton *et al*., 2007, after Max-Neef, 1992).

As contemporary patterns of transportation have demonstrated, however, engineering behavioural change—and modal shift in particular—is far from straightforward. Yet although the interventions required to engineer a 'transition to sustainable mobility' are likely to be hazy and indistinct, attention can (and should) be focussed on those formalised political processes that actively shape the course of material transport interventions. This paper, therefore, attempts to develop a critique of the UK transport appraisal framework as it currently relates to the evaluation of walking and cycling schemes. It is difficult to underestimate the importance of economic appraisal in current decision-making in transport policy; although theoretically their status is that of a tool for guidance, in practice, benefit-cost ratios appear to be a strong determinant of eventual policy decisions (Owens, 1995; Rayner, 2004). There is thus a real danger that if walking and cycling schemes are seen to somehow fall 'outside' of the current appraisal framework, adequate and fair investment in these modes will be unattainable. While commentators such as Ackerman and Heinzerling (2005; see also Verchick, 2005) are highly critical of the very principle of cost-benefit analysis ('CBA' hereafter), the broader aims of public policy appraisal are less controversial. Indeed, if we consider the act of evaluation to represent a "process which seeks to determine as systematically and objectively as possible the relevance, efficiency and effect of an activity in terms of its objectives" (Papaconstantinou and Polt, 1997, n.p. ; see also, Rossi *et al*., 2004), and we accept the twin premises of the economic problem (i.e. the presence of unlimited wants on the one hand and the scarcity of resources on the other), it is difficult to find fault with its overall goal (see also; Layard and Glaister, 1994).

The challenge for appraisal in the transport sector, then, is to aid the extent to which it is possible to maximise societal, environmental and economic welfare through transportation, subject to our collective desire to allocate scarce resources to other objectives (e.g. healthcare). This poses several subsidiary challenges—both philosophical and practical; not least it attempts to grapple with the inherent difficulties involved in establishing the opportunity costs of interventions involving apparently 'incommensurable' items (e.g. carbon dioxide emissions and accident costs). The underlying principle behind economic appraisal (and CBA in particular), therefore, is to establish a range of weights for such items expressed in some common denominator, i.e. money (Harrison, 1974). Furthermore, using monetary values in this manner appears particularly attractive to decision-makers as it not only enables them to evaluate potential interventions against a set of external criteria (e.g. what would be the environmental and economic implications of building a high-speed rail link?), it also—following a value for money approach—provides a means of comparing the merits of potential investments *against each other* (e.g. would 'cycling scheme A' or ' cycling scheme B' generate a greater benefit for the same sum invested?).

Current evaluation of transport projects in the United Kingdom: NATA

The Emergence of NATA

Until the mid-1990s, the transport planning in the United Kingdom was largely characterised by a philosophy of 'predict and provide', where the role of transport policy was seen to be one of servitude to overriding economic imperatives (Rayner, 2004; Vigar, 2002). As the description suggests, this ethos was most obviously manifested in the practice of increasing the supply of road transport infrastructure in response to projected increases in demand for automobile transport (see, for example, DoT, 1989). With the publication of *Transport: the new realism* (Goodwin *et al*., 1991), however, it became ever clearer that such supply-side interventions could never adequately accommodate the prospect of ever-increasing demand. Moreover, the 'predict and provide' philosophy had severe consequences for the environment, incurring substantial criticism both within the domestic sphere and also from the European Commission (Dudley and Richardson, 2001; ECMT, 2004). Yet, as Rayner (2004) makes clear, the most convincing objections to large-scale road building programmes were not borne out of a sentimentalist agenda; its critics, in principle, recognised the need for infrastructural provision. Rather, their objections arose from the belief that not only was the 'predict and provide' philosophy endemic to transport policy discourses, but that it had also percolated into very appraisal mechanisms that had been branded as impartial. Thus, critics of plans set forth in *Roads for Prosperity* (DoT, 1989) were questioning not only the broad assumption that new roads inherently aid economic growth, but also those working assumptions involved in the cost-benefit analysis that formed the bedrock of the appraisal framework.

The New Labour government of 1997 responded to the crisis of legitimacy then faced in the transport appraisal field with the publication of the 1998 white paper *A New Deal for Transport: better for everyone* (DETR, 1998). This document, with its commitment to furthering an 'integrated' approach to transport, heralded the arrival of the 'new approach to appraisal' ('NATA' hereafter). This new approach, it was argued, would be more sensitive to the complexities and competing priorities of the economy, the environment and society as a whole. In addition, it was touted as a break from the 'predict and provide' philosophy insofar as it would be explicitly 'objectives-led'. In other words, rather than prospective transport developments being assumed to represent inherently beneficial interventions, they would instead be assessed against a series of overarching criteria—the economy; safety; the environment; accessibility; and integration—colloquially known as the 'NATA five' (Rayner, 2004).

In May 2007, the UK Department for Transport invited various stakeholder groups to partake in a consultation exercise designed to inform and refine NATA. This consultation exercise was primarily a response to the conclusions of two high-profile 2006 reports commissioned by the UK government; the *Eddington Transport Study* and the *Stern Review on the Economics of Climate Change*. The Department for Transport received over one hundred written responses to the consultation, and published its official response to the feedback received in April 2009 (DfT, 2009).

The NATA Methodology

The ultimate output of the NATA process is the 'appraisal summary table' (AST hereafter), which is designed to provide decision-makers with a straightforward and concise overview of the extent to which a proposed transport scheme meets the 'NATA five' objectives. Ostensibly, the AST is designed to accord equal consideration to all sub-objectives, regardless of the methodology used to appraise them. It has been argued, however, that although qualitative evaluations are taken into account, in practice, the analytical core of the appraisal process is still dominated by the legacy of CBA (Rayner, 2004). Although this section is not intended to host a critique of NATA, the first point to make in relation to the nature of the appraisal procedure is, therefore, that although NATA claims to represent a significant departure from the past, the extent to which the appraisal process is truly different to the previous CBA approach has been questioned. In particular, given that CBA forms the mainstay of the appraisal, the tone of the WebTAG guidance is that factors more amenable to quantification and/or monetisation are tacitly accorded higher status in the process.

Wherever possible, NATA encourages those undertaking an evaluation to quantify and, if applicable, monetise the various costs and benefits of a potential scheme. Clearly, this is the case for the economy sub-criteria; it has the sub-objectives of: transport economic efficiency (both business users and consumers). As Rayner (2004, p. 467) notes, "typically, monetised time savings accrued by forecast future road users made up 80 percent of the calculated benefits of road schemes." The calculation of user benefits in NATA is heavily based on consumer surplus theory and considers travel to represent the cost of moving from point A to point B. Savings in travel time, therefore, largely account for the benefits of road building schemes. To obtain monetised values for the time saved by a potential scheme, the forecast time savings are multiplied by various values of time. These vary depending on journey purpose and the mode used. While average salary costs are used as a proxy for work-related travel, values of time for non-work-related travel are derived from stated preference surveys that probe respondents' 'willingness to pay' (WTP hereafter) for savings to their travel times.

Other factors that are monetised relate to noise, greenhouse gases, accidents and accessibility. For noise (see WebTAG, 3.3.2), the estimated change in the population affected by a potential transport scheme is derived from a comparison of the 'do-nothing' and 'do-something' scenarios. Subsequently, house prices in the affected area are used to determine households' WTP to avoid transport-related noise. It is noted in the NATA guidance, however, that a relatively substantial change in traffic volume is required to bring about a significant change in traffic-related noise. The appraisal of greenhouse gas emissions (see WebTAG, 3.3.5) from road transport primarily relies on the quantification of carbon dioxide emissions, yielding an absolute figure in tonnes. This is calculated by estimating the difference in CO2 emissions between the 'do-something' and 'do-nothing' scenarios using Highways Agency worksheets found in Volume 11 of *Design Manual for Roads and Bridges* (Highways Agency, 2008). The accuracy of these calculations can be significantly improved, provided that detailed information on vehicle and route composition is available. Interestingly, while WebTAG (3.3.5) doesn't actually mention subsequent monetisation of these figures, it is cited elsewhere as containing values for the marginal economic cost of units (i.e. tonnes) of CO2 which can subsequently be used to determine the present value of benefits derivable from a transport scheme in which levels of CO2 emissions are reduced (see, for example, WebTAG, 3.14.1). Accidents are also subject to monetisation (see WebTAG, 3.4.1). Estimated changes in the number of deaths, serious injuries and slight injuries as a result of the difference between the 'do-nothing' scenario and the 'do-something' scenario are extrapolated from existing accident rates. Costs incurred as a result of accidents vary according to their severity, thus NATA employs standard economic values from Volume 13 of *Design Manual for Roads and Bridges* to determine the present value of benefits (or otherwise) expected from a particular transport intervention (see Highways Agency, 2008). Another sub-objective that is subject to monetisation are 'option values' associated with the accessibility objective (see WebTAG, 3.6.1). Here, NATA (WebTAG, 3.6.1., p. 1) defines an option value as "the willingness-to-pay to preserve the option of using a transport service for trips not yet anticipated or currently undertaken by other modes, over and above the expected value of any such future use." NATA guidance recognises that research in this area is underdeveloped and thus the monetisation of option values are currently restricted to schemes involving the proposed removal of bus and rail services

Option		**Description**	**Problems**	**Present Value of Costs to Public Accounts £m**
OBJECTIVE	**SUB-OBJECTIVE**	(a) QUALITATIVE IMPACTS	(b) QUANTITATIVE ASSESSMENT	
ENVIRONMENT	**Noise**			net properties win / lose NPV £m
	Local Air Quality			Concs wtd for exposure
	Greenhouse Gases			tonnes of CO_2
	Landscape			Score
	Townscape			Score
	Heritage of Historic Resources			Score
	Biodiversity			Score
	Water Environment			Score
	Physical Fitness			Score
	Journey Ambience			Score
SAFETY	**Accidents**			PVB £m
	Security			Score
ECONOMY	**Public Accounts**		Central Govt PVC, Local Govt PVC	PVC £m
	Business Users & Providers		Users PVB, Providers PVB, Other PVB	PVB £m
	Consumer Users			PVB £m
	Reliability			Score
	Wider Economic Impacts			Score
ACCESSIBILITY	**Option values**			PVB £m
	Severance			Score
	Access to the Transport System			Score
INTEGRATION	**Transport Interchange**			Score
	Land-Use Policy			Score
	Other Government Policies			Score

Table 1 The Appraisal Summary Table (AST).

. *Source:* Department for Transport

Other sub-objectives, notably 'local air quality' (WebTAG, 3.3.3), are quantified but not monetised. Depending on whether a particular appraisal focuses on a specific plan or a local area strategy, the change in the population exposed to harmful transport-derived pollutants (such as PM_{10} and NO_2), is estimated in accordance with a distance decay relationship from the source of the pollution, usually a road. As noted earlier, the remainder of the sub-objectives are appraised qualitatively. These are presented in the AST in the form of an 'overall impact score' placed on a seven-point scale that assigns the effect of a potential intervention to one of the following categories: beneficial (large, moderate, slight); neutral; and adverse (large, moderate, slight). **Table 1**, above, shows the AST currently used in NATA.

NATA and sustainable travel: Broad Street, Oxford

This section seeks to explore the extent to which the CBA framework at the heart of NATA is able to adequately appraise the likely costs and benefits of transport interventions related to walking and cycling. As noted in the introduction, these modes are ostensibly encouraged by the UK government, given their status as 'multiple satisfiers' (DfT, 2004; Horton *et al*., 2007, after Max-Neef, 1992). As such, interventions designed to improve the facilities for pedestrians and cyclists can also be considered as implicit attempts to encourage more people to use these modes in preference to those with higher external costs. Firstly, we introduce a hypothetical transport intervention, outlining our reasoning as to why the scenario might be considered a useful exercise. Subsequently, following the NATA guidelines, we report on our attempts to appraise the likely costs and benefits of the intervention.

Context and Intervention

Since its earliest beginnings as a ditch outside the walls of the city, Broad Street has played a significant role in the social, cultural and political life of Oxford (for an overview, see Morris, 1965). In recent years, however, there has been growing concern regarding the quality of the urban experience in Broad Street and the extent to which its environment does justice to the significance and heritage of the surrounding area (Kim Wilkie Associates, 2004). As shown in **Figure 1**, the street is currently dominated by a central stretch of 25 short-stay car parking spaces. Although there is a relatively large supply of cycle parking (168 spaces), most spaces are permanently occupied by bicycles which are either left 'long-term' or have been abandoned. Furthermore, pedestrians are poorly provided for; there is a dearth of directional signage, a large number of unpredictable vehicle manoeuvres and only a handful of benches for the elderly to rest. In 2002, a steering group designed to oversee a revitalisation of the street was set up by Oxford Preservation Trust. Subsequently, Kim Wilkie Design Associates produced a potential vision for the pedestrianisation of the street. Although plans have yet to be finalised, it appears that this vision will be incorporated into the wider 'Transform Oxford' pedestrianisation programme currently being developed by Oxfordshire County Council.

Figure 1. Broad Street, Oxford (2008).

Source: Google Streetview

It is in this context that we shall explore the extent to which NATA is able to aid the quality of the decision-making process. Taking the proposed pedestrianisation of the street as a starting point, we extend the plans with the addition of some extra bicycle parking and, following NATA guidelines, attempt to assess the likely impacts. Following the recommendations of Kim Wilkie Associates (2004), therefore, our hypothetical intervention takes the following form: the creation of a 'shared space' environment achieved through re-surfacing the road with pedestrian-friendly paving and removing the existing raised pavements; the removal of the central parking strip and associated traffic management infrastructure; disabled parking and loading access, however, will be retained. However, given the nature of our interest, our hypothetical intervention extends the existing proposals with the introduction of 120 'Sheffield' bicycle stands set in the same footprint as the existing 25 capacity central car parking strip. Our intervention will go a step further than the straightforward provision of additional bicycle parking on Broad Street and will create a programme of capacity management, which would involve the removal of any bicycles left overnight. This is to prevent long-term storage of bicycles and to ensure that abandoned bicycles no longer take up spaces that might otherwise be used for cyclists seeking to park in the central area. If left, they would be impounded by the council and released only upon the payment of an appropriate fee.

Appraising the Intervention: Costs

The overall costs of the hypothetical intervention can be placed into three categories, namely capital costs, operating costs and costs to public accounts. The following capital costs factors were expected to be incurred, and estimates—derived from industry sources—are provided in 2010 estimated prices: removal of existing traffic infrastructure (£20,500); resurfacing of street with 'pedestrian-friendly' materials (£340,000); removing kerbing and relaying drainage (£37,500); and purchase and installation of bicycle stands (£23,000). Estimated annual operating costs were derived in the same fashion, and are as follows: personnel costs incurred as a result of clearing, storing and reclaiming bicycles (£9,000); leasing of storage space for confiscated bicycles (£12,000); and general maintenance (£1,000). Capital costs, by their nature, were incurred in Year 1 of the appraisal period only, whereas operating costs were incurred each year. In line with NATA guidance (see WebTAG, 3.5.1), the loss of tax revenue accrued through fuel duty was estimated using the forecast decline in car-km travelled as a result of removing the 25 central car parking spaces. The process by which these car-km savings were calculated will be explored in more detail below. The estimated figure for indirect tax revenue foregone in Year 1 was approximately £57,000 in 2010 prices. Following the procedure set out in WebTAG (3.5.9), all annual costs were discounted at a rate of 3.5% per annum over the appraisal period and expressed in 2010 market prices (est.). Although the standard appraisal period used in NATA is 60 years, the guidance makes clear that a shorter period may be more applicable to walking and cycling interventions (WebTAG, 3.14.1). The chosen appraisal period for our hypothetical intervention, therefore, was 20 years.

Appraising the Intervention: Benefits

Several of the likely benefits accruing from the intervention and, as shown above, some of the costs, were expected to arise as an immediate result of removing the central car parking on Broad Street. Specifically, this would arise through the attendant reduction in car-km travelled resulting from changes to the travel behaviour of existing motorists. We shall consider these to be *direct* benefits. In addition, it appears logical to assume that the planned intervention would result in *indirect* benefits. These would occur over and above the direct benefits and represent the additional benefits caused by the scheme that were experienced by individuals who, to all intents and purposes, were not existing users of Broad Street prior to the intervention. Direct benefits were all derived from savings in car-km. These were calculated on the basis of a stated preference survey of motorists' attitudes to the parking facilities on Broad Street, undertaken in November 2002 (Oxford Civic Society, 2002). Approximately 230 motorists were asked a variety of questions designed to a) establish their travel characteristics (including journey origins and purpose), and b) to probe their attitudes to the nature of the (then) current parking facilities on Broad Street, and to the potential removal of the parking. The resulting data were used to inform the appraisal, following implicit and explicit encouragement in NATA to make use of locally-specific information wherever possible. From these data, it was possible to make a tentative estimate of the number of car-kms saved as a result of the intervention that would, in turn, create *direct* benefits. This was achieved in the following manner: first, the number of annual trips ending at the Broad Street car park was estimated; working on the assumption that the average duration of a parking session was 45 minutes and assuming that the car park is full from 8am - 6pm (which, anecdotal evidence suggests, is a reasonable assumption), then, for the 25 spaces, approximately 333 visits, on average, are likely to occur on a given day.[1] Multiplying this figure by 365 gives an average annual trip count of approximately 121,363. Data from the 2002 survey revealed that approximately 52% of motorists questioned had driven from within the City of Oxford, 26% had driven from outside Oxford but within Oxfordshire and the remaining 22% had driven from outside Oxfordshire. Assuming, based on geographic boundaries, that the average distance travelled from each of these three origins was 2.5km, 18km and 68km, respectively, a baseline estimate of the total number of car-km associated with trips ending at Broad Street, per annum, was calculated. According to the survey, 37% of participants responded that, should the parking on Broad Street be removed, they would cease to drive. Assuming an even distribution across all journeys (i.e. regardless of origin), the total car-km saved as a result of removing the car parking on Broad Street was approximately 940,300km. In combination with monetary values, this figure was subsequently used to determine a various *direct* costs and benefits of the intervention, including the loss of tax revenue described above.

So what about the indirect benefits? Calculating these relied heavily on forecasting the likely number of additional walking and cycling trips that would be created as a result of the intervention, over and above the limited number that would directly result from current drivers who park in Broad Street switching to these modes. For cycling, following the guidance set out in WebTAG (3.14.1)—and in the absence of any locally-available data—we applied Wardman et al.'s (2007) mode choice logit model as a method of forecasting demand for cycling on the basis of improved utility experienced by future cyclists. The model is only based on commuting trips, however, and further assumes that a percentage of the population (i.e. total commuters) will never cycle. The given figure in NATA appears relatively high at 40%. Running the model incorporating the extra utility experienced by cyclists as a result of the new parking (£0.66 per trip), yielded a 2.88% increase on the total number of annual

[1] In 2002, the maximum permissible stay in the car park was 30mins and there was no charge for parking. At the time of writing, the maximum permissible stay is 1 hour, and there is a small charge. This clearly has implications for the reliability of our conclusions, and draws attention to the importance of access to accurate, locally-specific data.

bicycle trips into the centre of Oxford (equivalent to an extra 605 trips per day). For walking, the 1999 pedestrianisation of a neighbouring street in the centre of Oxford—Cornmarket St.—provided a viable proxy indicator for the likely increase in pedestrian flow that might occur in Broad Street as a result of the intervention (see Oxford City Council, 2004). The expected annual increase of pedestrian trips along Broad Street was thus expected to be approximately 12.5%, equating to 912,500 additional trips in Year 1.

The remainder of this section summarises the process of appraising the various benefits indirect and direct benefits. For the Consumer Transport Economic Efficiency (congestion) benefit, NATA follows the principle that a reduction in motor vehicle traffic will result in travel time benefits for existing road users. WebTAG (3.14.1, p. 36) indicates that the marginal external costs for cars vary according to the "type of road, the level of congestion (also affected by time of day) and area type." As with the local air quality, however, our Oxford Civic Society (2002) data were not fine grained enough to accurately evaluate the precise decongestion benefits that would arise as a result of the cessation of Broad Street parking. Instead, we followed example of the NATA worked examples where an average all-day value of £0.15 per km was used. Thus the decongestion benefit yielded was total km saved multiplied by 0.15, which yielded a figure of £189,689 (2010 est. prices). This appears to be relatively large, but is broadly in line with the three worked examples outlined in WebTAG (3.14.1).

When appraising greenhouse gases and local air quality benefits from walking and cycling interventions, NATA, only views this category as applicable where the intervention entails a reduction in motorised traffic relative to growth trends. Local air quality figures were attained using the model outlined in *Design Manual for Roads and Bridges* (Highways Agency, 2008, section 11.3.1.). In line with NATA guidance to use locally available data in preference to secondary data wherever possible, estimates for the number of car-km saved as a result of the intervention explained above were used. This ran contrary to the standard methodology employed in NATA for predicting the decrease in car km as a result of a walking and/or cycling intervention; where, instead, savings in car-kms are understood to be generated through determining—out of the new users or a walking and cycling scheme—those individuals who had the option of using a car but chose not to. In the three worked examples provided by NATA in WebTAG (3.14.1), stated preference surveys were used to explore this issue. Assuming that the traffic parking on Broad Street is 95% private cars and 5% light goods vehicles, then the local air quality improvements were: 555kg/year of carbon monoxide; 57kg/year hydrocarbons; 197kg/year oxides of nitrogen; and 6kg/year of particulates. The Highways Agency (2008) guidance is extremely detailed, and offers the potential for some accurate forecasting, based on the nature of the roads, for example. However, in order to monetise these savings, it is necessary to establish the population to be affected by the change integrating a distance decay rate of influence. As the pollutant estimates were generated through 'average km' saved by the cessation of broad street parking, the actual populations benefiting from the improved air quality will not be restricted to the immediate locality of broad street, but instead, would be present along the routes that the drivers had previously taken, almost half of which had their origins outside Oxford itself. For carbon dioxide, the savings amounted to 32 tonnes/ year. This was calculated using the marginal economic cost of a tonne of CO_2 given by the DfT (£75 in 2002 prices). As a result, the environmental benefits of schemes that reduce motorised transport are classed as negligible, as evident in the three worked examples provided in WebTAG (3.14.1).The relative insignificance of these CO_2 weightings is problematic and will be explored subsequently in the paper.

Reduced mortality from active travel schemes is recognised as significant in NATA. Drawing on the methods set out by the World Health Organisation (WHO, 2003), the DfT appears to be aware of the current methodological and epistemological challenges involved in attempts to quantify the benefits from walking and cycling and asserts that future research in the health profession will be crucial in addressing this. The guidance in NATA does, however, acknowledge a principle flaw in the WHO approach, insofar as it only appraises the benefits from a decreased risk of all-cause mortality, as opposed to incorporating the benefits that would be expected to result in terms of reduced sickness and morbidity (i.e. the condition of being diseased (although the benefits of this are attempted to be assessed for business benefits derived through reduced employee absenteeism). The methodology recommended in the NATA guidance explicitly involves: "calculating the number of preventable deaths per person taking up moderate physical exercise through walking and cycling…[making] use of the DfT's standard values for the statistical value of a life, giving a value to the benefits of changes in mortality as a result" (WebTAG, 3.14.1, p. 19).

Benefits relating to physical fitness were assessed following the procedure outlined in WebTAG (3.14.1). Firstly, changes in the extent of walking and cycling brought about by the interventions were predicted (in trips). These values were derived from the Wardman et al. (2007) model explained previously. The model predicted 220,752 new cycling trips per year and 912,500 walking trips. It was then necessary to work out how many addition users this correlated to, given the nature of the fitness thresholds in the WHO (2003) model. Consider the example of cycling: assuming average speed is 14km/h and average trip distance is 3.9km, what is the maximum number of individuals that could attain the 3 hours per week minimum? According to the above, the intervention scenario would create ~1182 extra cycling hours per week. If 3 hours per week is the necessary minimum to gain a 28% decrease in all-cause mortality, it is therefore assumed that the maximum number of individuals achieving this rate is 1182/3 = 394 individuals. For walking, the same method yields a figure of ~1170 individuals. These figures are then entered into the methodology to appraise the reduced mortality benefits. First, the relative risk for the Broad Street scheme was calculated in relation to the original WHO (2003) context, then this figure for relative risk is multiplied by the expected (i.e. 'do nothing') deaths in the new cycling population, thus giving a figure for the number of lives saved in year 1 of the intervention case. Multiplying this figure by the value of a statistical life equates to the reduced mortality benefits.

NATA also recognises journey ambience—a factor already present in the analyses for motorised transport—as particularly pertinent to walking and cycling scheme appraisals. It aims to encompass, and put a monetary value on, both infrastructural/ environmental quality and also estimate the positive effects of cycling and walking schemes that enable users to travel separately to motorised road traffic. Estimating the benefits of journey ambience is acknowledged in NATA to be challenging; a paucity of academic research on the subject is argued to exist. As the Broad street intervention is completely new, the beneficiaries from the scheme should be subjected to what NATA terms the 'rule of a half' (i.e. the benefits accruing to them should be divided by two). In other situations, for example, improvements to the quality of an existing bicycle path, the rule of a half would only be applicable to those using the facility for the first time, whereas existing users would experience the full benefit. For the Broad Street intervention, journey ambience for cyclists was estimated principally via the work of Hopkinson and Wardman (1996) and Wardman *et al.* (1997; 2007). This research ascribed monetised values to various components of cycling schemes. For our Broad Street example, the only relevant factor was 'secure cycle parking facilities', the presence of which was valued at £0.66 (2002 prices). Other infrastructural factors have values associated with usage; e.g. off-road segregated cycle track is valued at £0.05 per minute. As no other information specifies this for parking, therefore, our assumption is that this value of £0.66 is obtained *per trip*. To obtain the journey ambience, therefore, the total number of new cycling trips created (220,752) was multiplied by 0.66 and the resulting figure was subsequently halved following the rule discussed above.

For pedestrians, the process undertaken was almost identical, although this is largely due to the lack of research examining the journey ambience of walking rather than it representing the optimum mode of appraisal *per se*. In this case, WebTAG (3.14.1) adopts the values that Heuman (2005) used in the evaluation of the London Strategic Walk Network. Three factors appeared pertinent to the pedestrianisation of Broad Street: crowding benefit (£0.17/km); kerb level (£0.24/km); and pavement evenness (£0.08/km). Once again, these three values were each multiplied by the total number of new pedestrian trips created (assuming each new trip to be 1 km in length) and then, as they represented new trips, they were divided by 2. Combining the total journey ambience for both the walking and cycling trips thus gave a total value of £156,856 in Year 1 (2010 prices). There are issues here about the negative journey ambience, over and above travel time implications, that are overlooked by NATA. What of the negative consequences for those who previously drove to Broad Street and now decide to get the bus, for example? Also, what about the negative ambience felt by some pedestrians who will be uncomfortable with the presence of bicycles in the new Broad street environment? Problems thus exist in regard to how one might account for the utility of a pedestrianised space with lots of cycles.

To assess the benefits of health-related interventions to the private sector, NATA draws on WHO (2003) research that demonstrated that 30 minutes of exercise per day may reduce the extent of short-term sick leave taken by an individual by between 6% and 32%. The costs savings of this to the private sector are monetised in accordance with average gross salary costs for cyclists (£17 per hour; 2002 prices) and pedestrians (£29.64 per hour). Assuming a 40 hour working week, the maximum number of both cyclists and pedestrians able to derive the threshold level of exercise was determined using the method outlined above in the 'physical fitness' section. Using the UK average short-term sick leave rate of 54.4 hours per employee per year and—in the absence of any further information—taking 22% as the midpoint for exercise-induced time savings, the absentee benefits were: £78, 969 for cyclists and an astounding, £408, 578 for pedestrians. But why is the figure for pedestrians so much higher and should it be so high? Probably because the underlying assumptions are overly crude; for example, a) 22% is extrapolated from the WHO (2003) values of 6% to 32% and, as mentioned, we cannot assume a linear relationship exists in the model; b) trips generated by the pedestrianisation of the Broad are unlikely to be new completely new trips *per se*, but may instead pertain to existing pedestrians taking detours. Moreover, as correlation does not necessarily equal causation, perhaps those individuals who take exercise are simply just more motivated and apply the same commitment and discipline that they do in their exercise regimes to their careers.

The change in number of accidents as a result of an intervention is required under the NATA Safety objective. The procedure outlined in NATA to achieve this involves the application of standard accident rates to the change in vehicle usage, principally km-travelled. The accident data contained in NATA are considerable and, for those interventions where primary data on route choice (e.g. number of junctions on a route and type of road is available), aids the formation of detailed statistics. In the case of Broad Street, the number and severity of accidents for each affected mode (i.e. car, cycle and walk) were appraised separately. For motorised transport, the average annual incidence of deaths, serious injuries and slight injuries to car drivers and passengers on UK roads (2003 data; expressed in million car-kms per incident) was expressed in terms of the number of car-km/year saved as a result of the cessation of car parking in Broad Street (~1m), thereby yielding predictions for the absolute number of incidents—classified by severity—that would be prevented by virtue of those trips not taking place. These figures were subsequently monetised following the DfT guidance on accident costs contained in the Design Manual for Roads and Bridges (2007). The figure generated was a saving of £16,542. According to the DfT (2007) figures, both cycling and walking have substantially higher accident rates than driving. Following the same above process to determine the accidents that could be expected to occur as a result of the increased cycling and walking kms (860,932 and 912,500 respectively), the results were much higher, at a combined cost of £216,808. Evidence suggests (e.g. Pucher 07), and is cited in NATA (Jacobsen, 2003 in WebTAG, 3.14.1)) however, that the relationship between cycling levels and accidents is not linear. Accordingly, and following Jacobsen's (2003) power function model, the 2.88% projected increase in cycling would yield only a 1.14% increase in all-severity accidents. However, this was not used in our calculations, as there is no mention of a similar effect for walking and in the interests of consistency car, bike and walking rates were kept linear. This also follows NATA comments in WT 3.14.1 (p. 15) insofar as "for very small values [of increase in cycling], one should be careful in the application of this model as a close-to-linear increase in accidents per additional unit may well be more appropriate."

Clearly many people using the car parking on Broad Street choose to do so because they perceive driving to be more convenient than alternative modes. Reflecting the fact that a substantial element of such convenience relates to trip duration, the concept of travel time has long been recognised as an integral part of transport appraisal. Recent contributions to literature in the field, however, have questioned some of the core assumptions underlying its importance (Metz, 2008; see also, Givoni, 2008; Schwanen, 2008). In our numerical example, we used the stated preference data contained in Oxford Civic Society (2002) to estimate the would-be travel time implications for the original car parkers on Broad Street. As the envisaged *direct* modal shift would result in relatively greater travel time (due to a proportion of the original motorists 'becoming' cyclists, pedestrians and bus passengers), the result, according to NATA, would be a disbenefit to these individuals. Given that it was not possible to disaggregate the survey data to the required degree, it was necessary to estimate the likely geographical origin of respondents based on their stated preference for modal shift in the hypothetical event of the parking being removed. This would allow pre- and post-intervention average travel times to be estimated. Given the three origin categories (52% coming from inside the city; 26% coming from inside the county and 22% coming from outside the county), it was possible to make a logical assumption with regard to modal shift, to the effect that: the reported modal shift from driving to cycling and/or walking would only be applicable to those respondents whose trips originated from within the city; and that the reported modal shift from driving to taking the bus would be applicable to those coming from both the city and the county (but weighted 70:30 toward the former). It was, therefore, assumed that the car trips originating from outside Oxfordshire would not be replaced by any of the alternative modes mentioned in the stated preference survey. Having disaggregated the likely modal split by journey origin, the disbenefit resulting from increased journey time (incurred as a result of changing to a slower mode) was estimated in accordance with guidance provided in WebTAG (3.5.6). Given that the 2002 stated preference survey revealed that the vast majority of car trips to Broad Street were leisure-oriented, this was determined using a standard value of non-working time of £4.46 per person per hour. The total direct disbenefit experienced by the original car parkers in Year 1 of the appraisal period was approximately £30,000.

Towards a Better NATA

So how well does the CBA element of NATA perform and to what extent can the approach be considered a useful and adequate tool with which to improve the quality of decisions related to sustainable transport, and walking and cycling in particular? Before we examine the faults of the current approach, it is important to pay attention to NATA's strengths. Firstly, the NATA framework is relatively transparent and straightforward for practitioners to follow. Indeed, as we shall argue, regardless of the specific criteria included in NATA and the manner in which they are subsequently analysed, the conceptual foundations of the approach appear sound and its purpose clear. The inclusion of certain criteria pertinent to walking and cycling, too—such as physical fitness and journey ambience—is encouraging in its own right and certainly represents a more enlightened approach to transport appraisal in comparison to its predecessors. There are those who argue, however, that the CBA system still implicitly places too great an emphasis on establishing a narrow conception of 'value for money' than one may have originally been led to believe when the NATA framework was launched (see, for example; Elliot, 2008).

In evaluating our hypothetical intervention on Broad Street, assessing the costs was relatively straightforward. However, the public accounts criteria, specifically tax revenue deserves special mention, not least because of the attention it has received elsewhere (see Buchan, 2008; Elliot, 2008). As noted in the previous section, NATA currently treats the tax revenue 'lost' as a result of car-km saved as a cost, which, in turn is included in the monetised cost-benefit analysis. This position is clearly discriminatory against interventions that encourage a shift from motorised to non-motorised modes such as a walking and cycling and thus runs contrary to stated UK government transport policy (e.g. DfT, 2004). Despite strong criticism received in the recent NATA 'refresh' process, the Department for Transport still maintain that, in principle, this position is valid, although in future the place of tax revenue 'lost' will be shifted in the appraisal output (DfT, 2009; LTT, 2009).

In terms of appraising the estimated benefits of the intervention, two sources of variability can be identified. First, estimating a quantitative change in some criterion; and second, the subsequent application of a monetary value to this change. As discussed above, guidance contained in WebTAG (3.14.1) was used to estimate the number of *indirect* new trips resulting from the intervention. This relied on Wardman et al.'s (2007) mode choice logit model which, on closer inspection, is perhaps not so suitable for the Broad Street intervention. Specifically, the given model was originally derived from commuting trips and has an in-built automatic assumption that 40% of potential commuters will never cycle. This is perhaps understandable, but presupposes respondents' choices for an as yet unknown future. Moreover, NATA offers no guidance as to what might constitute relevant geographic boundaries for new interventions beyond those established in existing facilities. Thus, the model may potentially be suitable for estimating the increase in cyclists using an existing cycle path if improvements to the path's surface were made, but if we are putting new cycle parking into the city centre that did not exist previously, then how does one derive a baseline level? In our case, we used all trips into the centre of Oxford, but only as this was the best data available to us at the time. It might be possible to look at the number of people using existing cycle parking in Broad Street, but as the nature of the hypothetical bicycle parking is genuinely different (i.e. free of abandoned bicycles), it might not represent an ideal proxy.

So is NATA to be 'tweaked' or do we need a complete overhaul of the framework? While there are those who might make a strong case for the latter, it seems clear that the saving grace of NATA, and arguably its least controversial element, is the core framework through which it is able to orchestrate and structure decision-making processes. The core of our argument, then, is that the best way to improve NATA is to address the process by which criteria are assigned weights in light of contemporary transport-related problems of sustainability and public health. Leaving aside the (valid) argument as to whether it is ethically possible to trade-off unique and 'priceless' items with the short-term value derived from private consumption, there is the very real problem of weighting of criteria by the 'back door'. So whilst officially criteria are given equal weighting in the appraisal framework, their *values* are different and it is not clear where these have come from and whether—despite the influence they have in the calculations—they are open to the same external scrutiny that the 'front-end' of NATA is. Often, it appears that one will only become aware of the importance that such hidden weights can have once one has delved down into a worked example. **Table 2 and Figure 2**, for example, show the breakdown of the net present value of benefits by sub-criteria. Remember that the greenhouse gas criteria (very slight benefit) and the travel time criteria (moderate disbenefit) were both *direct* impacts of the hypothetical intervention. That is to say that the values for both were derived from the same car-km savings that were estimated to result from the cessation of the parking on Broad Street. Looking at the magnitude of these two variables, however, clearly demonstrates that for the same car-km foregone, the value placed CO_2 reduction is approximately a *tenth* of that attributed to travel time. Perhaps more alarming is that the marginal economic cost (MEC) of carbon adopted by NATA at the time of WebTAG publication, and the value of tax revenue accrued by the Government are, to all intents and purposes, equal; they both have a value of approximately £0.03 per km.

Modified Analysis of Monestised Costs and Benefits (To Year 20; 2010 discounted prices [£])		
Greenhouse Gases	43269	
Journey Ambience	2307322	
Accidents	-3589580	
Physical Fitness	7076554	
Consumer Users	2790294	
Business Users and Providers	9815024	
Travel Time	-439657	
Present Value of Benefits (PVB)	18003227	
Present Value of Costs (PVC)	1255449	
OVERALL IMPACTS		
Net Present Value (NPV)	16747778	*NPV=PVB-PVC*
Benefit to Cost Ratio (BCR)	14.3	*BCR=PVB/PVC*

Table 2 Estimated Costs and Benefits.
Source: Authors' calculations

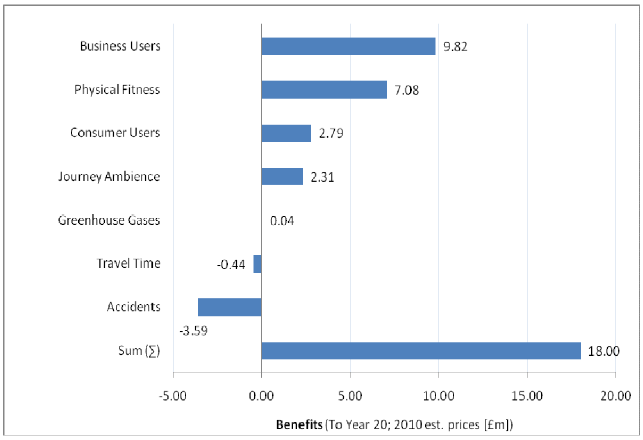

Figure 2 Estimated Breakdown of Benefits.
Source: Authors' calculations

While the issue of assumptions is a source of contention in all such economic analyses, perhaps one of the problems of NATA is that it might be considered a victim of its own success insofar as it makes its assumptions explicit and thus perhaps more prone to criticism than would otherwise be the case. One assumption, however, demonstrates a lack of appreciation as to the nuances and experiences of different modes in urban areas. Clearly, it seems sensible to assume that travelling in an automobile would be preferable than cycling for intercity travel, but NATA shows a relative ignorance to the actual practicalities of walking and cycling in urban areas. For example, it is assumed that if a motorist decides to cycle to Broad Street once the parking is removed, then he or she will experience a disbenefit because their travel time is longer. Leaving aside the valid point that, on average, the speed and versatility of the bicycle makes it an extremely competitive mode in urban areas, we still are left with the assumption that that the individual's subsequent cycling journeys will only be tolerated at best. But what if they find that they enjoy cycling? What about the cost savings that they makes in terms of vehicle maintenance, insurance and parking? Average speed is not the only factor related to values of time and personal benefit/disbenefit. These underlying assumptions are powerful determinants in the appraisal process and sometimes convey a lack of appreciation for lived experience and how people actually function in their daily lives. Despite the extremely high benefit-cost ratio shown in **Table 2**, therefore, the current CBA framework appears of limited use when one wishes to compare the likely benefits and disbenefits of alternative investment proposals. Not least, this results from the fact that there are major difficulties in both accurately predicting changes in travel behaviour and in attempting to compare different benefits on a single monetary scale.

Conclusions

Given the project of sustainable mobility, are the CBA components of NATA suitable for the radical policy interventions we need to see in the coming decades? The principle of appraisal certainly is vital, because although CBA might be used to try and 'objectively' evaluate whether to invest in cycling or driving, if we decide we should have more of the former and less of the latter, then appraisal can help decision-makers establish the likely return on investments from a variety of policy options that *all* attempt to increase cycling. The question then becomes: how can NATA be made to give adequate consideration to sustainable mobility objectives whilst retaining its existing advantages? It is easy to be seduced by the elegant simplicity of cost-benefit ratios. However, although they are appealing for various reasons, it seems crucial to move away from the monetisation imperative towards an evaluation framework based on the principles of multi-criteria analysis (MCA), whereby sub-objectives are presented solely in their appropriate units (e.g. kg of CO_2, minutes of travel time etc..). Politically, such a framework would be far more transparent, shifting the balance of decision-making power in favour of elected representatives and away from crude assessments of 'willingness to pay'. In addition, investment in *ex-post* evaluation of active travel interventions appears crucial if we are to gain a better understanding (and hence more reliable forecasts) of demand-side responses to walking and cycling schemes.

Currently, the automobile represents the best mode of urban transit for many people, but this is only because urban planning has catered to its every need since the middle of the twentieth century, rather than designing cities at the human scale. A vicious circle thus results that, if it is to be broken, requires not just a system of appraisal that is *reactive* to assumptions, but *proactive* in furthering the transition to sustainable mobility. It seems a laudable principle that appraisal frameworks should not be sites of normative political agendas; however, it would be naïve to imagine that the political dimension of appraisal can be altogether removed. Because assumptions present in CBA, such as those relating to 'willingness to pay', are based on rational/utility maximising conceptions of 'homo economicus', we are faced with a fundamental problem; the issues we currently face are much more serious than travel time.

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