ECONOMIC VALUATION OF CYCLING AND WALKING

Economic Valuation of Journey Ambience: Cycling and Walking

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1 Purpose and Scope

Land Transport New Zealand have recently reviewed their walking and cycling economic evaluation procedures and want to extend this to the area of route quality. During this review it was identified that recent work conducted overseas generates values to be placed on 'journey ambience'.

The United Kingdom Department for Transport (UK DfT) guidance has journey ambience as an identified benefit and it needs to be determined whether these advances can be applied to our walking and cycling procedures within the economic evaluation manual for projects in New Zealand. Sustrans UK claims a large portion of benefits in journey ambience.

This report provides a review of the literature on benefit value of travel ambience for cycling and walking, beginning with a summary of reported definitions including those provided by the UK DFT, United States National Cooperative Highway Research Program (NCHRP) and the CBA and the Nordic experience.

The review will challenge the basic methodological basis on which these values are derived and then attempt to overcome the identified limitations to place a value on walking and cycling ambience for New Zealand. This value will be compared to the existing guidelines in Land Transport NZ's Economic evaluation manual – volume 2 (EEM2) with a set of recommendations as to why these might be altered in the light of new evidence or derived calculations currently being applied overseas.

The purpose of this review is to outline the general models and methodologies that have been used to measure 'travel ambience' as this relates to cycling and walking. The review proceeds without much concern for the separation of cycling and walking because the methodologies considered tend to be applied to both modes, considered separately. However, at the outset it worth cautioning that this review identifies that cycling and walking ought not to be considered together and that there many problems in attempts to apply method suitable for the evaluation of cycling on a mode such as walking. The NCHRP (p.44-45), for example, lists four reasons why improvements to cycling facilities have a significantly greater impact (and therefore require quite different multipliers in economic calculations) than walking: 1) There is no real shortage of adequate walking facilities, 2) walking facilities do not create the unique advantages in terms of travel ambience that cycle facilities do, 3) walking trips are short creating a smaller travel-shed, 4) cycling tends to be more influenced by attitudes and facilities.

Notwithstanding differences identified between cycling and walking, our general concern is with travel ambience, and this could be applied to any mode, including motor vehicles. To this end our concern is to establish whether the existing literature is defensible against criticism on method or the derived economic values placed on travel ambience.

1.1 Limits

The purpose of this report is simply to outline the strengths and limitations of attempts to place an economic value on travel ambience for planning purposes; the aggregate benefits or costs of cycling and walking are not considered. Similarly then, cycling and walking have benefits which are not included for consideration here, particularly health benefits. It seems easy to separate health benefits but it bears a separate caution. A stated preference to obtain an evaluation of the

value of 'travel ambience' may well import other benefits. A sample asked to consider whether or not they might walk or cycle given an improved walking or cycling infrastructure will have difficulty just considering the ambience component of the activities.

2 Definitions of Journey Ambience applied to cycling and walking trips

2.1.1 The UK Department for Transport

The UK DFT presents journey ambience as contributing to one of the five sub-objectives in evaluating economic benefits of walking and cycling. These sub-objectives are part of their Appraisal Summary Table and are labelled environment (which includes journey ambience), safety, economy, accessibility and integration (pp. 2-3). For cycling, all aspects of ambience are included; environmental quality, comfort and convenience, and perceived improvements to safety (Department for Transport, 2007).

The UK DFT definition of travel ambience appears at first sight to be well-formed. Travel Ambience is defined by the UK DFT Transport Analysis Guideline (TAG) unit as three components, including:

"Traveller care: the quality and cleanliness of facilities and information provided"
"Traveller's views: the extent to which travellers can see the surrounding landscape and townscape"
"Traveller stress: frustration fear of potential accidents and route uncertainty"

The definition of travel ambience is intended to be exhaustive without being restrictive because the concept is conceptually sophisticated and therefore difficult to contain without any overlap into related areas. For example, the authors clearly distinguish traveller stress as a perception which acts as an impediment to the uptake of walking and cycling modes. It is not the 'accurate objective risk' of an accident on a route, so therefore improvements to the safety of a route will not affect the 'traveller stress' component of travel ambience unless these improvements also act on improving the perception of risk. Implicit in the definition is the view that these perceptions of improved safety must also translate into increased likelihood of actual uptake of the mode. Equivalently, the removal of a negative perception concerning traveller stress increases the mode choice. Calculating the relationship between perceptions and uptake is notoriously difficult because people are well know to over-estimate risk or fail to change behaviour despite changes to perceptions or attitudes. The NCHRP, for example, usefully caution that the …"number of people who say they would consider commuting by bike exceeds by a factor of 20 the number who actually do". (sic p.23).

Similar outcomes are required for both traveller care and traveller views—each links implicitly to improved rates of the uptake of the mode. The use of the word 'quality' in the definitional component of traveller care should be interpreted with caution. Unpacking the word 'quality' soon requires choices to be made which might conflict or overlap with other areas of benefit/costs concerns relating to a proposed intervention, upgrade or whatever. For example, the route quality might easily be conceptualised as including 'directness', which for walkers is fundamental because walkers tend to experience frustration when they are required to walk a longer route than is potentially available. Care needs to be taken to ensure the word 'quality' is not interpreted as being broader than the functional requirements of the definition.

2.1.2 NCHRP Guidelines

The NCHRP guidelines do not use the specific term 'journey ambience', however they do include benefit values for a number of related concepts including mobility and community liveability, as well as a discussion of safety (although no values are given). Mobility benefits included the values placed on improved cycle facilities, such as cycle lanes with no parking (NCHRP, 2006). The NCHRP Report does value travel ambience but it recognises certain limitations. First, the NCHRP recognise that the factors influencing cycling are 'highly subjective' and very different to those affecting car uses, including 'perceived safety and pleasantness of the riding environment'. Second, they suggest that requiring a detailed evaluation of the bicycling environment is too complex, and too labour intensive, to be justified against the complexity of valuing these details in an unambiguous way which can be easily applied. Rather, recognising the difficulty of valuing travel ambience the NCHRP suggest combining recreational and health benefits, recognising the overlap between valuing ambience for recreational benefits and health benefits.

2.1.3 CBA and Nordic Experiences

Again, the CBA report does not use the term 'journey ambience', although related concepts are explored. While only one study in this report estimated a value of comfort and security, all those involved suggest they are important components within evaluations of cycling benefits and are appropriately estimated from stated and revealed preference methods (Norden, 2005).

The common component to the elements of the definition are that they define influences on a travel mode (here restricted to cycling and walking) that if improved are thought to induce a concomitant increase in the mode choice. The difficulty with these approaches occurs when attempts are made to measure the separate components in the causal chain that lead from improvement, to perception, to actual uptake. When attempting to measure these components, or worse, develop an economic evaluation of the benefit associated with targeted improvements ahead of actual behavioural change, one has to determine the actual quantum of behaviour change that occurs through this very complicated chain against the background of many other factors that occur with an improved infrastructure, or the other benefits associated with an uptake of walking or cycling.

2.2 Accepted limitations and Cautionary Notes

THE UK DFT recognise something of a cautionary approach with a method they adopt for assessing value for new users, compared to existing users. The so-called 'rule of thumb' is to halve the value applied to new users. This at least recognises the difficulty of ascribing value to new improvements against the difficulty an error necessarily involved in estimating values in the causal chain from changes to perceptions through to changes in behaviour.

Despite placing values on travel ambience the UK DFT also advise the estimate would be best used for sensitivity analysis rather than determining a value for planning particular schemes.

While there has been a range of research conducted in this area, the authors of most studies and guideline publications raise a number of limitations. The monetary values outlined below are in most cases only approximate and there is significant uncertainty around the use of the techniques and valuations suggested (Department for Transport, 2007). There is also a general lack of data and robust methods, particularly in estimating demand for facilities (NCHRP, 2006). In particular, it is acknowledged that there is relatively little research specifically on walking, which the UK DfT

suggest is important as walkers do not regard their journey in a similar way to users of other transport modes (Department for Transport, 2007).

In the majority of the studies reviewed, the costs of facilities are estimated high and the benefits low to reduce the chance of overvaluing (Norden, 2005). There are also a range of other factors that are not often included in evaluations (e.g. consequences for public transport, work absenteeism) that are hard to quantify and are therefore not included in analyses but are considered important in valuing facilities (Norden, 2005).

2.3 Logic for placing a value on walking and cycling journey ambience

The fact that people invest into walking and cycling is obvious from a limited set of observations. People will drive sometimes considerable distances to walk in pleasant environments, such as walking along the foreshore, or perhaps a recreational area such as a forest park. The value these environments have to people can be measured in applied economics using Contingent Valuation techniques, though they have not been in New Zealand and are necessarily context specific to the contingency used for gaining the perceived valued. People reveal their preferences by purchasing bicycles and using them for leisure, with associated health benefit outcomes. The NCHRP offer an example of comparing house prices in high quality cycling environments with those not serviced by cycling facilities.

Despite these revealed preferences, the NCHRP offers the idea that people's time undertaking the tasks of walking and cycling is the best indicator of the basic underlying value of the activities. By associating a value to 'time' one can then develop an associated value based on the amount of time people spend on these activities.

Litman (2007) has outlined travel time values associated with improvements to transit facilities. The United States Department of Transport (USDOT) provides recommended values for travel times. The NCHRP value cycling as a recreational activity is as follows:

> The typical day involves about 1 hr of total bicycling which is valued at $10 (D), based on a variety of studies of outdoor recreational activities (appendix G). From the National Household Travel Survey and Twin Cities Travel Behaviour Inventory, the average adult cycling day includes about 40 mins of cycling. This is the amount used, plus some preparation and cleanup time. Multiplying this by the number of new cyclists minus the number of new commuters (the value of the facility to new commuters is counted in the mobility benefit). Annual recreational benefit = D*365.

The mobility benefits referred to relate to a stated preference survey that determines the relative value of a cycle-lane over not having this facility. These techniques generate values of time and then estimate the proportion of cycling that occurs as a function of this time cost (i.e the 40 mins).

It is clear that 'travel ambience' has an economic value, and that it can be determined using various methods. However, the problems that occur are considerable when attempting to isolate travel ambience from other benefits and when considering both the range of activities that comprise cycling and walking, and the range of environments in which these activities occur.

3 Measures used in research to determine Journey Ambience

The current EEM2 suggests that most studies use stated preference or revealed preference methods to value the social and economic benefits of walking and cycling (p8-3). They include the benefits to congestion reduction, accident reduction, health, user cost savings and community liveability. Stated preference methods involve giving cyclists or pedestrians route choice and in most cases, evaluating how much they are willing to spend in terms of time or money to use the more ambient route. Revealed preference methods in comparison are based on observed cyclist or pedestrian behaviour. In most cases, stated preference methods are useful in examining not only current, but prospective cyclists or walkers.

The current values used for walking benefits are set at NZ50c per person per km for new pedestrians using new facilities (based on health, safety and environmental benefits) (p.8-4). Promotional projects that generate new trips to work or education are 50c per new regular pedestrian (only on 250 workdays per year).

Cycle lanes, cycle ways and increased shoulder widths are valued at 30c per cyclist per km for all cyclists using the facility (includes health, safety and environment benefits). If the new facility eliminates or improves a site that is an impediment to safe cycling it is valued at 90c for all cyclists using the facility. Promotional projects that generate new trips to work or education are 90c per new regular commuter cyclist (only on 250 workdays per year). If a project combines benefits for walking and cycling, it can claim benefits for both modes as long as safety issues arising from pedestrian/cycling conflicts are addressed. These values are based on information from the Ministry of Transport, Land Transport Safety Authority and Transport Research Board reports (the latter presented later in this report as the NCHRP project).

In the UK DfT's Appraisal Summary Table, journey ambience was assessed qualitatively making it hard to emphasise its importance, however, the modified version of the Monetised Cost and Benefits Table includes an economic value (p7). Journey ambience is defined as aspects of traveller care, travellers' views and traveller stress (p4). Values are as follows (Table 4, p16-17).

Facility	Benefit value	Source
Off-road segregated cycleway	4.73p/min	(Hopkinson & Wardman, 1996)
On-road segregated cycleway	2.01p/min	(Hopkinson & Wardman, 1996)
Wider lane	1.22p/min	(Hopkinson & Wardman, 1996)
Shared bus lane	0.52p/min	(Hopkinson & Wardman, 1996)
On-road non-segregated cycleway	2p/min	(Wardman et al., 1997)
Secure cycle parking facilities	66p	(Wardman et al., 2005?).(sic)
Changing and shower facilities	14p	(Wardman et al., 2005?).(sic)

In addition, a total benefit of journey ambience can be determined by summing the value for existing cyclists (estimate of the total time existing cyclists make use of the new facilities multiplied by the value of benefits of the facility for existing cyclists) and the value for new cyclists (estimate of the total time new cyclists will use the facility multiplied by the value of the facility for

new cyclists, halved). The value of a facility to new users is subjected to the "rule of a half", while current users experience the full benefits of ambience improvements.

For walking (Table 5, p17) all the values below are based on Heuman (2005) as there was very little work available.

Facility	**Benefit value**
Street lighting	34p/km
Crowding	17p/km
Kerb level	24p/km
Information panels	8p/km
Pavement evenness	8p/km
Directional signage	5p/km
Benches	5p/km

Sustrans (2006a) applied the guidelines set out in the Department for Transport report in evaluating three cycle routes. This evaluation of journey ambience is based on the method employed by Hopkinson and Wardman (1996) which assigned a value to each individual trip carried by an intervention, known as the security-insecurity value, in this case £0.91 per trip. In this application, it is suggested that journey ambience and physical fitness are the most important benefit areas (Sustrans, 2006a)

The NCHRP report (US) suggests that bicycle facilities can be labelled as 'public goods', so to estimate the value of non-market goods, revealed and stated preferences are used (p28). Benefits can be both direct to the user and indirect for society, and included in values given by the authors are the benefits of mobility (greater satisfaction by making the trip faster, safer, or via more attractive means), health, safety, reduced auto use, liveability and fiscal (p30-).

Mobility benefit was measured by examining the amount of extra time cyclists would be willing to take on their journey in exchange for a more pleasant route (p39). Cyclists were found to be willing to spend an extra 20.38 minutes (M) per trip for an off-street trail, 18.02 minutes for an on-street lane without parking and 15.83 minutes for a lane with parking. These values were determined by giving 2 options of route (one faster, one longer but more attractive) and determining by algorithm the point at which the route that takes longer is the one chosen (pD-2). If hours (V) are valued at US$12 an hour, then per trip benefit is $4.08, $3.60 and $3.17 respectively, with an annual benefit of M - V/60 (existing commuters + new commuters) x 540 x 5 x 2.

Other benefits valued in this paper determined through extensive literature reviews include recreation benefit ($10 for a typical riding day of 1 hour with annual recreation benefit of $10 x 365 x (new cyclists-new commuters)), health benefits (total new cyclists x $128, value based on median of Appendix B studies) and reduced private vehicle use (new commuters x L x S x 50 x 5, L = average round trip length based on travel survey, S = savings per mile: 13c in urban, 8c in suburban and 1c in small towns and rural).

The CBA of Cycling (Norden, 2005) combined a number of studies that provided values of cycling benefits in Norway (Saelensminde, 2004), Sweden (Lind, Hyden & Persson), Finland (Metsaranta, Tervonen) and Denmark (Krag et al.). Most of these studies focus on benefits such as health and emission reduction, however there are some values of comfort and reduced insecurity that could be considered part of journey ambience.

Benefits of comfort provided included that of SEK 0-20 per trip or SEK 0-5 per cycle km (Lind et al) and €0.06 per cycle km (Krag et al.) (p47), with an average of €0-0.3 per cycle km (p77). Benefits for reduced insecurity were valued at NOK 2 per cycle km (Saelensminde) and were included within the comfort benefit by Lind et al. (p47) with an average of €0.2 per cycle km.

Members of the group agree that comfort and security, public health benefits, reduction of external costs, consequences for public transport, costs of cycling, effects on the transport of school children, accidents for cyclists and other road users and travel time are all important to include in a cycling cost benefit analysis. Other possible considerations include comfort changes in public transport, air pollution, climate gases, land use impediments, urban quality, aesthetics, visual intrusion and encroachment.

Additional values are presented in each of the papers from group members that may be relevant. Saelensminde suggests total benefits of NOK153.7, 309.1 and 3023.3 across 3 cities in Norway with a net benefit/cost ratio of 4.09, 14.34 and 2.94, taking in to account traffic accidents, travel time, insecurity, school bus transport, health, external and parking costs (p19). In Sweden, Lind et al. suggest 2600SEK/year (€290) for health improvements per new cyclist, 90SEK/year (€10) for the value of time for cycling in mixed traffic and 1.20SEK per km and cyclist (€0.13) for comfort improvement of a cycle track. Finnish guidelines (Saari, Metsaranta & Tervonen) argue if the share of walking and cycling increased from 37% to 40%, the net benefit-cost ratio would be 2.9M€ and if it increased from 37% to 44.5% it would be 7.7M€. This again did not specifically take in to account ambience but included account investment, health benefits, reduction of emissions, reduction of congestion, maintenance and reduction of wear and tear.

A small number of other researchers have attempted to assign monetary values to the benefits of walking and cycling. In their study of walking, Heuman, Buchanan, Wedderburn and Sheldon (2005) surveyed willingness to pay (WTP) for improvements to walkways with most expenditure to improve the quality of the walking experience. Across a range of different improvements, they found a total willingness to pay of approximately £119. Buchanan and Heuman (2004) conducted three case studies and compared values with those used in railway upgrades to determine a range for improvements to the Strategic Walk Network. These include signage/walkway marking and links £26080 (NPV), onsite information £52599, offsite information £13952, improvements to the walked surface £168612, improved safety and security £68072 and resting places £13641.

In cycling research, the Minnesota Department of Transportation includes some economic benefits of cycling based on literature reviews. They include user non-monetary benefits of $240 million, reduced medical costs of $24 million, productivity gains of $8-24 million, economic impacts of $30 million (payroll of approximately 900 jobs) and minor benefits (e.g. lower transport costs for cyclists) of approximately $3 million.

4 Methodological issues in measuring the value of journey ambience

4.1 Latent demand due to negative ambience

Inherent in the definitions of travel ambience so far presented is a recognition that people can, and do, cycle on poor quality or poorly provisioned roadways, and people can and do walk on footpaths and tracks. The problem is getting more people to uptake the activities and the idea is that improving the context will somehow facilitate this. We can call this 'latent demand caused by negative ambience'.

There are two ways to proceed recognising a hypothetical demand for increased travel that is suppressed by perceptions in the wider population. The first is to measure the latent demand that is contingently realised if the improvements are made. The second method is to assume a latent demand and to measure the benefits associated with the realisation of the improvement. This seems like a very subtle difference since both techniques result in a value associated with 'travel ambience'. However, the first method measures demand for a travel mode, the second measures the perceived value of the benefit and calculates increased demand for travel based on the size of the impediment perceived by the potential users.

The NCHRP usefully review the literature related to one aspect of travel ambience concerning cyclists. This concerns the value of the perceived safety of cyclists of what they recognise under the collective definition of a cycle Level of service. Level of service has had much attention but the NCHRP accept that "The degree to which perception of safety translates into actual increased safety, however, is still debated. It is difficult to translate perceived measures of safety into quantifiable or economic estimates". (p.35). However, the NCHRP fail to recognise that the relationship between perceived and actual safety is not the issue; it is the relationship between perceived safety and suppressed latent demand which is meaningful to any economic analysis.

4.2 Variability and context sensitivity due to lack of replicability

All stated preference surveys are subject to the characteristics of the contingencies that are evaluated, and few studies, with the noted example of Hopkinson and Wardman (1996) attempt to obtain an understanding of the basic characteristics that comprise the contingencies. As a consequence, case study analyses, and those that focus on particular project outcomes are unlikely to be replicated and further conflate all the benefits of walking or cycling within the general design.

There are local variations in walking and cycling rates, particularly influenced by geography, and these make calculations of 'latent' demand subject to significant variation. Cycling rates in Christchurch, for example, are significantly greater than in other areas, and thus the latent demand realised through facilities improvements will have a greater benefit compared to other areas.

There is some merit to the idea that local studies of each potential facility upgrade are an improvement to introducing overseas research. Studies conducted overseas provide estimates of the value of such things as travel ambience with error, that when calculated across the cost of a particular project, could exceed the cost of small scale studies designed to measure the latent demand and contingent valuation against viable alternatives.

4.3 Focus on recreational cycling and walking

Several studies examine the value of recreational activities and relate these to the value of improving walking and cycling rates. However, while some of the literature specifically relates to

recreational users of walking or cycling facilities (e.g. Siderelis & Moore, 1995; Fix & Loomis, 1997) and most studies do make some effort in their research to determine the purpose of the journey, there are few that particularly separate users into recreational or commuter. For example, in their evaluation of the Strategic Walk Network in London, Buchanan and Heuman (2004) suggest that the walkways may be used for a variety of purposes and differentiate between striders (who mainly focus on time savings e.g. commuters) and strollers (who are more interested in route quality and recreation). However, they do not separate these groups in their evaluation. Heuman, Buchanan, Wedderburn and Sheldon (2005) further separate users into pleasure users, shopping users, leisure users, commuters and non-users, but again these divisions have no direct effect on the values determined. Even research that appears to focus only on commuters (e.g. Saelensminde, 2004) does not always specifically define whether they have included recreational users also.

Krizek (2006) suggests that one of the most important reasons for separating journeys with different purposes is that in most cases, recreational trips are not replacing trips by other transport modes. In the evaluation of common cycling and walking benefits such as environmental effects or reduced congestion for example, the benefits of these modes may be overestimated. As a large amount of the current research on cycling and walking benefits either focuses on recreational trips, or is unclear as to what it includes, this is an area for caution.

4.4 Lack of differentiation between walking and cycling, and between different types of walking

The report by the NCHRP (2006) presents a number of issues with the combination of walking and cycling within the same valuations. For example, facilities specifically for pedestrians are often unsuitable for cyclists, however cycling facilities are often utilised by pedestrians and other road users. These authors also suggest that the focus for walking evaluation should be on current walkers, as there are more of these compared to cyclists and therefore less room for an increase due to facility improvements. Studies that do separate walking from cycling in calculating benefits are however unlikely to differentiate between different types of pedestrian behaviour, for example running and skating.

4.5 Cross-over into perceived safety and safety ambiguity

Perceived safety is an ambiguous concept when restricting understanding to travel ambience. Krizek (2006) acknowledges that the 'benefit' of a cycle facility when related to safety is 'poorly understood and highly controversial' (p.12). He reviews the literature well concluding, "It proves difficult to translate perceived measures of safety into quantifiable or economic estimates". The review provided acknowledges that the original research advocating different estimates of relative safety was conducted on mid-block roadway segments (eg. Landis 2003) and only recently have researchers evaluated the perceptions of cyclists concerning intersections. Krizek goes on to conclude, "while there is considerable literature suggesting perceived greater safety with facilities—and advocates certainly argue for such---the bottom line is that there is little conclusive evidence to suggest such" (p.13). While there are methods to understand the perceived characteristics of facilities (regardless of whether they are accurate in practice) there is little literature on whether these perceptions influence *actual* cycling behaviour, either in increasing use of routes perceived safe, or suppressing use of routes perceived unsafe.

The situation is worse when considering walking. The USDOT (1994) review of walking found perceptions of safety were ranked highest (18%) among participants' concerns when they are

asked to provide examples of what could be done to improve their likelihood of walking, but only 3.3% claim safety as an impediment to walking their activity.

4.6 Influence of advocates

Much of the research into cycling and walking facilities is conducted by groups with an interest in, or who are particularly supportive of these modes of transport. An example is Sustrans UK (cited above), a charitable organisation in the UK that supports and develops the National Cycle Network (Sustrans, 2006b). Such groups are often involved in the development of guidelines, as was Sustrans UK along with other organisations in providing guidance to the UKDfT in 2005 (Sustrans, 2006a). In this case, this group conducted appraisals of programmes they themselves had carried out, with positive results (Sustrans, 2006a).

5 UK DfT paper history and application to a New Zealand context

The key document referred to by the UK DfT is Hopkinson and Wardman (1996). The current review needs to develop a clear and independent assessment of the merits of the Hopkinson and Wardman paper to evaluate whether or not it is accurately used by the UK DfT who might ordinarily and reasonably rely on the conclusions of a published peer-reviewed paper for uptake into their analysis.

5.1 Hopkinson and Wardman (1996)

The Hopkinson and Wardman paper purports to offer a stated preference for the value of cycling and walking considering four alternative routes and their attributes. The emphasis is on the valuation of improved facilities within a route choice context. This allows for five factors to be considered: A wider nearside road lane (increased from 11 to 13 feet), a segregated path, a combined cycle/bus lane, a special cycleway and journey time.

Hopkinson and Wardman (1996) use what appears to be a complete sample frame: all households within 1 km of the cycleway. However, the survey is only completed by those who 'currently cycle or who expressed some interest in cycling'. This undermines the key criterion of measuring 'travel ambience' when considering what has been described above as a measure of latent demand by negative ambience—latent demand is represented by those who currently do not express an interest in cycling or do not own a cycle but would if circumstances changed (such as by the provision of an improved infrastructure).

Of the 6286 households, 1117 surveys were delivered. Hopkinson and Wardman claim a base rate of cyclists being about 14% of people. This defies sense when cycling represents about 1-2% of travel from travel surveys in New Zealand and elsewhere. The sample collected is further cast into suspicion when it is revealed that 253 (50%) of the returned surveys were from cyclists who, despite having access to a vehicle, made cycle trips in the week prior to the survey. If one takes into account the 7900 people with whom contact was made, and the 253 cyclists who returned

surveys, the sample frame appears to represent about 3% of cyclists, and 3% who express some interest in cycling, a clear difference from the 14% base rate claimed.

Hopkinson and Wardman list response rates to various concerns that potentially suppress cycling including, safe networks, reductions in traffic speeds, secure parking for cycles, shower facilities and so on. Again, it defies practical common sense that 22% of people would cycle more because 'a roving cycle repair service' was made available. The outcome simply indicates that the survey required features that would be known to have no impact on cycling rates to be included as a comparison to the key indicators used in the analysis. The consequence of asking a group with a predilection to cycling whether a 'network of safe and convenient cycle routes' would increase their cycling is that 91% suggest it would. However, the methodology is far from convincing, and the claim 'there is a significant amount of suppressed demand for cycling' is not supported by the data collected. What remains is a set of conclusions drawn on the relative merits of various improvements, so despite the lack of a representative sample, it seems reasonable to infer that, for example, 'a safe and convenient route' is valued more than 'companions on rides'.

It is notable that the Hopkinson and Wardman study omits the questionnaire form, or indeed any mention of the question format on which they base the stated preference estimates of route choice. It is a serious omission, made worse because the differences they detect in their model of choice are insignificant. It might be inferred from the form of the report that the stated preference is of the form 'how much would you pay for the construction of x cycle lane?' Contingent valuation techniques using stated preference outcomes are notoriously difficult to construct without introducing bias. Particularly relevant here would be the embedding effect that needs to account for whether cyclists state a value recognising the size of the contribution that would be made by others. Because the 'latent' demand is unknown (or exaggerated by Hopkinson and Wardman) the true value attached to each choice is likely to be inaccurately represented by the participants, or overstated by the authors to the report. The form of the apparent survey items departs from international best practice as defined by the NOAA panel (Arrow, Solow, Portney, Learner & Schuman, 1993).

Hopkinson and Wardman neglect to mention in their discussion the preference reversals that appear in their data, these being the first sign that something is seriously wrong with the construction of the SP survey design. A nearside lane a cyclist would travel on for 25 minutes was valued lower (by nearly 50%) than the same design that the cyclist would use for a shorter time (10 minutes). The same data show that cyclists value higher a bus lane cycled on for 20 minutes compared to either 15 or 10 minutes. The contradiction is unacceptable particularly when the authors then compare the two figures to estimate a value for cycling time (at .79 pence per minute).

Hopkinson and Wardman concede it is a difficult task to obtain coefficients for the estimation of a stated choice and recommend an approach that develops a generalised cost, a composite of all attributes affecting cycling choice, to be used in cost/benefit calculations.

5.2 The UK Department for Transport (UK DfT) (2007)

The UK Department for Transport (UK DfT) present Hopkinson and Wardman as reference to travel ambience and place values on these (Table 4 p.16). These estimates are at first incomprehensible—there is no mention of how they are calculated as they are not reported this way in the Hopkinson and Wardman study. It is also noted that the reference to Wardman et al 2005 is not provided and the reference to Heuman (2005) cannot be located.

Backward calculation shows the dependence on the Hopkinson and Wardman study. An off-road aggregated cycleway, for example, is valued at 4.73p/min with reference to Hopkinson and Wardman (1996). This figure (notwithstanding Hopkinson and Wardman is now more than 10 years old) is simply the 71 pence approximated by Hopkinson and Wardman divided by the average length of time the cycleway is travelled (15 minutes). The logic is straightforward. A hypothetical cycleway has an estimated value given by a sample of those who 'currently cycle or who expressed some interest in cycling' based on what they would pay for the introduction of the hypothetical cycleway. This is poor scholarship on the part of the UK DfT. Hopkinson and Wardman go on in the paragraph from which that figure is extracted to state:

> Whilst it could be claimed that respondents had an incentive to strategically exaggerate their willingness to pay a toll to increase the chance that a cycleway is introduced, there is a counter incentive to understate the willingness to pay a toll in an attempt to reduce the likely charge in the event of a cycleway being constructed. (p. 245)

Here at least we gain some idea of the form of the questionnaire (i.e. that it concerns a hypothetical toll to use the facility), but it would not save Hopkinson and Wardman from criticism for the method they have adopted. They have clearly departed from a recognised set of methods for getting accurate willingness to pay (WTP) estimates which they might do without criticism in an academic context —notwithstanding the criticism that appears above concerning a clear preference reversal. However, Hopkinson and Wardman attempt to compare the relative contribution of various attributes of cycle facilities and their concern to cyclists and so accurate WTP estimates are less important than the relative variation in value associated with the features of the hypothetical scenarios. Indeed, to illustrate the point concerning contingent valuation method, how often would the cyclists actually be prepared to pay the hypothetical toll: everyday, every now and then or never? Without such a detail and much more in-depth comparison of the WTP estimates their use beyond the study is very, very limited.

Using the estimates in the way the UK DfT has done is quite a step up from the intended outcome of Hopkinson and Wardman. The wholesale adoption of the values (even without some adjustment to 2007 figures) makes little sense at all.

An important point omitted in the UK DfT report is that cycle facilities less than 10km failed to gain significance in the Hopkinson and Wardman model. There is an important distance threshold that should be taken into account which is neglected in the calculations provided for in the UK DfT report.

The other material that is relied on significantly by the UK DfT is a report by Heuman (2005). The material we could locate suffers similarly to that of Hopkinson and Wardman (1996) except it is not peer-reviewed, presents insufficient detail to be relied on and makes claims based on results which are not linked to a clear methodology. The work is not possible to review completely because even limited information about the sample is omitted.

6 Conclusions

1. There is no defensible reason to use the estimates of the value of 'travel ambience' provided by the UK DFT for planning new cycle facilities. The estimates are dated by the material from which they are drawn, poorly considered and capricious.

2. Similarly, there is insufficient justification to have confidence in the values associated with walking facilities that are presented by the UK DfT.

3. The claim in the UK DfT report that non-cyclists value cycle facilities more highly than existing cyclists in unfounded; it relies on the fallacy of the base-rate which has not been taken into consideration.

4. Cycle facilities less than 10km should be excluded from consideration as evidence suggests they are qualitatively different from facilities of greater distance.

5. When considering walking research care should be taken to avoid conflating different types of walking with the facilities upgrades. Walking for recreation has considerably different influences on its uptake compared with active modes such as walking to public transport, or walking to work.

6. In general there is insufficient supporting research to measure latent demand for negative ambience, and what work is conducted is poor quality and incapable of supporting economic valuations

7. The best method given the literature currently available for measuring travel ambience is a one-off case study analysis attached to a planned upgrade that measures both the value of the upgrade in a representative group of people who might use it and measures the latent demand that would be realised upon the contingency of the facility being built.

6.1 Recommendations for adjustments to the EEM for travel ambience values

Walking and cycling have gained greater attention because of concerns for an ongoing sustainable form of travel. Advocacy groups and environmentalists place much attention on the provision of facilities for cyclists and Government policy is clearly directed to supporting the modes as an alternative to motor vehicle use (Allan Kennaird Consulting, 2007). To meet these ends it seems reasonable to recognise that 'travel ambience' has a value as it is defined and to shift these values upwards to reflect a changing political and social context. However, to make such an adjustment based on evidence or data that estimates the real cost of travel ambience is premature. There is no quality to the evidence that would support any estimate provided.

Any adjustment would be based on a policy concern to promote the infrastructure to support the modes. It is beyond our brief to estimate what level of adjustment is reasonable but the logic of the decision is straightforward. Given a current value of travel ambience estimate how much more resource is being directed to the modes based on an estimate of the policy shift? The relative increase apportioned to cycling and walking over and above any normal increase can be apportioned to the estimates of the value of travel ambience that operate currently.

6.2 Suggestions for further research

1. Base rates for cycling need to be determined accurately by travel survey diaries or specific investigations.

2. Cycling and walking distance thresholds need to be determined accurately in a New Zealand context. It seems clear that there is a minimum threshold for cycling which is not determined by research here or elsewhere.

3. Cycling speeds should also be carefully understood if 'time values' are to be used in estimates of benefits associated with planning purposes. It is almost never stated how fast a representative group of cyclists travel across cycle facilities which are valued on a per minute basis. Walking speeds have recently been estimated (Finnis & Walton, 2008)

4. Safety of the network should be contrasted with perceptions of (or concerns for) safety which are generally separately evaluated in research. It is not clear in research whether concerns for one's safety relate to personal security or to risk of an accident. Because each requires quite different types of support to reduce the associated risk to both walking and cycling separate research to determine the relative levels of concern could be commissioned.

5. The true value of travel ambience can be secured by estimating the WTP for infrastructure improvements that will lead to an increase in the use of that infrastructure. Calibration of a stated preference survey can be achieved by estimating the before and after rates of uptake of actual facilities upgrades (especially in combination with a WTP survey before

and a post-hoc follow-up survey to determine what features of improvement lead to the perceived benefit). A revealed preference survey can be undertaken for certain types of infrastructure improvement but are prone to include error as the fundamental reasons people choose or prefer walking or cycling routes are not clearly understood in basic research.

6. To calculate the benefit attributable to a policy shift (see section 6.1) requires a comparison of public expenditure (both local and Central Government) for the time of the current estimates in the economic evaluations manual and current. This estimate could be improved by including any analysis of private investment in the activities of cycling and walking (which could derive from such things as the NZ household travel survey which specially addresses cycling activity over the previous year). The relative change can be used to adjust the current estimates. This approach has the disadvantage that an error in the existing estimates will be retained.

7 Annotated Bibliography

Allan Kennaird Consulting (2007). Review of evaluation procedures for walking and cycling (draft). Report to Land Transport NZ.
Provides summary of the key findings of the key highlighted documents including values given. Evaluated the EEM and advises route/facility quality is important and should be included, and that health benefits should be valued higher

Antonakos, C. L. (1994). Environmental and travel preferences of cyclists*. Transportation Research Record No. 1438*, 25-33.
Surveyed cyclists' opinions of environment designs and preferences at bike tours for different types of facilities and environmental factors e.g. traffic volumes and surface quality. Most of these factors are more important to women than men. Age and experience also affect the level of preference for safer and more separated routes. Theorises factors that influence environmental preferences. Recreational route choice affected by traffic, surface quality and scenery with commuters choosing safe, quick and direct routes with smooth pavements. Bicycle lanes rated highest improvement overall.

Arrow, K., Solow, R., Portney, P.R., Learner, E., & Schuman, H. (1993). Report of the NOAA panel on contingent valuation. *Federal Register*, 58, 4602-4614. This report outlines a review and recommendations on how to conduct stated preference willingness to pay surveys without introducing bias. The report is regarded as defining international best practice on Contingent Valuation Methodology.

Aultman-Hall, L., Hall, F. L., & Baetz, B. B. (1997). Analysis of bicycle commuter routes using geographic information systems: Implications for bicycle planning. *Transportation Research Record No. 1578,* 102-110.
Examining routes taken by commuter cyclists – see if take the shortest route and if not, what they are avoiding. Most commuters don't avoid vehicle traffic routes, although some do so – suggested vehicle-free routes more for recreation. Quality of these routes also affects use.

Buchanan, P., & Heuman, D. (2004). Measuring the benefits of pedestrian improvements. Paper presented to Walk 21-V Cities for People. The Fifth International Conference on Walking in the 21st Century, June 9-11 2001. Copenhagen, Denmark.
Argue more money put in to other transport modes as there are ways to evaluate their economic impacts established – need an "agreed, quantitative evaluation" of walking benefits. Outlines the improvement of the strategic walk network in London and the benefits of these. Qualitatively assessed a range of benefits, quantitatively determined benefits to safety, health, quality and security. Quality benefits include experience of walking and was only examined for recreational "strollers". Applied what had been used with other transport forms to walking. Safety based on number of accidents – vary in value from £300-3000 per 'spot' improvement. Health benefit-cost ratio of up to 4. Quality based on the levels used for railway improvements but with some adjustment. Tables of values and cost-benefits included.

Bureau of Transportation Statistics (2002). National survey of pedestrian & bicyclist attitudes and behaviours: Highlights report.
Survey of scope and magnitude of bicycle and pedestrian activity and public behaviour and attitudes to cycling and walking including frequency, trip info, reasons for not, safety perception and practices, facilities, community design, safe routes. Focus on the data reported in the survey, not particularly evaluation, although good source of raw data and some info on attitudes to environmental design/facilities.

Department for Transport (2007). Guidance on the appraisal of walking and cycling schemes. Tag Unit 3.14.1
(UK Department for Transport) Guide for the analysis of walking and cycling schemes, particularly for improving route conditions. Key for monetising benefits of walking/cycling schemes, although point out the uncertainty of these measures. 1.9 specific method given for evaluating journey ambience impacts of new cycling/walking facilities. Also provides case studies for comparison.

Ewing, R., Handy, S., Brownson, R. C., Clemente, O., & Winston, E. (2006). Identifying and measuring urban design qualities related to walkability. *Journal of Physical Activity and Health, 3*(Supplement 1), S223-S240.
Focus on urban design characteristics as related to walking – quantifying qualitative urban designs. Created measure for evaluating how urban design (including variables that relate to journey ambience) affects perceptions of streetscapes and willingness to walk.

Fix, P., & Loomis, J. (1997). The economic benefits of mountain biking at one of its Meccas: an application of the travel cost method to mountain biking in Moab, Utah. *Journal of Leisure Research, 29*(3), 342-352.
Travel cost model for estimating economic benefits (consumer surplus) of mountain bike trails in Utah. Estimated per-trip value of $197-205 (per day $53.08-55.27 and annual $8422800-8770300). Suggest riders therefore receive substantial per-trip benefit.

Heuman, D., Buchanan, P., Wedderburn, M., & Sheldon, R. (2005). Valuing walking: Evaluating improvements to the public realm
Quantitative assessment of health, safety, environment and quality benefits that pedestrians accrue evaluated – focus here on quality benefits. Surveyed values placed on various improvements to the walkways. Majority of expenditure on walking to improve the quality of the walking experience. Used stated preference/willingness to pay and divided based on type of walker. Break down evaluations into different types of improvements – total willingness to pay

approx £119. Applied methodology to a series of proposals suggesting expenditure will offer good returns.

Hopkinson, P. & Wardman, M. (1996). Evaluating the demand for new cycle facilities. *Transport Policy, 3*(4), 241-249.
Costs and benefits of new cycle facilities. Used survey to gain estimate value of different attributes of four potential cycle routes. Found safety (reductions in risk) more valued than time and some schemes can be justified economically on benefits to current cyclists. Willingness of cyclists to pay more for a risk-free route compared to a time saving one.

Krizek, K. J. (2006) Estimating the Economic Benefits of Bicycling and BicycleFacilities: An Interpretive Review and Proposed Methods. In *Essays on Transportation Economics*, P. Coto-Millan & V. Inglada (Eds.), Physica-Verlag, HD., pp.2-28
Review of literature on economic benefits of bicycle facilities and suggests ways of evaluating in future. Critiques much of the past research in this area. Summary tables of existing literature in appendix Table 3. Some monetary values given in a summary also. No specific mention of journey ambience, except briefly under mobility section. Contains references for a lot of the relevant literature.

Krizek, K. J., Birnbaum, A. S., & Levinson, D. M. (2004). A schematic for focusing on youth in investigations of community design and physical activity. *American Journal of Health Promotion, 0*(0), 59-64.
Looks at time spent on travel and at destinations of youth and how much time spent on physical activity. More general focus on physical activity. Solely theoretical schematic paper – argue community design may be able to affect levels of physical activity (although do not provide empirical basis here). Focus on health benefits.

Lawlor, D. A., Ness, A. R., Cope, A. M., Davis, A., Insall, P., & Riddoch, C. (2003). Thechallenges of evaluating environmental interventions to increase population levels of physical activity: the case of the UK National Cycle Network. *Journal of Epidemiological and Community Health, 57*(2), 96-101.
More of a focus on the health benefits, however raises some issues about environment in increasing use. Evaluates the effects of the UK cycle network – talks about the reasons given for why cyclists use the route including the surroundings and safety. Use health benefits in the actual analysis of effectiveness, and mentions some of the variables of interest.

Litman, T. (2004). Economic value of walkability. Victoria Transport Policy Institute.
Ways to evaluate walking and walkability (quality of walking conditions) generally undervalued. Outlines methods to measure accessibility, consumer cost savings, public cost savings, land use efficiency, community liveability, health, economic development and equity. Again, few economic evaluations provided, focus on methods for evaluating. Good focus on walkability rather than just walking.

Litman, T. (2007). Valuing transit service quality improvements: considering comfortand convenience in transport project evaluation. Victoria Transport Policy Institute.
Investigates value placed on qualitative factors in travel such as comfort and convenience and integrate this into travel time value evaluations. Focus on public transport but idea that there is a need to adjust evaluations to incorporate comfort variables. Outlines how different types of travel time are quantified and can be affected by comfort variables. Paper only really talks about public transport in any detail but may be possible to apply to cycling/walking (these are mentioned briefly also).

Lumsdon, L., Downward, P., & Cope, A. (2004). Monitoring of cycle tourism on long route distance trails: the North Sea Cycle Route. *Journal of Transport Geography, 12,* 13-22.
Evaluation of North Sea Cycle route – levels and patterns of use and level of visitor spending. Cyclists gave overviews of their travel including route, distance and spending. Level of spending dependent on group composition and duration of activity. Only economic evaluation really level of spending and no particular discussion of journey ambience (other than what we know about the cycle routes). Contains references on visitor spending if this is required.

Meletiou, M. P., Lawrie, J. J., Cook, T. J., O'Brien, S. W., & Guenther, J. (2005). Economic Impact of Investments in bicycle facilities: case study of North Carolina's Northern Outer Banks*. Transportation Research Record No. 1939*, 15-21.
Economic impact analysis of spending, estimated 60 million/year. Suggest spending on cycle facilities therefore justified as a fraction of what they earn. The region studied not just cycling attraction although had high level of spending on the facilities recently. Also asked about attitudes to the facilities for cycling in the area – many suggested safety of the paths particularly important. Quality of the routes for cycling had a positive impact on the planning of vacations to the area.

Minnesota Department of Transportation. The benefits of bicycling in Minnesota, 2004-05 Final report.
Estimates of total benefits of cycling in Minnesota. Make experience more appealing, more people will take part. Some monetary benefits put on different aspects of cycling in chapter 4 although still not precise – give an idea of how big or small the benefits are.

Mogush, P., Krizek, K. J., & Levinson, D. (2005). The value of trail access on home purchases (need to confirm where this has been published).
Effects of proximity to different types of bike trails on home prices. Suggest different types of trails affect house prices in different ways – not all positive. Off-road away from busy traffic the most positive. Suggest bike trails tied in to liveability and liveability affects house prices. Type of route might be linked to ambience – feeling of space a key feature of this.

Moudon, A. V., & Lee, C. (2003). Walking and bicycling: An evaluation of environmental audit instruments. *American Journal of Health Promotion, 18*(1), 21-37.
Walkability and bikeability of environments – review of measures of environmental factors in this. Includes route quality and area quality assessments. Gives theoretical frameworks for trip characteristics and criticism of current methods of evaluating variable effects. Argues for integrating value of transportation components and health effects currently separated in the literature (or undervalued). Contains references for more general ambience literature e.g. preferences for residential area visual qualities.

NCHRP (2006). Report 552: Guidelines for Analysis of Investment in Bicycle Facilities.
(Transportation Research Board – US) Systematic methods and tools for evaluating costs and potential values and benefits of bicycle facilities. Guidelines provided also on website with worksheet for estimation. Looks at a wide range of areas – includes sections on assessing safety and liveability benefits.

Norden (2005). CBA of cycling.
Based on Nordic seminar on current experiences of Cost-benefit analysis of cycling – different from and not often included in CBA of roads. Details what should be included in CBA, with others

to include if able to quantify. Comfort and security specifically addressed and gives guidelines and values for range of Nordic countries, taking in to consideration a range of different variables.

Pikora, T., Giles-Corti, B., Bull, F., Jamrozik, K., & Donovan, R. (2003). Developing a framework for assessment of the environmental determinants of walking and cycling. *Social Science and Medicine, 56*, 1693–1703.
Identifies potential environmental influences on levels of cycling and walking and gives weightings to each. Framework of 4 factors – functional, safety, aesthetic and destination with factors that influence these included. Lists factors included in other reviews of what appealing and unappealing features of the walking environment – a lot of these key to journey ambience. Differences between walking and cycling behaviour and between recreational and transport behaviour.

Reed, J. A., Wilson, D. K., Ainsworth, B. E., Bowles, H., & Mixon, G. (2006). Perceptions of neighbourhood sidewalks on walking patterns in a southeastern community in the US. *Journal of Physical Activity and Health, 3*, 243-253.
Survey examining relationship between perception of sidewalks and walking, across race. Perception of sidewalks refers to whether or not they are present in their community. Irregular walkers more influenced by presence of sidewalks – makes no difference to regular walkers. Relationship between perception and physical activity differs by race. Cites a lot of articles on environmental influences on physical activity if required.

Richardson, A. J. (2006). Estimating bicycle usage on a national cycle network. *TransportResearch Record No. 1982*, 166-173.
Survey of riders on Swiss national cycle network looking at trips and kilometres ridden and expenditure estimated. Gives values in Swiss Fr of average day and overnight trips. Focus on evaluating the economic impact of the cycle route in terms of cyclist expenditure while on day/overnight trips on the route.

Ryley, T. (2006). Estimating cycling demand for the journey to work or study in West Edinburgh, Scotland. *Transportation Research Record No. 1982*, 187-193.
Used random utility theory to estimate cycling demand – showed that facilities affect likelihood of cycling (esp those at the destination, but also those on the route). Included attitudes toward cycle lanes. Safety of route again very influential.

Saelensminde, K. (2004). Cost-benefit analyses of walking and cycling track networks taking into account insecurity, health effects and external costs of motorised traffic. *Transportation Research Part A, 38*, 593-606.
CBA of tracks in Norway assessing reduced insecurity, health benefits and reduced external costs. Estimate benefits to be 4-5 times the cost. Gives some values that may be relevant eg reduced insecurity for current/future pedestrians/cyclists.

Shay, E., Fan, Y., Rodriguez, D. A., & Khattak, A. J. (2006). Drive or walk? Utilitarian trips within a neotraditional neighbourhood. *Transportation Research Record No. 1985*, 154-161.
Neotraditional neighbourhoods – intended to support nonautomobile travel. Focus on utilitarian (destination-focused) trips. As distance increases, vehicle travel increases. Features of neotraditional neighbourhoods enough to increase likelihood to walk.

Siderlis, C., & Moore, R. L. (1995). Outdoor recreation net benefits of rail-trails. *Journal of Leisure Research, 27*(4), 344–359.

Individual travel cost method for estimating net economic values of 3 rail-trails. Measure of consumer surplus (CS) of the net recreation benefits to individuals (willingness to pay over mean trip travel costs and gained range of values for each location. Includes formulas used for determining values.

Sustrans (2006a). Economic appraisal of local walking and cycling routes AND Sustrans Economic appraisal of local walking and cycling routes. (Summary).
Uses government (UK) methods for economic benefit measurement and applied to walking and cycling routes. Benefit cost ratio of 20:1 found. Suggest creating right environment can result in savings to treasury and benefit public health. Relate impact measure of cycling and walking users to monetised cost/benefit of journey ambience. Journey ambience calculated on basis of safety-insecurity value (*see article 7*) - £0.91 per trip. Presents case studies in which journey ambience and physical fitness are the greatest benefit areas.

Sustrans (2006b). The National Cycle Network: Route user monitoring report to end of 2005.
Mostly presents figures on numbers of users of the cycle network. No particular evaluation, but good source of raw figures on use of "ambient" routes. Presents in case study fashion 5 different areas.

Sustrans (2007). Thames cycle and pedestrian bridge.
Specific economic appraisal of a bike/pedestrian bridge – looks at benefits including those to health and uses allowance for the quality of the journey compared to alternatives. Focus on one particular project cost/benefits.

Tilahun, N. Y., Levinson, D. M., & Krizek, K. J. (2007). Trails, lanes, or traffic: The value of different bicycle facilities using an adaptive stated preference survey. *Transportation Research A: Policy and Practice, 41*(4), 287-301.
Looks at willingness to trade time for better facilities or vice versa – utility maximisation model. Willing to trade 20 minutes of travel time for designated bike lanes, then lesser for absence of parking in street, and off-road bike-lane facility. Focus on what is important (preferred) to cyclists in their riding environment, mostly in terms of safety.

Tolley, R., & Boyd, H. (2001). Walking – the bottom line. A presentation at Australia: Walking the 21st Century, 20th to 22nd February 2001, Perth, Western Australia.
Economic impacts of walking for individual and community. Distinguishes between financial appraisal and economic appraisal. Argue economic the more relevant to walking – wider picture that ignores whether those who spend the money are the ones getting the benefit (as in financial). Refers to NATA and AST for costs and benefits considered by the UK government, journey ambience one of the sub-objectives of Environment.

Transport for London (2004). A business case and evaluation of the impacts of cycling in London (draft).
Presents business case for the impacts of cycling for London with costs and benefits if adequate facilities provided. Compares costs and benefits of 3 different London scenarios – current rate, 80% increase in cycling or treble level of cycling and the level of spending required to achieve these. Some of the possible expenditure ambience related. Some economic evaluation of comfort provided – most of the evaluation based on numbers of cyclists. Depending on scenario, benefits factor of 1.8 to 2.6 and benefits not limited to cyclists but all road users.

Wardman, M., Hatfield, R., & Page, M. (1997). The UK national cycling strategy: Can improved facilities meet the targets? *Transport Policy, 4*(2), 123-133.
Aims to create a mode choice model to examine cycling benefits by evaluating the ability of new cycle schemes to achieve UK DfT aims for greater levels of cycling. Suggest that in economic terms investments are worthwhile to users and will increase cycling. However they will not meet the targets of interest. Risks and unpleasantness of cycling found to be major influences on decisions to cycle.