Sustainable transportation and quality of life

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Abstract

We consider the continuing increase in the use and density of automobiles (more vehicles with fewer people in them travelling greater distances over proportionally shorter roads) in relation to transportation sustainability and quality of life. The social dilemma perspective views this trend as the outcome of an unfortunate preference for short-term gains by car users at the cost of long-term losses to society. Approaches to measuring quality of life, its relation to sustainable transport alternatives, and the potential implications for informing policy, are considered.
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1. Introduction

Automobile use has strongly increased during the last few decades. The number of passenger kilometres by private car per capita increased by 90% in Western Europe and 13% in the US between 1970 and 1990. In 1990, the average number of passenger kilometres travelled by private car in the US (18,650 km) was more than double the Western–European figure (8710 km; OECD, 1996). The number of motorised vehicles in the world grew by about 600 million between 1950 and 1990. Of the 675 million motorised vehicles in 1990, approximately 80% were for passenger transport. However, the number of people in the world not owning a car increased even more in this period, by over 2 billion (Adams, 1999; OECD, 1996). On a typical day in 1998, 75% of the adult population of Canada went somewhere in a car, up from 70% in 1986 (Clark, 2000).

The increasing number of cars and their daily use causes various problems (e.g., OECD, 1996; see also http://home.connection.com/~regan/carcosts.htm for Canadian data and http://www.rivm.nl/milieu/ for Dutch data). Many have stressed that the current transportation system is not sustainable (e.g. OECD, 1996). Various strategies have been proposed to arrive at a more sustainable transport system. In general, a distinction can be made between behavioural and technological changes. Behavioural changes are aimed to reduce the level of car use, e.g. by shifting to less polluting modes of transport, changing destination choices, combining trips, or travelling less. Such strategies may improve environmental quality, urban quality of life, and destination accessibility. Technological solutions are aimed at reducing the negative impact per car and per kilometre. Examples include increasing the energy efficiency of cars and developing new forms of road surface to reduce the level of traffic noise. Such solutions do not appear to sufficiently reduce the problems of car use, such as to make it compatible with sustainability (e.g., OECD, 1996). The mitigating effects of new technologies tend to be overshadowed by the continuing growth of car use. Whereas new technologies are capable of

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substantially reducing various emissions, other sustainability problems such as urban sprawl and accessibility are rooted in a wider complex of causes for which new technology, per se, is not a solution. For example, energy-efficient cars may help control environmental problems, but will hardly solve accessibility problems. Drivers might even be tempted to use their energy-efficient car more often because it is cheaper and more environmentally friendly. This phenomenon is referred to as the rebound effect (Berkhout et al., 2000) or the Jevons principle (OECD, 1996).

Behavioural and technological strategies not only differ in the extent to which they may improve different sustainability aspects, but probably also in the extent to which they affect the quality of life of citizens. In general, people prefer technological solutions to behaviour changes, because the latter is perceived as more strongly reducing the freedom to move (e.g., Poortinga et al., 2003). This may be explained by the different psychological properties of the two strategies (Gardner and Stern, 1996). Behavioural changes generally are associated with additional effort or decreased comfort. For example, reducing car use implies that we need to adjust our lifestyle, which may evoke (initial) resistance because it requires effort and reduces freedom, comfort and convenience. Many people believe that technological measures require few behavioural changes. For example, an energy-efficient car allows individuals to drive as much as they used to do, thereby significantly reducing adverse environmental impacts. However, technical measures generally require initial investments, and are therefore often rather expensive, especially for low-income groups. In the long term, technological improvements may be beneficial, e.g., because of energy (and consequently cost) savings. Although technological measures are usually preferred to behavioural changes, many also believe that reductions in the volume of car use are needed to manage the problems caused by traffic and transport, and that technological solutions will not be sufficient to solve these problems (Steg and Sievers, 2000). Thus, drivers agree that car use should be reduced in order to manage transport problems, but they are not in favour of measures that restrict their own car use.

Many agree that the current transport system is not sustainable. However, little is known about which kind of transport system would be sustainable and acceptable, and which criteria for sustainability should be used. In this paper, we describe possible ways to examine whether transportation systems are sustainable and acceptable. We focus on private transport, especially car use. Section 2 reviews methods for assessing sustainable transport. In Section 3, a method for assessing the quality of life effects of transport plans is introduced. This method enables the examination of the degree to which sustainable transport is acceptable to the public. We also briefly review psychological factors that affect individual quality of life judgements and the acceptability of transport plans. The main conclusions and the practical value of instruments for assessing sustainable transport are offered in Section 4.

2. Sustainable transport

Although no common accepted definition of sustainability, sustainable development or sustainable transport is available (Beatley, 1995), it is generally accepted that sustainable development, and more specifically, sustainable transport, implies finding a proper balance between (current and future) environmental, social and economic qualities (e.g., OECD, 1996; Ruckelhaus, 1989; Litman, 2003; WCED, 1987). It is less clear which environmental, social and economic qualities should be guaranteed and balanced. Although various attempts have been made to define sustainable transport indicators (see below), a key set of indicators that adequately reflects environmental, social and economic qualities have not been identified yet. Ideally, theory-based conceptions and operationalisations of sustainable transport indicators should be developed, first by defining sustainable transport, and then by deriving significant performance indicators that enable us to measure sustainable transport. Many performance indicators have been derived from current practices (e.g., in transport plans and policies) and stakeholder perceptions of sustainable transport. Indicator development often has not been based on an explicit definition or vision of sustainable transport (Gilbert and Tanguay, 2000).

Sustainable transportation might be considered by examining the sustainability of the transport system itself, focussing on the positive and negative values and externalities of traffic and transport as they are apparent now or in the near future. These kinds of indicators have been used by governments (e.g., V&W, 1991; see Gilbert and Tanguay, 2000; Gudmundsson, 2001) to set sustainable transport goals and to monitor whether the current transport system is moving towards sustainability. In some cases, future projections are also made, to forecast developments in transport and relevant sustainability indicators (e.g., RIVM, 2000). Various attempts have been made to list such indicators (e.g., Gilbert and Tanguay, 2000; Gudmundsson, 2001; Litman, 2003). Examples are energy use, CO_2 emissions, emissions of toxic and harmful substances, land use, disruption and fragmentation of natural areas, waste, traffic safety, noise pollution, health consequences of transport, crash costs, the contribution of the transport sector to economic welfare, and accessibility. Also, indicators have been defined that are based on the quality of the current transport system, including commuting speed, congestion delay, variety and quality of transport options available

in a community, accessibility of activities (for drivers and non-drivers), and the proportion of household expenditures devoted to transport (e.g., Litman, 2003).

One may also assess the effects of possible future transport systems on sustainable development in general. In this case, a broader range of sustainability indicators may be considered. Changes in the transport sector may induce changes in various other sectors, which in turn may affect sustainable development. For example, they may induce macro-economic changes (e.g., lower production values in transport, and higher production values in trade and industry), resulting in changes in GDP and employment levels (Geurs and Van Wee, 2000). Thus, valid sustainability indicators are needed to examine the extent to which possible future transport systems affect sustainable development. Various methods and models have been developed to assess environmental, social and economic effects of transport plans (see Geurs and Van Wee, 2003; for an overview). These models need improvement. In particular, social indicators are rarely included, because of a lack of knowledge and rigorous methods, tools and techniques for assessing the social impact of transport changes.

Sustainability indicators are needed to examine possibilities and conditions for sustainable transportation. The extent to which various sustainable policies would affect important sustainable transport indicators should be assessed by systematically examining the economic, social and environmental effects of these transport systems. Economic indicators should measure possible effects on economic welfare, such as macroeconomic changes, GDP, economic efficiency, income distribution and unemployment rates. Social indicators should reflect effects on societal and individual quality of life, such as health and safety (e.g., OECD, 1976, 1982). Environmental indicators should measure effects on environmental qualities, such as resource use, emissions and waste, and the quality of soil, water and air that may affect human (and non-human) life (e.g., OECD, 2002; Steg et al., 2003).

Geurs and Van Wee (2000) examined whether various future transport scenarios would be sustainable. First, they defined environmentally sustainable transport criteria, such as emissions of CO_2, NO_x, VOS, particles, noise, and land use. Second, they defined three environmentally sustainable transport scenarios that would meet these criteria, following a backcasting method: a high-technology scenario (only technological changes), a mobility-change scenario (only behaviour changes aimed to reduce car dependency) and a combination scenario (technological and behavioural changes). Next, they examined which policy measures are needed to reach these environmentally sustainable transport systems. Moreover, they explored possible economic and social consequences of the combination scenario, which they compared to the economic and social consequences of a business-as-usual scenario. The social impacts were qualitatively assessed by experts. Their study revealed that environmentally sustainable transport goals can be met only if a large increase in technological development is assumed, and/or very stringent behavioural adaptations and changes in spatial and economic structures are assumed. Moreover, they concluded that the current policy life cycle should change radically to bring about the timely implementation of measurement instruments. The economic and social consequences of environmentally sustainable transport scenarios appeared to be less drastic than is often assumed. However, they focussed on social indicators that are threatened by motorised transport, such as safety, health, perceived environmental qualities, and community relationships. Other probably important social indicators, such as equity, freedom, convenience and comfort, may be threatened if sustainable transport were in place, especially for groups which are forced to reduce their car travel.

The above-cited (prescriptive) studies are important to examine whether and how we could reach sustainable transportation systems. It clarifies what a sustainable future might look like. Of course, the next important questions are: How does the public evaluate such sustainable futures? Is a sustainable transport system broadly acceptable? The answers will depend, among other things, on the extent to which members of the public think these futures result in an increase or decrease of their quality of life.

Improvements in collective qualities of life, as aimed in sustainable transport, may conflict with individual short-term interests, especially when individuals must adapt their lifestyles in order to reach the sustainability goals. Thus, collective and individual interests may be at odds. In fact, this is often the case with sustainable transport issues. For that reason, the problems caused by traffic and transport may be defined as a typical example of a social dilemma. To reach a sustainable transport system, drivers may have to drive less; (see Section 1) and enhance accessibility. However, from an individual point of view it may be more attractive to continue driving because of the many advantages of individual car use. For many, driving a car is much more attractive than are other modes of transport. The car is especially attractive because of its convenience, independence, flexibility, comfort, speed, perceived safety, and privacy. The car also provides more status and pleasure than other modes; it is a means of self-expression, and enables one to control a powerful machine (e.g., Reser, 1980; Steg, 2003a,b). Thus, improved quality of life for most citizens may imply that drivers forfeit some of the individual advantages of car use, which may (at least initially) be perceived as a threat to their individual quality of life. In such situations, many are tempted to

act in their own interest, especially because these are experienced immediately, whereas the collective problems will be visible only in the long term. Moreover, individuals themselves cannot control the problems caused by car use; the problems will be solved only if many individuals cooperate. For many, it does not seem sensible to forego the individual advantages of car use because of the uncertainty about whether others also will do so. However, various factors may encourage people to act in the common interest, even though this may not have immediate positive consequences for themselves, like problem awareness, perceived responsibility for the problems, trust in others' contributions and personal norms (see Gifford, 1997; Steg, 2003c; for extensive overviews).

From the above it may be concluded that we should not only examine which transport scenarios or plans are sustainable on a collective level, but also whether such scenarios are acceptable to the public and why, especially when significant changes in travel behaviour are needed to achieve transportation sustainability. More specifically, it would be extremely helpful to know which critical factors in alternative sustainable transport scenarios cause such scenarios to have low acceptance ratings. This will, among other things, depend on the extent to which members of the public expect that the scenarios would affect their quality of life. Obviously, we can hardly speak of sustainable transport when most citizens believe it will significantly reduce their quality of life. The Brundtland Commission also stressed the importance of quality of life in their definition of sustainable development: "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43). This definition emphasises that "quality of life" depends on the extent to which current and future generations are able to fulfil their needs. Thus, sustainable transport should also be concerned with human needs and values. The effects of strategies aimed at stimulating sustainable transport should also be assessed in terms of human needs and values. Section 3 describes a measurement instrument aimed to assess quality of life effects of (more-or-less sustainable) future transport scenarios.

3. Sustainable transport and quality of life

Quality of life (QoL) is a multi-dimensional construct, and may be defined as the extent to which important values and needs of people are fulfilled (e.g., Diener, 1995; Diener et al., 1999). QoL refers to well-being, conceptualized either as the objective conditions of living of an individual, as the person's experience of life, or both. Here, we focus on subjective well-being or QoL, which refers to individuals' cognitive and affective evaluations of their lives (Diener, 2000).

Based on an extensive literature review of needs, values and human well-being, a list of QoL indicators has been developed and used in various research projects on sustainable household consumption at the University of Groningen (see Gatersleben, 2000; Poortinga et al., 2001, 2004; Skolnik, 1997; Slotegraaf and Vlek, 1996; Steg et al., 2002; Vlek et al., 1998, 1999). This list appears to represent a wide range of non-overlapping dimensions that are important to consumers (and thus travellers). Table 1 provides an overview of the most recent version of these QoL indicators. The mean importance rating of each QoL indicator is included. The data are from a questionnaire study of 455 Dutch respondents in 1999; scores could range from 1 'not important' to 5 'very important' (see Poortinga et al., 2001, 2004, for more details).

Table 1 reveals that most QoL indicators are considered to be (very) important to people's lives. This is not surprising, because these QoL indicators refer to important needs and values. However, based on Table 1 we may also conclude that impacts on health, partner and family, social justice, freedom and safety are valued more highly (at least by Dutch people in 1999) than impacts on material beauty, spirituality and religion, status and recognition, and challenge and excitement. Policymakers should especially consider possible impacts on the most important QoL indicators when designing and implementing sustainable transport policies, because the public will especially oppose measures that negatively affect these QoL indicators. In these cases, one may need to look for other ways to achieve sustainable transport that would affect these QoL indicators in a less negative, or even a positive way. One may also look for possible ways to compensate the expected negative effects.

3.1. Assessing quality of life effects

QoL effects of transportation scenarios or plans may be assessed by asking respondents to indicate the extent to which various sustainable transportation scenarios would affect relevant QoL indicators in positive or negative ways. Next, these expected changes may be weighted, based on importance judgments of the relevant QoL indicators, since changes in important QoL indicators will be more significant for individuals than changes in QoL indicators that are considered to be less important. Subsequently, the overall expected changes in QoL might be calculated. A multi-attribute QoL scale can be created by summing the expected changes on the QoL indicators, each multiplied by the importance judgment assigned to it.

This method has been successfully applied in various studies on sustainable household consumption. For example, Vlek et al. (1998) examined which changes in QoL respondents would expect from future economic

Table 1
Description and importance ratings of 22 quality-of-life indicators

Indicator	Description	M
Health	Being in good health. Having access to adequate health care	4.9
Partner and family	Having an intimate relationship. Having a stable family life and good family relationships	4.7
Social justice	Having equal opportunities and the same possibilities and rights as others. Being treated in a just manner	4.7
Freedom	Freedom and control over the course of one's life, to be able to decide for yourself, what you will do, when and how	4.5
Safety	Being safe at home and in the streets. Being able to avoid accidents and protected against criminality	4.5
Education	Having the opportunity to get a good education and to develop one's general knowledge	4.3
Identity/self-respect	Having sufficient self-respect and being able to develop one's own identity	4.2
Privacy	Having the opportunity to be yourself, to do your own things and to have a place of your own	4.2
Environmental quality	Having access to clean air, water and soil. Having and maintaining good environmental quality	4.2
Social relations	Having good relationships with friends, colleagues and neighbours. Being able to maintain contacts and to make new ones	4.2
Work	Having or being able to find a job and being able to fulfil it as pleasantly as possible	4.2
Security	Feeling attended to and cared for by others	4.1
Nature/biodiversity	Being able to enjoy natural landscapes, parks and forests. Assurance of the continued existence of plants and animals and maintaining biodiversity	4.1
Leisure time	Having enough time after work and household work and being able to spend this time satisfactorily	4.0
Money/income	Having enough money to buy and to do the things that are necessary and pleasing	3.6
Comfort	Having a comfortable and easy daily life	3.5
Aesthetic beauty	Being able to enjoy the beauty of nature and culture	3.5
Change/variation	Having a varied life. Experiencing as many things as possible	3.3
Challenge/excitement	Having challenges and experiencing pleasant and exciting things	3.2
Status/recognition	Being appreciated and respected by others	3.0
Spirituality/religion	Being able to live a life with the emphasis on spirituality and/ or with your own religious persuasion	2.9
Material beauty	Having nice possessions in and around the house	2.6

Adapted from Poortinga et al. (2004).

and environmental improvements or deteriorations. Dutch respondents evaluated three different scenarios. Various negative QoL changes were expected when environmental conditions would deteriorate under either an improved or deteriorated economy. In particular, environmental quality, nature, health, aesthetic beauty and safety were expected to be threatened. In contrast, the respondents expected mixed positive and negative changes in QoL when economic conditions would deteriorate under improved environmental quality. Positive changes were expected in environmental quality, nature, safety and health, whereas negative changes were expected in comfort, money, material beauty and work.

Gatersleben (2000) examined how the QoL of Dutch households would be affected if they had to reduce their energy use to a sustainable level. Study participants first indicated which energy savings they would choose to reach a sustainable consumption level. Next, they indicated to what extent this would result in changes in 16 QoL indicators. Reductions in freedom, comfort, pleasure, social relations, work and leisure time were expected, as were some minor reductions in privacy and social justice. Improvements in environmental resources, quality of nature, income, safety, and recognition were expected, while few changes were expected in material beauty, education and health. The more respondents expected energy savings to have negative effects for health, social justice, leisure time and freedom, and the less they expected negative effects for privacy, the more they believed that the quality of their life in general would be reduced.

Poortinga et al. (2001) examined the extent to which sustainable household energy consumption scenarios would affect judged QoL. Scenarios were presented that systematically varied on 3 dimensions: the focus of energy saving (home versus transport), the means of energy saving (technical innovations, behaviour changes, or a combination of both) and the amount of energy

saving (20% versus 30% energy reduction). Dutch respondents indicated which QoL changes would be expected from the scenarios. For present purposes, the expected QoL changes from the transport scenarios are most relevant. In general, the transport scenarios were expected to result in a reduction in comfort, work, money, privacy, and freedom, whereas improvements were expected in nature/biodiversity and environmental qualities. Overall QoL appeared not to be affected much, which implies that the expected improvements nearly compensated the expected reductions in QoL. The respondents expected most negative consequences from the transport scenario that involved technological as well as behavioural changes that would result in small energy savings. The multi-attribute QoL measure appeared to be significantly correlated with an intuitive measure of expected QoL changes (i.e., respondents indicated to what extent their QoL would change if the scenario was implemented; Poortinga et al., 2001).

Steg et al. (2002) asked respondents to indicate how and to what extent their QoL was affected by reducing their household energy use. In this study, Dutch households were asked to (voluntarily) reduce their household energy use by at least 5%. Each household received tailored information about possible ways to reduce their household energy use. They also received feedback about the amount of energy saved. Before the experiment, respondents expected improvements in environmental qualities and in nature and biodiversity when they would reduce their energy use by about 5%, while few changes were expected on the other 20 QoL indicators listed in Table 1. One month after the experiment started, households indicated to what extent their QoL actually changed because of their energy savings. They reported improvements in environmental quality and in nature and biodiversity. No changes in the other QoL indicators were reported.

3.2. Factors influencing judgements of QoL effects

Based on these studies, we believe that the QoL concept is useful for assessing expected effects of future scenarios. They not only reveal whether overall QoL would be affected by transport plans, but also how QoL would be affected, i.e., which QoL indicators would improve and which would deteriorate. The studies reveal that deteriorations in specific QoL indicators may be compensated for by improvements in other dimensions. Clearly, sustainable scenarios typically threaten individual QoL indicators such as comfort, freedom and privacy, while QoL indicators that refer to collective qualities such as environmental quality and nature and biodiversity would improve. This once again illustrates the conflict between individual and collective interests discussed earlier, and demonstrates that individual and collective interests must be balanced. As noted earlier,

most current drivers choose to act in their own interest by continuing to drive, especially because cars are believed to have many advantages over other modes of transport, such as public transport or bicycles.

Most studies reported above (except Steg et al., 2002) examined only anticipated changes in QoL, i.e., respondents indicated to what extent they expected their QoL to be affected in such cases. These may differ from actual QoL changes that would occur when the proposed changes would be implemented. For example, studies of the acceptability of transport policies have shown that public support may be higher after transport policies have been implemented (Tretvik, 2003; see also Steg, 2003b). This may occur when respondents' opinions are better informed after policy implementation, because they have more experience with the pros and cons of the measures. For example, a study by Heath and Gifford (2002) revealed that attitudes toward bus riding improved and bus riding increased after a policy change, i.e., the implementation of a U-Pass that allows free bus riding after a mandatory addition to student fees at the University. Individuals may also be more convinced of the advantages of the new policies because they perceive that the problem is being solved. Moreover, changes typically are resisted at first, because these *may* have negative consequences. As long as individuals are unsure of the consequences, they prefer the status quo (Kahneman and Tversky, 1984). Similar processes may play a role when people are asked to assess which changes in QoL they would expect from future (transport) scenarios. Therefore, the QoL concept should also be used to monitor QoL over time, to examine the extent to which changes in society or in transport actually affect judged QoL. Further, this highlights the importance of the way in which future scenarios are presented. To ensure that respondents provide well-considered judgments of the expected QoL effects of transport plans, the plans should be described in a plausible and imaginable way. Clear description of proposed changes in the transport system is important for helping respondents think through possible consequences of the plans for them personally. It is also important to involve the public in the development of sustainable transport plans, and to listen carefully to their wishes and views in an early stage. This may well result in better and more acceptable sustainable transport plans.

The method described above is based on a compensatory decision-making model. People may use other decision rules when evaluating future scenarios. Whether drivers or other concerned individuals are "involved" (that is, actively considering) or not in the issue of sustainable transport may imply different models of how proposed alternatives are evaluated (e.g., Greenwald and Leavitt, 1984). When individuals are involved, compensatory models like the multi-attribute model described above may better describe their evaluations of

transport alternatives presented to them. That is, involved persons are able and willing to compensate less-desirable consequences with more-desirable consequences of scenarios presented to them. However, many persons may have little cognitive or emotional involvement in transport issues. For these individuals, a variety of non-compensatory models may better describe their evaluation of alternatives, because they have limited beliefs and limited knowledge, and care little for the issues. Their evaluations may be better predicted by conjunctive or disjunctive rules. When a conjunctive rule is used, the person rejects any alternative that does not meet all his or her minimum criteria for acceptability. When a disjunctive rule is used, the person accepts any alternative that meets or surpasses any of his or her criteria. Individuals may also use "fast and frugal" criteria when they are less involved (Gigerenzer and Todd, 1999); transport users have many things on their minds in their daily lives besides sustainability, and must be "cognitive misers" (Fiske and Neuberg, 1990) to survive and prosper. Future research should reveal whether the level of involvement indeed affects the evaluation of transport scenarios.

A few other factors should be considered when examining QoL effects of sustainable transport scenarios. Diener et al. (1999) found that general subjective well-being has not changed much over the last several decades, even though incomes and consumption levels have increased significantly (see also Veenhoven, 2004). Individuals seem to adapt to positive as well as to negative changes in their lives; they change their expectations and goals (e.g., Diener, 2000; Meyers, 1992; Suh et al., 1996). QoL is judged in comparison to some standard (Diener, 2000; Ormel et al., 1997). We feel more satisfied with our lives when we believe we are better off than others are, when we are better off than yesterday, or when we are closer to our aspirations. These standards used to judge QoL do change over time, i.e. we adapt our comparative standards to changes in our circumstances (which might improve or deteriorate). This implies that further increases in consumption levels, including transport, will not necessarily enhance QoL, and reductions in consumption and transport levels may not necessarily reduce QoL. Although in such cases individuals may initially experience a reduction in QoL, they probably will adapt soon after the changes (Diener, 2000). Thus, the conviction of many politicians that a truly sustainable transportation system is not feasible because environmentally sound transportation systems will seriously threaten quality of life may not be true, and should at least be tested.

Theories of QoL and human well-being typically assume that a general set of indicators for QoL can be defined that does not differ over time or between cultures (e.g., Maslow, 1954; Max-Neef, 1992; Rokeach, 1973; Schwartz, 1992; Schwartz and Bilsky, 1987, 1990; see Vlek et al., 1999; for a review). However, the way individuals (prefer to) fulfil their needs and values does change over time and differs between cultures and groups. Moreover, the relative importance of various QoL indicators (or needs and values) may differ between groups (see Gatersleben, 2000; Gatersleben and Vlek, 1998; Inglehart, 1990; Poortinga et al., 2001). For example, Dutch respondents with greater environmental concern evaluate environmental quality and personal freedom as more important, and material wealth as less important than do respondents with less environmental concern. Dutch women value personal freedom and maturity more than do men, and unmarried persons evaluate family, health and safety as less important than do couples and families (Poortinga et al., 2001). Obviously, current (and future sustainable) forms of transport may affect various groups in society differently, and group differences may exist in what is considered to be sustainable (or livable) transport (see also Adams, 1999; Button, 1982). Consequently, the interests of various groups should be balanced, and it may be necessary to compensate groups that are disproportionately affected by current as well as future transport systems. Also, the relative importance of QoL indicators may vary over time (see Gatersleben, 2000; Inglehart, 1990). This implies that the multi-attributive evaluation of QoL effects of sustainable transport scenarios may be time dependent. We know reasonably well which QoL aspects should be considered, but the relative importance of various QoL aspects, and consequently, overall (multi-attributive) QoL effects should be monitored regularly. This will also reveal to what extent actual QoL effects differ from those anticipated (see above). Based on this, sustainable policies may need to be adapted.

3.3. Significance for policy making

Policy makers should take into account the extent to which their policies may affect judged QoL. Transport policies will be less acceptable, and consequently, less feasible and less effective, if they have significant negative impacts on QoL. For example, restrictions in freedom of choice may evoke serious resistance or may even evoke psychological reactance (Brehm, 1966). As a consequence, restrictive policy plans may have no or even opposite effects to what was intended (Tertoolen et al., 1998). If specific transport policies aimed at reducing car use are believed to seriously threaten freedom of choice, drivers might be motivated to continue driving, regardless of the possible negative consequences.

Sustainable transport may imply different things in North America and Europe, and consequently, specific sustainable transport plans may be evaluated differently in North America and Europe. For example, North American society is more strongly tuned towards the regular use of cars than Dutch society. Of course, inter-city distances in Canada and parts of the US are

much greater than those in the Netherlands. Also, the public transport system in the Netherlands is fairly good compared to that in many parts of North America. Thus, car dependency (i.e., the level of car use, car-oriented land use and quality of travel alternatives; Newman and Kenworthy, 1999) is much higher in North America compared to the Netherlands. This implies that reductions in car use may have more significant consequences for the QoL of North Americans than for the Dutch. Similar differences may emerge when comparing regions within a country. For example, reductions in traffic volume may significantly enhance the QoL of people in densely populated areas (e.g., less traffic jams, less noise, better urban quality of life), but may reduce the QoL of country dwellers (e.g., some activities cannot be reached anymore).

4. Conclusions

Although there is no common definition of sustainable transport, it is generally accepted that sustainable transport implies balancing current and future economic, social and environmental qualities. A key set of sustainable transport indicators has not yet been identified. However, it is generally believed that current traffic and transport patterns are not sustainable in the long term. The negative environmental, social and economic externalities outweigh the social and economic values of transport. Sustainable transport is mainly investigated by examining the sustainability of current transport systems. In this case, the positive and negative values and externalities of current transport systems are examined, such as energy and land use, waste, traffic safety, traffic noise, health consequences, accident costs, accessibility and economic wealth. Governments and international bodies such as the OECD often apply this approach. Sustainability indicators are defined and operationalised as sustainable transport policy goals, and whether the transport system is moving towards sustainability is monitored. In some cases future projections also are being made.

In addition, the effects of various transport plans on sustainability are being assessed. This implies a need to consider a broader range of sustainability indicators, because changes in current transport systems may affect other sectors that also contribute to unsustainable development (such as employment levels in industry). Various methods and models have been developed to assess economic, social and environmental consequences of transport plans. However, at present, only a few social indicators are being considered, because of the lack of knowledge and valid methods, tools and techniques for assessing relevant social impacts.

Obviously, an important next question concerns how the public evaluates such sustainable futures, and whether transitions to sustainable transport systems are acceptable to the public. These transitions may not be acceptable, because sustainable transport may conflict with individual short-term interests, especially when individual car users are asked to significantly adapt their lifestyles and transport behaviour. We should therefore also examine to what extent transitions to sustainable transport would affect individual QoL, and to what extent such transitions are acceptable to the public.

Here, a compensatory method is proposed for assessing the QoL effects of transitions to transportation systems that systematically differ in the extent to which they are sustainable. QoL is a multi-dimensional construct and is defined as the extent to which important values and needs are fulfilled. We considered subjective evaluations of QoL, i.e., cognitive evaluations of their lives. A list of 22 QoL indicators was introduced to assess QoL effects of transport policy plans that represents a wide range of dimensions that are important to consumers (and thus travellers). The QoL effects of possible transportation scenarios are assessed by asking respondents to indicate to what extent various transportation scenarios would affect relevant QoL indicators, and how important each indicator is to their lives. The overall expected changes in QoL may be calculated by summing the expected changes on the QoL indicators, after multiplying the importance assigned to it. Several empirical studies revealed that the QoL concept is useful for assessing revealed as well as expected QoL effects of various sustainable (transport) scenarios. They reveal not only whether overall QoL is or would be affected by transport plans, but also how QoL would be affected, i.e., which QoL indicators would improve and which would deteriorate under a sustainable transport scenario. Moreover, the method enables examination of whose QoL would be affected most strongly. Based on this, politicians and policy makers should be able to decide whether and how certain groups should be compensated, and to better inform the public about expected (positive and negative) effects of the proposed sustainable policies. This would greatly improve the current situation, in which decisions are based on expectations set by various interest groups. At present, significant minorities that wield sufficient political power can obstruct particular solutions or compromises, which leaves governments with options that are unacceptable for others and/or watered down so much that their effectiveness becomes questionable.

The objective and subjective approaches described above are not contradictory; they complement each other. Assessments of sustainable transport typically are based on objective measures, while QoL assessments typically are based on subjective evaluations. It is important to consider QoL effects when designing and implementing sustainable transport plans, because they are crucial for the acceptability, and consequently the feasi-

bility and effectiveness, of such plans. Sustainable transport plans will be strongly opposed when users believe the plans will significantly reduce their QoL. Moreover, we can hardly speak of sustainable development when sustainable transport is believed to be associated with significant reductions in the quality of life. In such cases, we should examine the basis of the expectations that sustainable transport will reduce QoL. If the expectations are realistic, it is advisable to look for other ways to reach sustainable transport that would affect QoL less negatively, or even positively. Further, the extent to which possible negative effects could be compensated, e.g., by implementing additional policies, must be examined. However, it may also be that such expectations are based on lack of knowledge (e.g., people are not aware of environmental problems caused by car traffic) or misperceptions. In this case, the public should be informed and educated to the need for and possible consequences of sustainable transport, compared to a business-as-usual scenario.

The method described in this paper may be applied to collect subjective judgements of which QoL changes would be anticipated if possible future scenarios were to be enacted. Many psychological processes and other factors will influence these judgements. For example, well-considered judgements about the expected QoL effects of transport plans may not be obtained if respondents do not think enough about the advantages and disadvantages of sustainable transport compared to a business-as-usual scenario. This might be facilitated by providing study respondents with clear descriptions and possibly visualisations of plausible changes in transport, and by indicating what this implies for them personally. It is also important to involve the public in the development of sustainable transport scenarios. Further, changes normally are met with initial resistance, as long as individuals are unsure of the (positive) consequences. Moreover, individuals generally judge their expected QoL in comparison to some standard, e.g., the QoL of others, their current QoL, or their aspirations. These standards are adapted to changes in their circumstances. This implies that changes in transport may influence QoL initially, but as individuals usually adapt soon, no significant changes in QoL may occur in the long term. Thus, support for sustainable transport plans may be higher after they have been implemented. Finally, as the relative importance of QoL indicators may vary over time, it is important to monitor (expected and actual) changes in QoL of sustainable transport scenarios continuously, and to adapt policies when needed.

Although much important work has been done to understand sustainable transport, many questions remain. The methods used for assessing sustainable transport and for assessing QoL effects of sustainable transport scenarios need to be further developed. For example, methods must be developed to examine how valid judgements can best be collected, and how psychological processes and factors that may affect QoL evaluations can best be understood. Further, it should be examined whether results of studies like the ones reported here may be generalized to transport behaviour in everyday life. As noted earlier, a multi-attribute model may be especially appropriate when involvement is high, and participating in a transport study may raise involvement temporarily. Real everyday preferences might be better predicted by fast-and-frugal or non-compensatory models. Finally, whether the present list of QoL indicators is comprehensive should be investigated. Although we believe all relevant QoL indicators are included, and the different QoL indicators do not overlap, additions and changes may still be needed Also, relationships between QoL indicators should be examined more thoroughly. For example, some QoL indicators refer to goals (e.g., comfort, status, affection), while other refer to resources (e.g., money, time, health) that may be used to fulfil these goals (see Ormel et al., 1997). It may be important to make this distinction more clearly, to better understand how transport plans affect QoL.

We believe it is important to combine the development of sustainable transport scenarios with QoL assessments of those scenarios. One may assess the QoL effects of transport plans that fulfil general sustainability criteria, but one may also assess the sustainability of transport plans that optimize the QoL of current as well as future generations.

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