Author: Marta Karlik-Neale

Title: One-Planet Living and Sustainable Transport in London

URS New Zealand
Level 4, Lambton Quay, Wellington
PO Box 33 67
Tel. 04 496 3750 Fax. 04 495 1486
E-mail marta_karlik-neale@urscorp.com

ABSTRACT

London's ecological footprint has been recently estimated to be 5.8 global hectares (gha) per person, while the Earth capacity is only 1.9gha per person. If everybody on Earth consumed the same amount of resources as Londoners, we would need 3 planets. A big part of this consumption is related to resources used in transportation—93% of environmental resources used in London transport come from personal mobility.

This paper considers issues of personal mobility from the perspective of individual choice and sustainable lifestyle —a lifestyle that can be maintained with only one planet. The author investigates ideas developed by London's public bodies and businesses in a task force "Towards a Sustainable London: Reducing the Capital's Ecological Footprint". A number of behavioural models are used to consider how effective different strategies could be in inducing change in travel behaviour. The role of infrastructure is highlighted, while indicating opportunities for synergies in co-ordinated actions between road development, public transport, educational campaigns and changes to working and living urban environment.

1. SUSTAINABLE LIFESTYLE

1.1 ONE-PLANET-LIVING

The concept of sustainable development is usually discussed in regards to global issues and it is sometimes unclear how it applies to individual people. One of the ideas that tries to make it applicable for individuals is the idea of one-planet-living - an idea of the lifestyle which would only use a proportional share of the planets resources. The concept is based on the ecological footprinting methodology: an accounting tool that represents the environmental impacts of a process or person's lifestyle in terms of an area of land required to produce a particular natural resource or to absorb waste from consumption. It measures the area of biologically productive land that is required to meet the needs of a given product, person or population. It compares this area with the actual available area on Earth and informs us whether we are living within the Earth's regenerative capacity. (BioRegional, 2003). A large pool of footprinting studies is already available for review: WWF carries out an annual footprint study of individual nations (The Living Report, WWF, 2004), in the UK a significant proportion of funds raised through landfill tax have been diverted towards evaluating the footprint of individual cities (London, BFF, 2002.) areas (Scotland, BFF, 2004, Isle of White, BFF, 2000), industries (education, public sector, Waste Watch 2001) or even individual organisations.

All of these studies indicate that we are currently exceeding Earth's carrying capacity. The 2004 study of the London's footprint established that an average Londoner requires 5.8 global hectares (gha) to maintain his/her current lifestyle (London First, 2005). What it means, in practice, is that if all the people in the world consumed the same amount of land, energy and materials as Londoners do, we would need over three planets to sustain ourselves. This poses two challenges: fair sharing of resources between nations and using Earth's resources past its regenerative capacity. There is a wide disparity in the level of consumption, with United Arab Emirates and USA at close to 10gha per person (more than 5 planets) and the vast majority of African and some Asian countries at around or below 1gha. As a result, the global average for 2004 was 2.2gha per person. This means that as a species we are already exceeding the Earth capacity by 21% - it takes approximately 14.5 months to regenerate the resources humanity consumes in one year. As a result, we live on credit extended by non-renewable resources and emissions of greenhouse gases to atmosphere. This overshoot causes the liquidation of natural capital: carbon accumulates in the atmosphere, fisheries collapse, deforestation occurs, biodiversity is lost, and freshwater becomes scarce. On the positive side, recent efficiency strategies are contributing to decoupling of the ecological footprint from the economic growth: humanity's ecological footprint has grown more slowly than economic activities.

These studies led to the idea of one-planet-living – maintain a lifestyle that would only use 1.8gha. A key question here is if it is at all possible and how much quality of life would have to be sacrificed. A number of experimental developments have been attempted to answer these questions, among them the largest eco-village in the UK – Beddington Zero Energy Development (BedZED), developed by Peabody Trust in

cooperation with BioRegional (BioRegional, 2003). The development applied a series of innovations such as use of alternative energy technologies (biomass CHP (combined heat and power/cogeneration), solar PV panels and energy efficiency measures within houses). The apartments use 90% less energy and half the water of an average English house and all the construction materials are from local, recycled or certified sources. Nonetheless, the average footprint of the BedZED community is still above the one-planet goal (ecological footprint of 1.8 gha per person. The key reason behind this higher than expected footprint is the every-day lifestyle choices made by the residents – many of them still own cars, don't use provided recycling facilities and some even replaced the eco-efficient appliances originally provided in order to catch up with latest trends as advertised on TV.

This paper looks at the lessons footprint studies can offer in regards to our transportation options and investigates the behavioural background of individual transport decisions to suggest most efficient set of actions that could be taken to progress towards one-planet mobility – travel behaviour that would contribute to one-planet-living.

1.2 ONE-PLANET-MOBILITY

In the recent years, London has managed to put itself on the map as a city to watch in terms of transport innovation. Congestion charging, which achieved a significant improvement in terms of traffic, speed of travel and air quality in central London, is well known, but not the only example. The need for improving sustainability of transport permeates all of the recent development strategies including the London Plan, social policies and five environmental plans.

In response to that, London First, a network of businesses operating in London, launched a project aimed at reducing the capital's ecological footprint. The study aimed at discovering what the largest components of the footprint are, and what strategies are most likely to be most effective and widely accepted. The initial footprint analysis established that the area of land needed to sustain London was twice the size of Great Britain at 5.8gha per person.

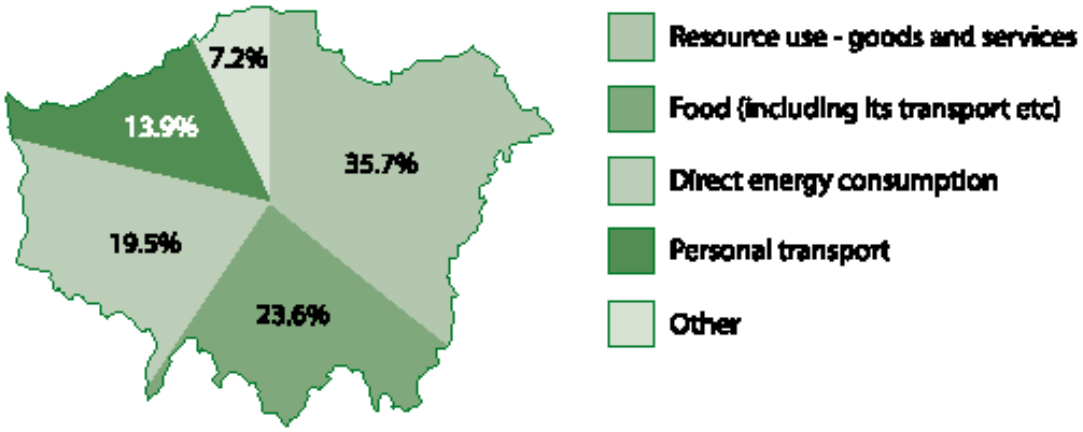


Figure 1 Elements of London's ecological footprint (London First, 2005)

Resources used for transportation, without even considering those related to development of supporting infrastructure, form a substantial part of this footprint – close to 15%. While freight still contributes significantly (Table 1), it is the resource use associated with the personal mobility that constitutes the vast majority (93%).

Freight mode	**Ecological footprint (gha/per year/ tonne km)**
Air Freight	0.315
Road Freight	0.075
Rail Freight	0.014
Sea Freight	0.006

Table 1 Ecological footprint of freight modes (WSP, 2003)

The personal mobility footprint includes travel by car, bus, motorcycle, river boats, air, rail and underground. All these activities occupy space for road and other civic infrastructure and are therefore responsible for energy and resources for building the infrastructure and manufacturing the vehicles, as well as energy for operating them.

Overall, people in London require 1.01gha per person to sustain their travel habits – over half of per capita one-planet share (WSP, 2003.). Considering that 37% of London households don't have a car and only 18% have two or more, we can safely assume that this figure would be significantly higher in more car-dependant countries. Car transport is by far the highest contributor to the footprint (3.5 million gha, while accounting for 66% of all travel). Public transport only contributed just below one million gha, while providing 26% of travelled kilometres. A third of the personal mobility footprint resulted from building and maintaining road infrastructure. The impact of walking and cycling was minimal – these modes don't use fuels and don't require substantial additional infrastructure (and, if so, it is usually to protect cyclists and pedestrians from cars).

Transport mode	Ecological footprint (m^2 per 1000 passenger-km per annum)	Relative to car (car+100)	Distance travelled by Londoners (km/year/person)
Taxi	600	102	121
Car	590	100	5706
Aircraft	500	86	2.6
Bus	397	67	654
Motorcycle	370	62	72
Train	210	36	1604
Bicycle	20	3	52
Walking	0	0	382

Table 2 Ecological footprint of different modes of transport (WSP, 2003)

Following the completion of the study, London First led a wide consultation programme to provide suggestions on the possible long-term and short-term initiatives that could enable reduction of the footprint. The total potential savings identified could generate an estimated 20 to 25 million global hectares reduction in the footprint, which equates to

half of London's present footprint. The key area for reducing personal mobility footprint was related to car travel, which is the most resource intensive. A total shift from car to public transport would reduce the capital's footprint by 1.2 million global hectares. The strategies proposed during the project are presented in Table 3. They focused on reducing demand, changing the transport mode and using existing modes more efficiently. Changes to urban transport infrastructure and increase of city compactness provided equally significant opportunities. Such changes would not only minimise the need for travel, but also improve the quality of life through improved air quality, noise reduction, improved public spaces.

Agent	**Actions**
London public authorities	1. Plan London and its region around denser developments with 'high-bandwidth' public transport connections between them. 2. Promote high-density, mixed-use developments on all sites accessible to public transport. 3. Plan for new housing to be of high-density and highquality, and accessible to public transport. 4. Plan to locate all new centres of education, shopping, employment and health with good links to transport. 5. Make funding available to help reduce car usage for journeys to school, e.g. for school buses and 'walking buses'. Take the opportunity presented by reduced car usage to create more attractive pedestrian environments and facilities for cycling. 6. Establish more 20mph zones, Homezones, car-free environments, and traffic calming in residential areas, while allowing for the needs of the emergency services. 7. Change the balance of cost between car and public transport and examine, in the long term, using a sophisticated road pricing system across London.
Business	1. Produce Travel Management Plans. 2. Provide financial incentives to organisations that introduce working methods that enable people to work at home, and other means of reducing travel. 3. Use of new vehicle technologies with low or zero CO2 emissions, as long as the original source of energy does not release further CO2. 4. Lobby for a system of emissions trading in air travel, to encourage use of lower emission planes.
Central government	1. Continue to improve London's modern 'high-bandwidth' telecommunications infrastructure. 2. Lobby for additional investment in public transport. 3. Lobby for increased capacity of the rail network. 4. Expand UK and European long-distance express rail services. 5. Extend government programmes to improve fleet fuel efficiency and reduce fuel mileage.

Table 3 Strategies for reduction of personal mobility footprint (London First, 2005)

As part of the project, a number of case studies have been carried out to test the proposed strategies. A development at Convoys Wharf was chosen as a number of identified

strategies were being implemented there: increased urban density, improved public access, riverbus transportation, transportation of materials for recycling plant by barge, on-site recycling facility, landscaping and green roofs, recycling of construction debris, use of energy efficient lighting. The footprint analysis showed that compact urban development can reduce the footprint by 1gha/cap compared with suburban lifestyle. Density and proximity reduced dependence on car transportation without restricting people's choices. Similar conclusions were drawn from the analysis of the BedZED project where use of electric cars, pool sharing and shopping delivery systems complemented benefits from mixed use (work-life units), compactness of the development and proximity to public transport.

A study of public support for some of these measures was also carried out. Public transport was seen as the most acceptable strategy (30% support), while car sharing and remote working had only around 10% support. 6% of respondents thought that reducing amount of parking spaces was a good idea. Only 3% supported reduction in the number of company cars.

Footprinting methodology provided an interesting insight to quantify the impact of the transport options in regards to resource use. It is also useful to provide a benchmark – an overarching objective of one-planet-mobility. On the other hand, it doesn't shed much light onto socio-economic aspects of the travel behaviour and, as such, the effectiveness or acceptability of suggested strategies. The next section reviews some of the current thinking in regards to behavioural aspects of travel to build on this research and suggests which strategies are most likely to succeed.

2. TRAVEL BEHAVIOUR

2.1 WHY PEOPLE USE CARS

Definitions of sustainable transport vary: WBCSD in Mobility 2030: public health, greenhouse gas emissions, accidents, noise, congestion, social exclusion due to lack of mobility opportunities; Donaghy et al., 2004: urban forms must be planning driven and transit friendly; transit mode choices should be market driven; infrastructural investments should be efficiency driven; financing must be innovative; and the system must be flexible enough so that it can be reinvented.

Very often though, a common understanding of the sustainable transport is simplified (inappropriately) to issues focused on car use minimisation. This is because cars are without doubt a dominant mode of transport, and their arguably negative impacts on our society are most evident and discussed (Table 4).

Negative impacts of car use
• Use of non-renewables, • Greenhouse gases and other emissions, • Land use, • Eutrofication (spelling) and acidification of ecosystems,
• Noise, • Traffic jams, • Alienation of other forms of transport leading to restricted access to markets, employment and social facilities for disadvantaged groups, • Increasing obesity, • Road accidents • Changes to urban form (suburbanisation) that lead to social exclusion and criminality, • Impact of poor air quality on health

Table 4 Negative impacts of car use (Garvill et al., 2003; Mason, 2001; Campbell & White, 2003; WBCSD, 2003; Button & Nijkamp 1997; Engel-Yan et al., 2005; Mackett, 2003; Banfield, 1997)

Faced with the negative impacts that have been identified, the question is why the use of the car is so prevalent. The answer is not difficult – it is without doubt the most convenient form of transportation. Cars provide the best means to satisfy our needs to travel (for work, to acquire goods and services) and desire to travel (to interact with others and to gain a feeling of freedom). It is closest to the way humans have always travelled – as individuals: able to run and save ourselves regardless to what was happening to the rest of the group (Diekstra & Kroon, 2004). Only walking and cycling provides the same ability, but they are much more energy demanding and we are genetically conditioned to preserve our energy – our lives always depended on it, and we still continue to choose the easiest options for these reasons.

And that is not all. Cars are such a great invention that they have become ingrained within our society and provide a rare channel to express ourselves. Table 5 provides a list of psychological associations that cars have acquired, and people often use to make themselves feel better.

Symbolic and affective motives of car use
• "auto" regulation: freedom of movement and autonomy (man as nomad/hunter) • archetypal meaning: chivalrous/macho/heroic/superior (King-of-the-Road) • power motive: dichotomy of the desire for power and community spirit • territorial/possessive aspects (car as a mobile territory) • individualism/status/communication: I am what I drive • anthropomorphisation: the personification of the car, identification • emotional/relational aspects: the car as an object of desire or love (car as a toy) • social cohesion function: the car as a common interest • neuronic stimulation: speed and neurobiochemistry (narcotic effect, speedaholism) • pilot or engineer function: the skill and fun of handling a complex machine • structuring the day: the car as a time-filler • protective function: the car as a second skin, womb or friend

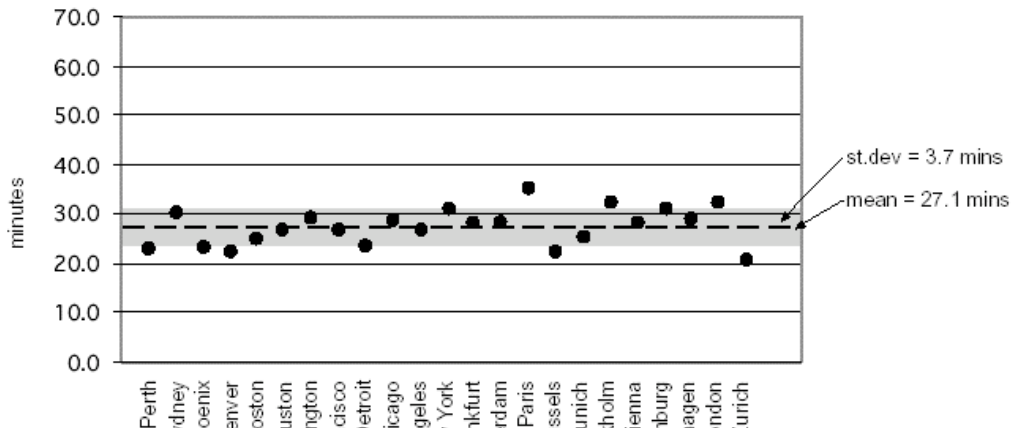
Table 5 Psychological associations with car use (Diekstra & Kroon, 2004.)

Public transport might be able to move us from one place to another but it can not replace the feelings that many associate with cars. Nonetheless the problems associated with the car use are real, and it is a policy of many central and local authorities to minimise car travel. The usual messages related to required changes in travel behaviour relate to more careful driving, higher occupancy, downsizing cars, shift from car to public transport, shifting in public transport from air and bus to rail, shifting from motorised to non-motorised modes and reducing travel and replacing it with electronic communication.

Recent studies of travel behaviour (examples outlined below) have allowed better understanding of the travel decision. This in turn can improve our understanding of which sustainable transport strategies are likely to succeed. This paper will have a closer look at two of them – time budget and decision making process.

2.2 TIME BUDGET

It has been established that most populations on average spend around 30 minutes on their daily commute (Figure 5) irrespective of the city, wealth, transport system, size or density (Zeibots 2003). This is explained based on other time demands placed on people within a 24 hour day – 8h sleep, 8h work, 1h lunch, 1-2h for personal hygiene, 1-2 for meals and time left for both personal time and travel is limited to 3h. This phenomenon is called time budget constancy. It applies not only to commuting but also to combined



daily travel time – 70 and 50 minutes on total travel per person per day (Zeibots, 2003). In consequence, we operate within a framework of two conflicting objectives – on one hand, we want to reduce travel time so that we have more time for other daily activities, but on the other we are driven to travel further to better jobs or residential locations, or other new destinations in search of new experiences and activities, which Zeibots argues is the whole point of living in a city.

Figure 2 Average travel times for the journey-to-work in 23 industrialised cities (1990) (Zeibots M.E. 2003).

Our time budget compels us to choose the fastest modes of travel, but at the same time we are quick to take advantage of an increased speed (faster cars, better infrastructure) to make more or further trips in order to increase the quality of our precious personal time. That leads to a difference in the number of trips in different types of cities. In denser cities, people, on average, make fewer trips incorporating more purposes into their trips (Zeibot, 2003). In some of the densest Asian cities, where walking and cycling tend to be the most common modes of travel, overall daily travel times tend to be slightly higher, but the number of trips is slightly lower, travel distances are shorter and speeds are slower. In low density cities single purpose trips are more prevalent, overall distances are longer and speeds are higher.

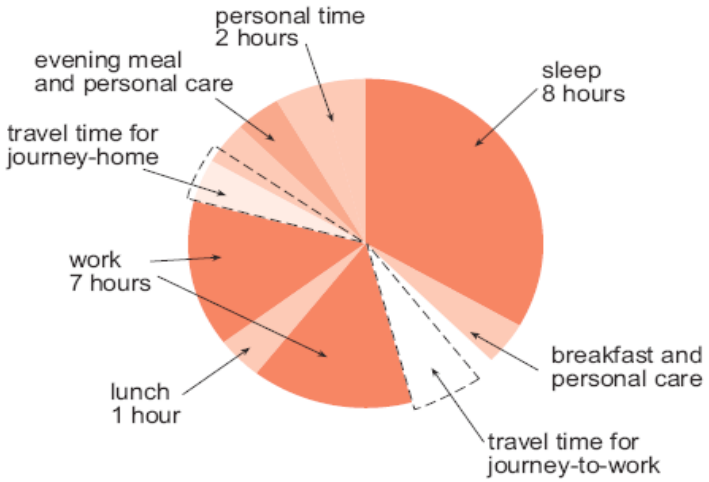


Figure 3 Typical daily tasks that make-up a daily routine (Zeibots M.E. 2003)

Thus, based on the time-budget theory, improved infrastructure and, consequently, speed of travel encourages people to make or longer trips. Many researchers have concluded that construction of motorways have the effect of reducing efficiency of transport networks and pushing travel cost up – they commit the city to a structure that requires a greater throughput of materials for the same time of travel (Knoflacher, 2004).

On the other hand, strategies designed to improve speed comparison between different transport modes e.g. under-provision of parking combined with measures to increase speed of public transport (e.g. congestion charges, bus priority lanes) are likely to encourage people to leave cars at home. Travel budget theory suggests the key challenge for public transport is to reduce waiting time – increasing transport frequency can often be too expensive and inefficient if it is not matched with the level of usage, but there are new technologies allowing for on-demand public travel that are on the edge of commercialisation. First examples include a new train system discussed in Germany, which would work like an elevator, an escalator system for travel in Hong Kong and even automated public cars ranging in size from 1 to 10 people capacity.

Being available on-demand is the key benefit of walking and cycling, but these modes, being much slower, can only be efficient if the urban environment is purpose designed for them – just like the historic cities were. A positive trend is the current come-back of the traditional urban forms. In the UK this trend is reflected in homezone design guidelines issued and promoted by The Institute of Highway Incorporated Engineers (IHIE), and urban villages promoted and developed in co-operation with The Princes Foundation. In the US and Canada this neo-traditional urbanism is taking off (ref).

Decisions regarding daily time budget also relate to who and where we spend our time. Harvey and Taylor (2000) calculated that on average we spent 53% of our daily time budget at home, 22% at work, 17% in community and 8% in transit. This has consequences for our interactions with others – we spent 40% of awake time alone (most of it at home and while we are travelling). Our psychological health usually requires that we don't spend more time alone (Harvey and Taylor 2000).

This raises the question of the effectiveness of the remote/home working strategies. By working at home we drastically reduce our daily social circle interactions and our social space – those working at home only spend 16% of their awake time with others. This unfulfilled need for social interaction drives people to travel more. Harvey and Taylor found that people working at home make significantly more trips a day, then those employed at the workplace (Table 6). What changes is not the amount of travel but only its purpose. Anecdotal evidence shows that people sometimes substitute social interactions with travel – driving the car to escape an empty home and depression caused by lack of social interaction.

Level of social interactions	Number of trips
No work	4.4
High at work	3.7
Average at work	5.7
High work/community	5.5
High work/home	3.7
High work/community/home	5.8
Low at work	4.8
Low work/community	7.0
Low work/home	4.9
Low work/community/home	7.2

Table 6 Relationship between social interactions and number of trips a day (Harvey and Taylor 2000)

This is not to say that we should abandon pursuing the home-working strategies, but they must be complemented with development of new social spaces (parks, streets, cafes) that make social interaction easy, but don't require cars to reach them from home. Otherwise home-working strategies could backfire. An example of successful strategy in London is the renaissance of the so called "villages" – mini town centres scattered around Greater London within easy reach by walking or public transport. A typical village would have “a green” with the regulars on the benches and space for kids on the grass, a corner store, a couple of cafes with tables outside, deli and some sport/activity centres. These spaces replace home gardens for many living in small London flats, while also providing opportunity to interact with the community.

3. TRANSPORT DECISION MAKING

While travel time budget and reasons for car use offer suggestions on how to increase the use of alternative travel modes, analysis of the decision making processes can shed light onto the strategies for shifting away from the use of cars.

3.1 HABITUAL DECISION MAKING

Not all decisions we take involve going through the entire decision making process. There are some that are intuitive, some that are habitual, and only a fraction can be called planned behaviour (Weggemans, 2004). Intuitive or habitual behaviour follows a perception of need straight into a pre-decided action – there is no evaluation involved and no decision has to be taken. Most of daily travel decisions are either habitual or intuitive – we don't make decisions about how to get to work every morning; when we need to go to a shop to pick-up milk, and we don't enter into a complex evaluative exercise if the car is waiting downstairs.

This idea carries important consequences for sustainable transport campaigns. Most of our travel behaviours are triggered mindlessly and consideration of negative impacts on

the environment, health benefits or improved public transport don't enter the equations (Weggemans, 2004). There is no place for persuasion.

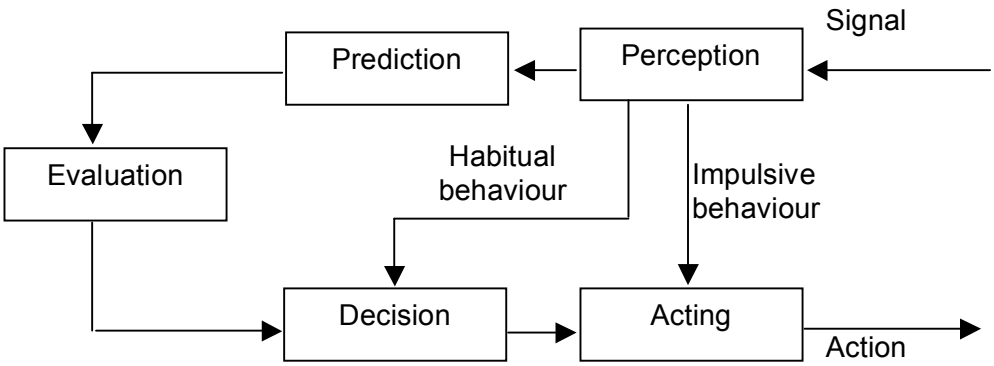


Figure 7 Types of decisions making (Weggemans, 2004)

We can apply to strategies to deal with this situation: try to stop habit formation or to develop new habits. In the society where car use is a norm, the first strategy is difficult to implement, but still interesting to consider. A number of studies (Gilbert, 2004) have shown that the car ownership is very closely associated with a number of kilometres travelled by car. We travel by car because we have it – because the price structure of car ownership places less than half on its usage, with the rest divided between the cost of purchase and maintenance. Most sustainable transport strategies are targeted at car usage not ownership, while it might be possible that if we improved accessibility of options for using cars without owning them (e.g. rentals, car pools, public cars) we could reduce usage significantly avoid development of unsustainable habits.

Formation of new travel habits might be easier. The process starts with awareness of problems e.g. loss of time in traffic, through understanding of underlying problems (use of car), search for options (research into public transport options and different locations for shops), evaluation (what will take the least effort and result in fastest fulfilment of need), through to first experimental behaviours and their evaluation. Only if the evaluation is positive and the behaviour is repeated sufficient number of times does the new behaviour becomes habitual.

Current experiences (e.g. Garling and Axhausen, 2003) seem to indicate that this process can be assisted by affecting the context of the habitual behaviour (e.g. increased price of petrol, new congestion pricing), initiating experimental behaviour (free monthly bus passes) and targeting people who are in the process of change in relation to other aspects of their lives – changing jobs or moving houses. Once initiated, the change process can be easily reversed and requires positive evaluation at each stage. Planned behaviour is reinforced by positive attitude (own and that of peer group) and perceived situational control. While educational campaigns and incentives at work might not be sufficient to develop new travel habits, when combined with contextual changes e.g. changes to

infrastructure (better support for walking or cycling, better costs/benefits balance) they have much higher chance of success. When road works are taking place in the neighbourhoods, changing the urban environment, it is an ideal time and context for targeted educational campaigns.

3.2 MORAL DECISION MAKING

The decision making process is different again when moral issues are considered. Most sustainability campaigns refer to negative impacts of travel on a moral ground – making it a moral obligation to reconsider travel options. According to the model of moral decision making, travel choices are made in four steps (Figure 9). First we need to become aware of the problem (e.g. air pollution) and be able to identify some actions that we would be able to take to solve the problem (use car less). An obligation to take this action is formed based on pre-existing values (e.g. concern for the environment), as well as social (expectations of others) and non-moral (potential savings/ improved health) reasons. In the next stage, cost (loss of comfort, violating peer groups norms) and benefits (feel good factor, any benefits of using public transport) of the action are compared. Only if the evaluation indicates that overall benefits outweigh the cost is an action initiated. If conclusions are unclear, people will become defensive. A dissonance between the feeling of obligation and a decision not to act on it will cause them to re-evaluate their pre-existing values and deny any responsibility. These analyses show that the sustainable transport campaigns have to focus on more than just moral reasons if they are to be effective. Moreover, if the campaign is held while there is no attractive alternatives to car use, it will only reinforce (cause people to justify) their existing behaviour. It is therefore essential to combine those educational measures with changes to infrastructure that would sway anticipatory evaluation towards desired behaviour.

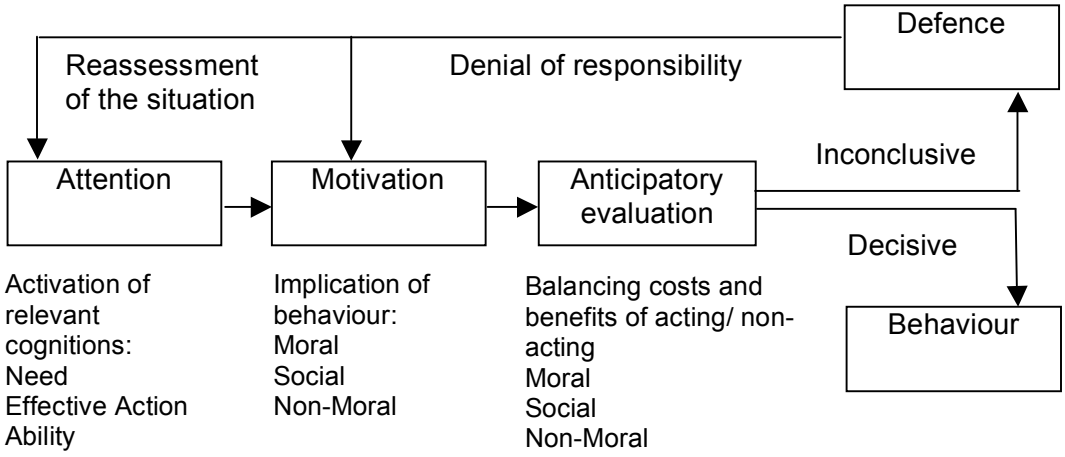


Figure 8 Moral decision making (Matthies, 2004)

Gilbert (2004) provides a list of amenities that would increase chances of moral behaviour in a neighbourhood:

- schools, stores, and recreational and cultural facilities within a walk, a bicycle ride or a short public transport journey (reduction of potential time, discomfort costs);

- safe and enticing routes along which to walk or ride a bike (benefits of enjoyable exercise and contact with nature);
- good public transport, which in lower density areas could include demand-driven service to the door or to nearby pick-up and set-down points;
- ready access to places of employment and to services that support home-based employment;
- car-sharing services for longer or special trips;
- delivery of purchased goods and for other purposes;
- excellent information about all of the above.

4. CONCLUSIONS

In order to achieve (or get a bit closer to it) one-planet mobility, people will need to re-evaluate their transport habits. As the car is the most resource intensive mode of transportation, this may mean a drastic reduction in car use. This reduction would take place within the constraints of our daily time budget, and would require breaking habits and weighing moral and non-moral costs and benefits of the new behaviours. To enable this shift, a whole package of actions needs to occur in the urban environment. Most of the strategies proposed by London First's think tank could play a role, but what is important is that the strategies are co-ordinated so that the synergies between them can take place.

Those responsible for road infrastructure (maintenance, planning, construction) play one of the most important roles. The environment within which we live is the only medium that can compare its "share of voice" (a marketing term to describe differences in exposure to public) with the advertising budgets of the car companies. Usability, as well as look and feel of the urban environment, influences us everyday, and any changes to it will provide a strong impulse to a change of behaviour. Roads became synonymous with car use only recently. Before that they played an important role in communities providing meeting places, children's playgrounds and green spaces. This is starting to happen again through the neo-traditional design, homezones and urban villages design models.

Car-orientated design can often encourage further car use and create ugly, anti-social spaces, which create barriers to pedestrians and cyclists. Redesigning the streets for pedestrian and cycle traffic could improve sense of community, enhance the streetscape and provide grounds to interact with others. Road design has a central role to play, but it has to be co-ordinated with other strategies if the vision of one-planet-mobility is to be achieved.

5. ACKNOWLEDGMENTS

This paper drew extensively from the work of the project team of “Towards a Sustainable London” including London First, London Remade, steering committee (of which the author was a member) and consultants WSP and Natural Strategies. Insightful feedback has been provided by Kerry Griffiths and Graham Chapman, consultants at URS New Zealand.

REFERENCES

1. Banfield K. 1997. Should planners underprovide car-parking. UTS
2. BFF 2000. Island State: An ecological footprint analysis of the Isle of Wight (2000)
3. BFF 2002. The City Limits
4. BFF 2004. Scotland's Footprint - a mass balance and ecological footprint of Scotland
5. BioRegional 2003. One –Planet Living in the Thames Gateway
6. Button K. & Nijkamp P. 1997. Social change and sustainable transport. Journal of Transportation and Geography. Vol.5 No.3 pp.215-218
7. Campbell S. & White S. 2003. Integrated Resource Planning for Transport: asking better questions. Institute for Sustainable Futures
8. Diekstra R. & Kroon M. 2004. Cars and behaviour: psychological barriers to car restraint and sustainable urban transport. In: Communicating Environmentally Sustainable Transport. OECD
9. Donaghy K., Rudinger G., Poppelreuter S. 2004. Societal trends, mobility behaviour and sustainable transport in Europe and North America. Transport Reviews. Vol. 24 No. 6 pp.679-690
10. Engel-Yan J., Kennedy C. Saiz S. Pressnail K. 2005. Towards sustainable neighbourhoods: the need to consider infrastructure interactions. Canadian Journal of Civil Engineering. 32/1
11. Garling T. & Axhausen K.W. 2003. Introduction: Habitual travel choice. Transportation. 30
12. Garvill J., Marell A., Nordlund A. 2003. Effects of increased awareness on choice of travel mode. Transportation. 30. pp. 63-79
13. Gilbert R. 2004 Soft measures and transport behaviour. In: Communicating Environmentally Sustainable Transport. OECD
14. Harvey A.S. & Taylor M.E. 2000. Activity settings and travel behaviour: a social contact perspective. Transportation 27 pp. 53-73
15. Jones P. 2004. Comments on the roles of soft measures in achieving EST. In: Communicating Environmentally Sustainable Transport. OECD
16. Knoflatcher H. 2004. Roles of measures in changing transport and other behaviour. In: Communicating Environmentally Sustainable Transport. OECD
17. London First 2005. Towards a Sustainable London: Reducing Capital's Ecological Footprint.
18. Mackett R.L. 2003. Why do people use their cars for short trips? Transportation 30/3 p329
19. Mason C. 2001. Urban Roads. A health Assets. RAPI (NSW) Conference Proceedings
20. Matthies E. 2004. A social psychologist's perspective on transport behaviour and the effectiveness of soft measures. In: Communicating Environmentally Sustainable Transport. OECD

21. Waste Watch, 2001. Adding value to public services: Analysis of public sector resource use
22. WBCSD, 2003. Mobility 2030.
23. Weggemans T. 2004. The effectiveness of measures to change transport behaviour. In: Communicating Environmentally Sustainable Transport. OECD
24. WSP & Natural Strategies 2003 London Ecological Footprint Phase 1 Report
25. WSP & Natural Strategies 2003 London Ecological Footprint Phase 2 Report
26. WWF 2004. Living Planet Report
27. Verhoef E., Ubbels B., Rodenburg C., Nijkamp P. 2001. Sustainable Mobility. Research Memorandum 14
28. Zeibots M.E. 2003. How do cities work and why is transport so significant? Regional sustainability and the search for new evaluation tools. Proceedings of Second meeting of the Academic Forum of Regional Government for Sustainable Development.