A new way to organize parking: the key to a successful sustainable transport system for the future

HERMANN KNOFLACHER

Professor Hermann Knoflacher works at the Institute for Transport Planning and Traffic Engineering (Interdisciplinary Mobility and Accessibility Research), Technical University of Vienna.

Address: Technical University of Vienna, Institute for Transport Planning and Traffic Engineering, Gusshausstraße 30/231, 1040 Vienna, Austria; e-mail: hermann.knoflacher@ivv.tuwien.ac.at

ABSTRACT This paper reviews the failure of conventional transport policies to address the many problems caused by private car use in cities in high-income nations, and suggests that restructuring parking provision can address these problems. It discusses how increasing car use has not produced more trips per day, and increasing speed has not increased leisure time, because of congestion and increased travel distances. Transport planning that provides parking spaces for car owners at their homes, workplaces, shopping centres and recreational places has supported increased private car use. Not only does this make people car drivers but its effect also restructures cities so that shop, workplace, recreational and social contacts within neighbourhoods disappear, city landscapes become remodeled for cars, and public transport becomes unviable. Meanwhile, car-oriented city streets discourage walking. This paper suggests that these problems can be solved if strong incentives are provided for cars to be parked in garages that are only as accessible as public transport stops – at all origins and destinations.

KEYWORDS land use management / sustainable cities / transport

I. INTRODUCTION

The innovation of technical modes of transport driven by artificial energy (fossil fuels or electricity), such as railways, cars and airplanes, has fascinated the general public as well as engineers and researchers. Increasing numbers of people have gained access to this wonderful and nearly effortless kind of movement, which appears to enhance mobility and save time. Technological innovation and (superficially) positive economic effects have driven the development of a vast network of railways, roads, motorways and airports that move people, goods and information faster. However, neither the social implications nor the ecological effects have been adequately recognized. Unlike such domains as health or education, transport does not improve with economic development. Over time, more and more negative effects have appeared: accidents, noise, air pollution, urban sprawl, congestion on the roads, and the need for increasing subsidies for the operation of public transport. Transport is also a major contributor to greenhouse gases and thus also to the risks that come with climate change.

For more than 50 years, traffic engineering has focused primarily on traffic flows and congestion. The growing number of cars was seen as a natural function of the system, and the solution was to provide enough

Vol 18(2): 387–400. DOI: 10.1177/0956247806069621 www.sagepublications.com

parking space or, if this was not possible, to introduce parking fees. The effects of these measures were not encouraging as they failed to reverse or even halt the main trend. The parking of individual cars was not seen as a traffic engineering issue, but as a fact that had to be tolerated or an issue for urban planning. System-wide effects were not recognized – architects and urban planners were responsible for urban structures, and transport engineers and economists were responsible for the functioning of the transport system. The behaviour of cars, consumers and transport system users was taken into account, but the feedback effects on each other were not.

II. CURRENT TRANSPORT POLICIES

Most city transport systems suffer from heavy congestion and, if greenhouse gas emissions are to be cut, are increasingly unsustainable. An analysis of current transport policy points to helplessness in the face of problems, to basic ignorance concerning the causes of the problems and, often, to measures that are not cost-effective and that produce problems rather than solving them. The applied measures and areas of political interest today are based on traffic flow theory, congestion charging, road pricing, public transport subsidies, telematics (ITS Intelligent Transport Systems) and urban and land use planning based on such assumptions.(1)

The effects of these approaches have been:

- increasing transport problems;
- increasing deficits in public transport and in community budgets;
- often, increasing air pollution; and
- "solutions" driven by ideology instead of rationality, and populism instead of responsibility.

A few selected indicators regarding the transport system can support this harsh assessment:

- driving a car for one hour costs at least 40 minutes of a person's lifetime in the system in high-income nations, when one takes into account the lifetime lost through premature death by victims of accidents and air pollution;
- in most cities, the congestion problem is greater then ever before;
- carbon dioxide emissions (the main cause of global warming) from road traffic are increasing;
- the growth in transport miles is greater than the growth in GDP;
- public transport subsidies have not provided a solution;
- urban sprawl is increasing, and increasing amounts of land are paved for a more and more inefficient transport system;
- there are increasing conflicts between infrastructure developers and the public; and
- people's freedom of choice is decreasing in many places, and more and more people are forced to use the car.

The development of the technical means to achieve speed in transport systems has taken place so quickly that almost no-one, at least in the professional arena, has understood the consequences for the transport system, cities and other settlements, families and society, cultures and the environment (including the global climate). In general, the public is content as long as speed is high and traffic flows are uninterrupted.

1. DETR (1998), *A New Deal for Transport: Better for Everyone*, TSO, London; also DETR (1998), *Planning for Sustainable Development: Towards Better Practice*, TSO, London; Knoflacher, H (1994), "Denken – Planen – Entscheiden – Verantworten", *Gemeinde Stadt Land* No 19, pages 41–51; and Knoflacher, H (1997), *Landschaft Ohne Autobahnen. Fuer Eine Zukunftsorientierte Verkehrsplanung*, Boehlau Verlag, Vienna.

Transport science has lost its way. Measures are introduced that address symptoms rather than causes. This is happening on all levels, from local communities to the European Union. Instead of supporting scientific research, funds are devoted to so-called "best practice", but most "best practice" is a symptom-oriented response that has – at best – temporary effects. Transport policy within Europe, both at the European Commission level and within national governments, has at its base a lack of knowledge about this technology-driven transport system and its interactions with society, environment and economy. It is driven more by ideology than by knowledge. At the local level, many experiments are underway, but without any systematic research.

In many ways, walking is the only mode of transport that we are really familiar with. We have several million years experience with walking, about 10,000 years experience with settlement, cities, boats and horses, only 200 years with bicycles, about 150 with railways, 100 years with cars and airplanes, 50 years with TV and a few decades with telecommunications. The fascination with speed is obvious, as the rapid development of speed in cars indicates. In a graph of how average travel speed has changed over time, on the time scale of human existence travel speed only explodes in the last micro-millimetre of the time axis.

The speed of this change has proved too much for professional disciplines, politicians and society to take in rationally. Instead, personal experiences with this new environment have been viewed as system effects and been extrapolated to the whole system. Instead of a sound scientific analysis, professionals translated their assumptions into a set of beliefs that are, in effect, dogmas defended by national and international professional societies and lobby groups: a belief in the importance of the growth of mobility; of increasing speed as the way to save time and of providing freedom of modal choice.

Dogma 1: More cars will produce a growth in mobility and more trips per person per day. This was based on the observation that with increasing motorization, the number of possible trips per person per day increases. This was so impressive that large amounts of urban space were converted into parking space.

But the reality is different. Mobility is always related to a purpose, and if the purpose does not change, mobility does not change. As the number of trips by car increases, the number of trips on foot, by cycle and by public transport decreases. The number of trips per person per day remains constant (Figure 1).

The system as it stands today can be influenced by appropriate measures as demonstrated by the case of Eisenstadt in Austria, where scientific system-related transport principles, taking real human behaviour into account, have been successfully implemented. In 1975, the city was crowded with cars. While 10,000 cars passed through the city centre each day, only 6,000 pedestrians were counted (Photo 1).

Today there are between 26,000 and 40,000 pedestrians per day, and no cars, and both mobility and business in the city centre have increased (Photo 2). A number of measures were necessary to change this human behaviour: besides developing a pedestrian area in the city centre, parking management was also needed. Now, cars are parked in garages instead of on the streets, traffic-calming methods have been introduced around the city centre and the city taxi has been introduced.

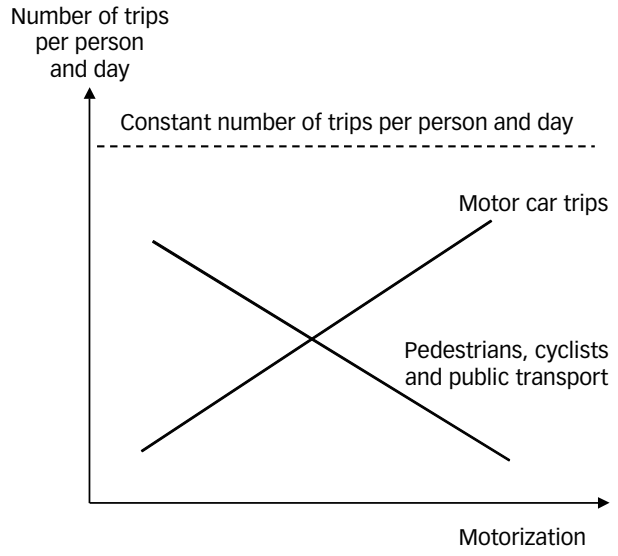

FIGURE 1
More car trips, less other trips

SOURCE: Knoflacher, H, W Gatterer, R Gross, S Winkelbauer and H Zukal (1985), "Raumwirksamkeit von Verkehrssystemen, Straßenforschung", *Heft 268*, Bundesministerium für Bauten und Technik, Vienna.

Dogma 2: Increasing speed saves time. Investment in transport infrastructure is based on calculations which assume that increasing speed means less travel time. But this is not supported by data. An analysis of the development of the individual speed of Austrians between 1955 and 1982 found that the average Austrian (using cars, cycles, motorcycles or walking) has experienced a ten-fold increase in speed within this 25-year period. Thus a surplus of time would be expected, since everybody is moving faster and therefore should benefit from saving time. But this has not been the case. As seen in Figure 2, if faster modes such as cars saved time, as would be expected, they should be found on the left side of the travel time distribution of slow modes, like pedestrians or cyclists.

If the travel time distribution of different transport system users is analyzed, all individual transport system users – whether pedestrians, cyclists, motorcyclists or car drivers – not only have similar total travel times, they also have similar travel time distribution. Although car drivers are six times faster than pedestrians, they do not spend less time in the system. These basic findings from the 1970s were demonstrated again in the 1990s in an analysis of travel survey data from different countries of the world.[2] People living in societies without cars have to walk; Europeans, North Americans and Japanese, by contrast, have 500 cars or more per 1,000 inhabitants. But everywhere in the world, the average travel time budget is similar because as speed has increased, so have both congestion and the distances that people travel (Figure 3).

For traditional demand-oriented transport experts, traffic data mean car data. This produces more data on cars, which then leads to more

2. Goodwin, P B (1981), "The usefulness of travel budgets", *Transportation Research A* Vol 15, No 11, pages 97–106; also Zahavi, Y (1979), *The UMOT Project*, US Department of Transportation, Research and Special Programs Administration and the Federal Republic of Germany Ministry of Transport; Schafer, A (1998), "The global demand for motorized mobility", *Transportation Research Part A: Policy and Practice* Vol 32, No 6, pages 455–477; and Schafer, A (2000), "Regularities in travel demand: an international perspective", *Journal of Transportation and Statistics* Vol 3, No 3, pages 1–31, December.

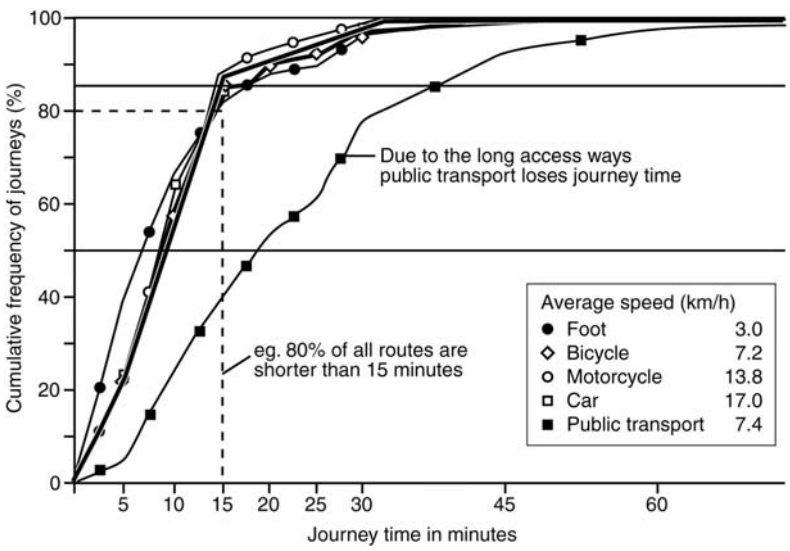

FIGURE 2
Journey time by means of travel (cumulative frequency based on shopping trips) in the city of Wels

SOURCE: Knoflacher, H (1989), "Generalverkehrsplan Wels", Durchgeführt im Auftrag des Magistrats der Stadt Wels, cited in Knoflacher, H (1996) *Zur Harmonie von Stadt und Verkehr*, Böhlam Verlag, Vienna, second edition.

car-oriented solutions, so "transport growth" is the logical outcome and congestion the inevitable by-product. Demand-oriented transport engineering produces and maximizes congestion, while simultaneously producing both urban sprawl for housing and a concentration of business and shopping activities along motorways and on the fringes of cities.

Dogma 3: The assumed benefits of freedom of modal choice. Since new transport modes are a human invention, it should also be possible to control and master them. This is the basic assumption, which leads to the expectation that we have an unlimited freedom of modal choice. Given the choice, people will select easier modes of travel (Figure 3).

Before motorized transport, there was a strong relationship between people's movement patterns and their body energy. However, car drivers use only a fraction of the body energy per time compared to pedestrians[3] (Figure 4). Although cars are part of our technical civilization, they affect people on the very fundamental, even evolutionary, level of basic energy use.

This can change values, structures and cultures. It has tremendous effects on the whole of society – which are not well understood by all the disciplines related to transport. If the level of body energy changes, our relationship with everything else also changes.

Policy related to our freedom of modal choice becomes, in effect, a policy for car drivers. This can be seen if the basic rights of pedestrians are compared to those of car users. If all pedestrians were to carry a frame the size of a car, the resulting blockage of public space would be

3. Hettinger, T (1989), "Physiologische Leistungsgrundlagen", in H Schmidke (editor), *Handbuch der Ergonomie* Vol 1, Carl Hanser Verlag, Munich and Vienna; also Spitzer, H, T Hettinger and G Kaminsky (1982), *Tafeln für den Energieumsatz be körperlicher Arbeit*, Beuth Verlag GmbH, Berlin and Cologne.

PHOTOS 1 & 2
Eisenstadt before and after

considered the consequence of crazy behaviour (Figure 5). But when people in cars cause this same blockage, it is not considered craziness but congestion. Driving is recognized by everybody as a kind of unsocial behaviour, but at the same time is accepted as a real human need.

Traditionally, cars are parked directly at the origin or destination of a trip. This means that public space which formerly was road used by everyone becomes privileged space for motor vehicles – used mainly by private car users. This also influences pedestrian behaviour. The distance that people are prepared to walk is dependent on the quality of the walking environment. In a car-free environment, people accept walking distances that are more than 70 per cent longer than in a car-oriented environment[4] (Figure 6).

4. Peperna, O (1982), "Die Einzugsbereiche von Haltestellen öffentlicher Nahverkehrsmittel im Straßenbahn – und Busverkehr", Masters thesis, Technical University of Vienna.

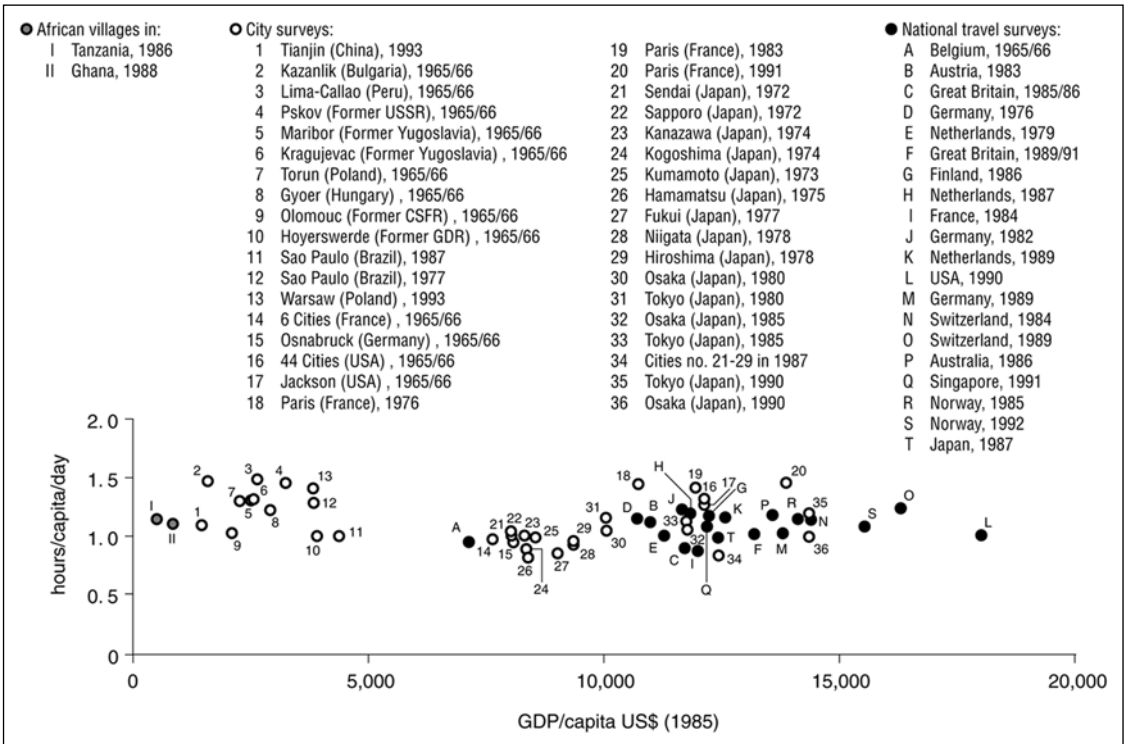

FIGURE 3
Travel time budgets

SOURCE: Schafer, A (1998), "The global demand for motorized mobility", *Transportation Research Part A: Policy and Practice* Vol 32, No 6, pages 455–477.

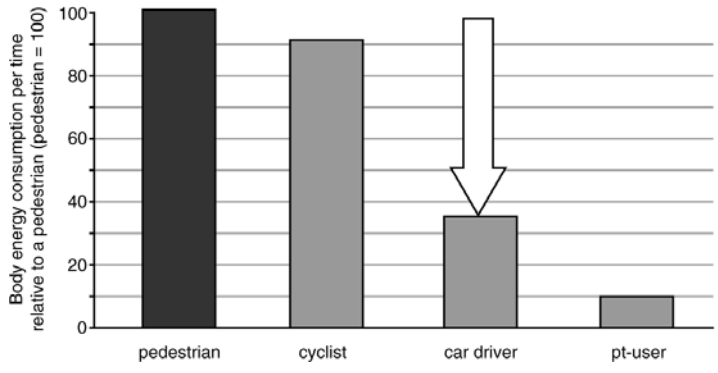

FIGURE 4
The differentials in body energy consumption per time of different transport modes

SOURCE: Hettinger, T, G Kaminsky and H Schmale (1980), *Ergonomie am Arbeitsplatz* 2, überarbeitete und erweiterte Auflage, Friedrich Kiehl Verlag, Ludwigshafen.

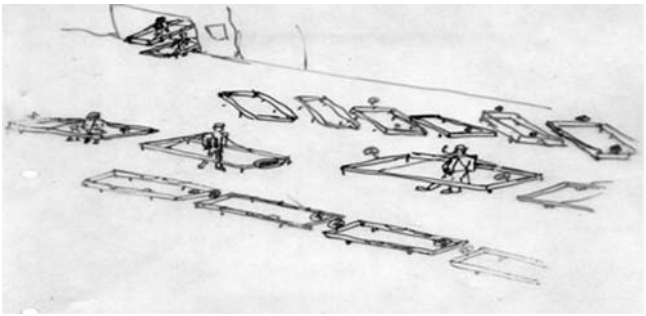

FIGURE 5

What if pedestrians needed the same space as cars? A pedestrian with his walking tool, searching for a parking space

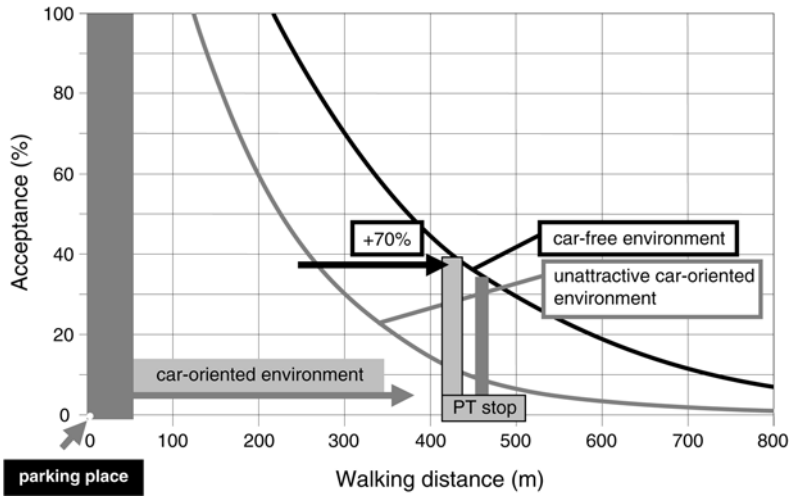

FIGURE 6
How car-free environments encourage people to walk more

SOURCE: Peperna, O (1982), "Die Einzugsbereiche von Haltestellen öffentlicher Nahverkehrsmittel im Straßenbahn – und Busverkehr", Masters thesis, Technical University of Vienna.

III. THE KEY FOR A SUCCESSFUL SUSTAINABLE CITY OF THE FUTURE

Since the beginning of motorization in the 1930s, parking has been a problem for urban planners, transport engineers and politicians. The *Reichsgaragenordnung* (Order on Garages of the Third Reich) of 1939 tried to solve the problem by introducing parking standards. The city of Hamburg introduced parking fees in the city centre in 1955 (Law of 13 September 1955). Newman and Kenworthy mention various examples of how to reduce parking on public roads.(5) And Shoup deals with parking from the position of an economist and urban planner.(6) But these solutions only scratch the surface of the problem. The underlying causes are more deeply rooted in the human physiological structure.(7)

If private cars can be parked at home or in the street next to the home, places of work do not need to be close by (Figures 7 and 8). This is also true for shops and recreational facilities. In effect, parking at home makes people car drivers – for going to work, for shopping and for recreation. It also means that parking facilities are needed in the workplace and where people go to shop and for recreation. Parking at home and at all these destinations takes up large amounts of space. If the walking distance to the public transport stop is further than to where the car is parked, the average human being will use the car. It is interesting that transport literature does not recognize this problem. Instead, it accepts the existing parking regulations, which stipulate the need for parking places close to all activities and facilities. Such an arrangement can never allow for the development of a sustainable city structure. Cars

5. Newman, Peter and Jeffrey Kenworthy (1999), *Sustainability and Cities: Overcoming Automobile Dependence*, Island Press, Washington DC, 442 pages.

6. Shoup, Donald (2005), *The High Cost of Free Parking*, Planners Press, American Planning Association, Chicago and Washington DC, 752 pages.

7. Knoflacher, H (1981), "Human energy expenditure in different modes: implications for town planning", in *International Symposium on Surface Transportation System Performance* Vol II, US Department of Transportation, Washington DC.

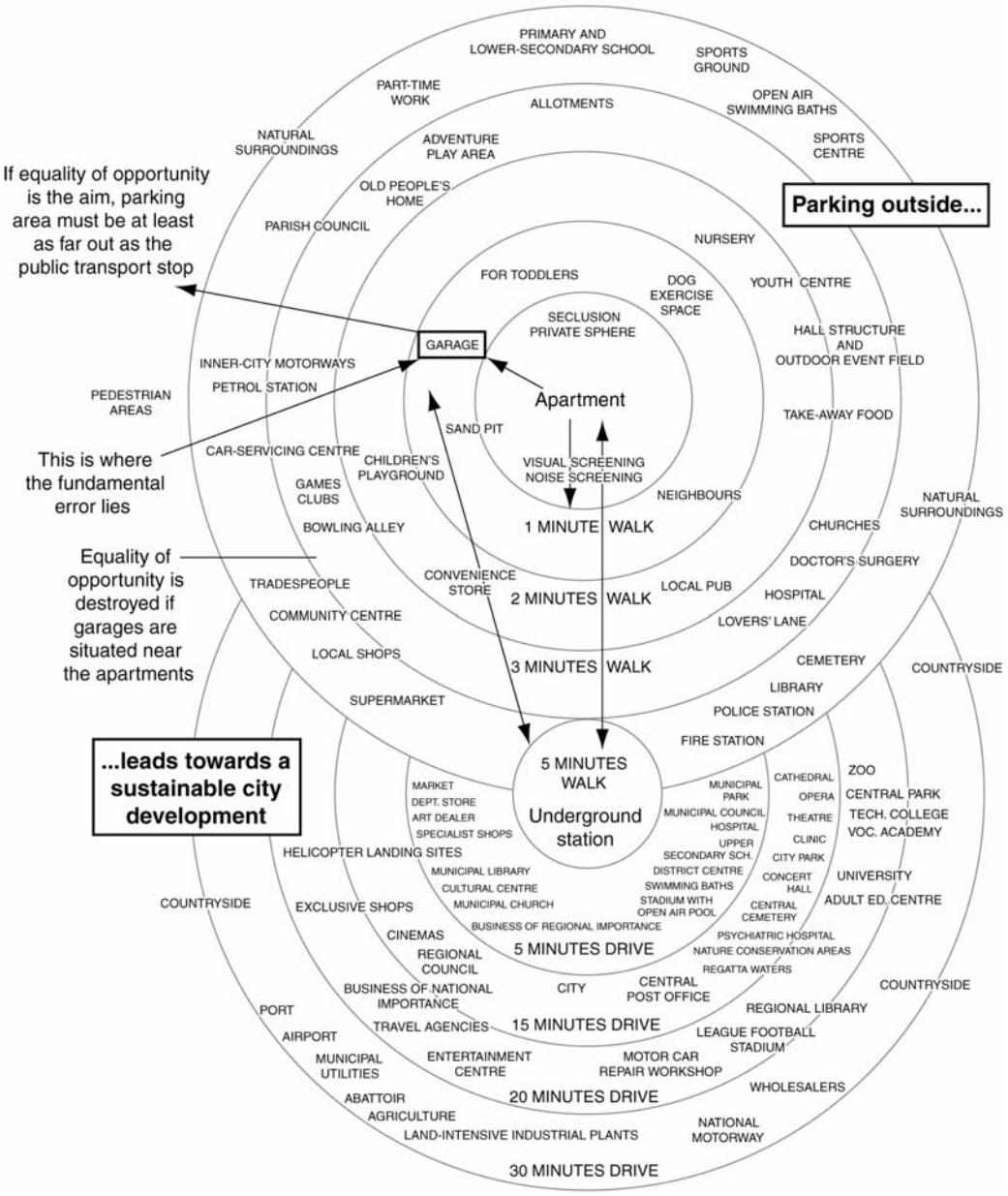

FIGURE 7
Parking in garages leads to a more sustainable city development

SOURCE: Lehmbrock, J and W Fischer (1979), "Von Profitopolis zur Stadt der Menschen. Katalog zur gleichnamigen Ausstellung." Die neue Sammlung des staatlichen Museums für angewandte Kunst, Münich, cited in Knoflacher, H (1996), *Zur Harmonie von Stadt und Verkehr*, Böhlau Verlag, Vienna, second edition.

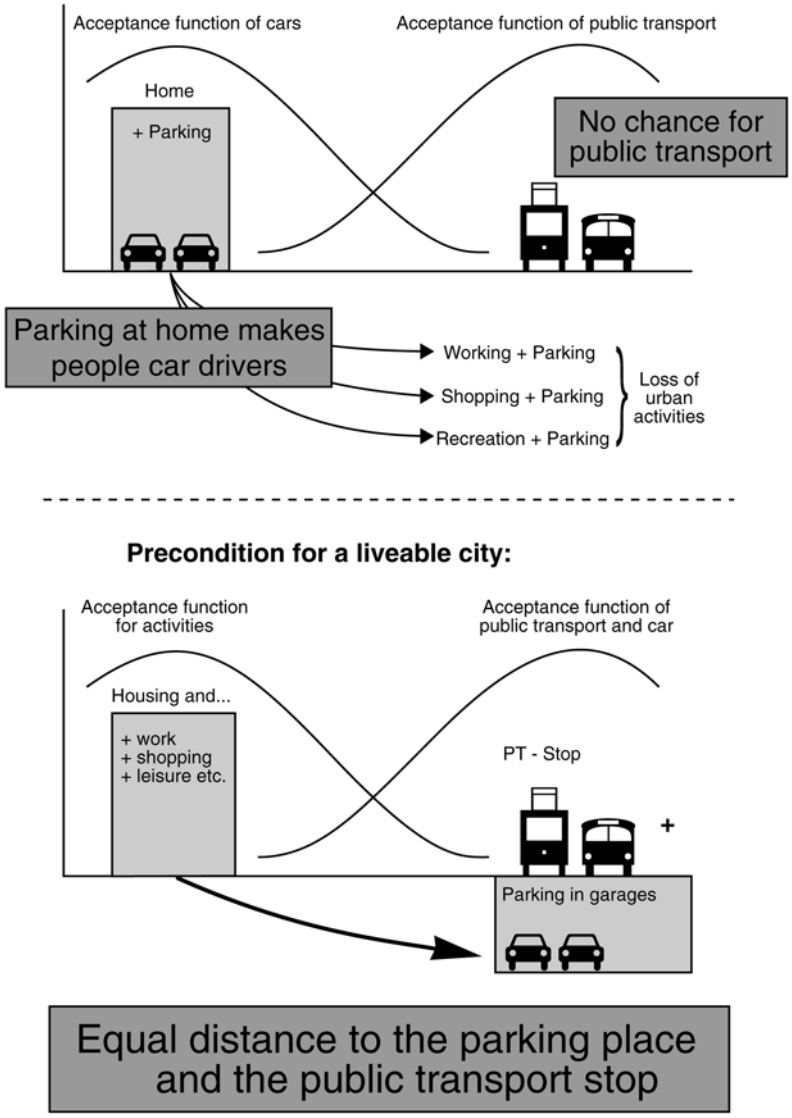

FIGURE 8
The shift from a car-oriented city to a liveable city

SOURCE: Knoflacher, H (1980), "Öffentliche Verkehrsmittel – Neue Strukturen zur Verbesserung ihrer Chancengleichheit im städtischen Bereich", *Internationales Verkehrswesen* Vol 32, No 3, pages 176–178.

at home replace everything else in the neighbourhood. As a result, shop, recreational and social contacts are disappearing and public transport is unviable. Private parking places are destroying the living space of cities – as a result of what Professor Whitelegg called "intelligence-free planning".[8]

8. Whitelegg, J (2002), "Roles of soft measures in changing transport and other behaviour", Paper presented at the OECD Workshop on Environmental Sustainable Transport, Berlin, 5–6 December.

a. The solution

As long as existing planning and parking guidelines prescribe parking close to human activities, it will mean increasing private car use – with all the damaging implications that this brings, as noted above. The solution lies not in addressing traffic flows, road pricing or changing technologies, nor in tariffs for public transport – but in changing parking management.[9] The *intelligent* solution is a new kind of parking organization – the right organization of the origin and destination of trips (Figure 8).

One of the most important goals of transport policies is the prioritization of public transport – but this does not work if much of the population has cars parked in front of their homes or in garages and the public transport stop is several hundred metres away. And if the destination is organized in the same way, public transport has no chance against car traffic. Under these conditions, everybody will try to buy a car and increase the degree of motorization, thereby exacerbating the problem.

The solution is a total reorganization of the existing parking situation everywhere (not only in cities). Instead of the individual optimization of human activities and car parking, strong incentives should be provided to park cars in garages that are only as accessible as public transport stops – at all origins and destinations.

If a transport structure was provided that gave people a genuine choice between cars and public transport, better environmental conditions, more flexibility and opportunities for nearby jobs, and recreational activities and social contacts, it would take no time to switch from *intelligence-free* planning to *intelligent* planning, taking into account real system behaviour. About 70 per cent of urban space would then become car free. This is a tremendous benefit relative to the costs of restructuring the existing unsustainable system. With the space recovered, new urban activities would develop from this equality of choice between cars and public transport. If we take real human behaviour into account, the effect is bigger, as around 80 per cent of the urban structure could become multifunctional.

b. The way to reach this goal

Anyone parking at home contributes to all the problems for the city as described above, including transport problems, congestion, environmental problems and urban sprawl. The solution therefore is to introduce charges in relation to benefits. A person who parks at home would have to pay for the benefits of this exclusive and privileged position. A person who parks in a centralized garage, at least as far away as the next public transport stop, would have to pay less. The charge should be related to public transport fares and the financial and operational costs of the garage operators. The minimum monthly charge for parking in the right place (a centralized garage) would be equivalent to the cost of a monthly ticket for the public transport system, and a person who parks their car in the right place would also get a ticket for the public transport system. People parking at home would have to pay three or four times more (depending on the distance to the public transport stop) for the benefits of their privileged situation, but they would still only get one monthly ticket for their

9. See reference 1, Knoflacher (1997); also Knoflacher, H (2001), *Stehzeuge. Der Stau ist kein Verkehrsproblem*, Boehlau Verlag, Vienna; and Knoflacher, H (2002), "Wie die Trendumkehr der Verkehrsentwicklung denkbar machen?" *Österr. Ingenieur- und Architekten-Zeitschrift (ÖIAZ)* No 146.

payment. The same charge would be introduced for all other opportunities – work, shopping, recreation etc. This would provide enough money to restructure the system within a relatively short period of time. Once the system is restructured in this sustainable way, public transport would need no more subsidies and garages could operate on the running costs.

This new structure would create a lot of local jobs in construction, since thousands of garages would have to be planned and built, hundred of thousands of kilometres of roads would have to be reshaped and a lot of local activities would be established everywhere. And the responsible parties would pay all the costs.

During the transition period, funding would come from home or street parking charges, and could be used for the recovery of the urban structure and economy, the construction of garages, the improvement of public transport and the strengthening of the local community and the local economy. After reshaping the structures, the system would be much cheaper, needing little or no subsidy. This would be a problem-solving and not a problem-producing structure.

REFERENCES

DETR (1998), *A New Deal for Transport: Better for Everyone*, TSO, London.

DETR (1998), *Planning for Sustainable Development: Towards Better Practice*, TSO, London.

Goodwin, P B (1981), "The usefulness of travel budgets", *Transportation Research A* Vol 15, No 11, pages 97–106.

Hettinger, T (1989), "Physiologische Leistungsgrundlagen", in H Schmidke (editor), *Handbuch der Ergonomie* Vol 1, Carl Hanser Verlag, Munich and Vienna.

Hettinger, T, G Kaminsky and H Schmale (1980), *Ergonomie am Arbeitsplatz, 2 überarbeitete und erweiterte Auflage*, Friedrich Kiehl Verlag, Ludwigshafen.

Knoflacher, H (1980), "Öffentliche Verkehrsmittel – Neue Strukturen zur Verbesserung ihrer Chancengleichheit im städtischen Bereich", *Internationales Verkehrswesen* Vol 32, No 3, pages 176–178.

Knoflacher, H (1981), "Human energy expenditure in different modes: implications for town planning", in *International Symposium on Surface Transportation System Performance* Vol II, US Department of Transportation, Washington DC.

Knoflacher, H, W Gatterer, R Gross, S Winkelbauer and H Zukal (1985), "Raumwirksamkeit von Verkehrssystemen, Schriftenreihe Straßenforschung", *Heft* 268, Bundesministerium für Bauten und Technik, Vienna.

Knoflacher, H (1989), "Generalverkehrsplan Wels", Durchgeführt im Auftrag des Magistrats der Stadt Wels.

Knoflacher, H (1994), "Denken – Planen – Entscheiden – Verantworten", *Gemeinde Stadt Land* No 19, pages 41–51.

Knoflacher, H (1996), *Zur Harmonie von Stadt und Verkehr, Böhlau Verlag*, Vienna, second edition.

Knoflacher, H (1997), *Landschaft Ohne Autobahnen. Fuer Eine Zukunftsorientierte Verkehrsplanung*, Boehlau Verlag, Vienna.

Knoflacher, H (2001), *Stehzeuge. Der Stau ist kein Verkehrsproblem*, Boehlau Verlag, Vienna.

Knoflacher, H (2002), "Wie die Trendumkehr der Verkehrsentwicklung denkbar machen?", *Österr. Ingenieur- und Architekten-Zeitschrift (ÖIAZ)* No 146.

Lehmbrock, J and W Fischer (1979), "Von Profitopolis zur Stadt der Menschen. Katalog zur gleichnamigen Ausstellung", Die neue Sammlung des staatlichen Museums für angewandte Kunst, Münich.

Newman, Peter and Jeffrey Kenworthy (1999), *Sustainability and Cities: Overcoming Automobile Dependence*, Island Press, Washington DC.

Peperna, O (1982), "Die Einzugsbereiche von Haltestellen öffentlicher Nahverkehrsmittel im Straßenbahn – und Busverkehr", Masters thesis, Technical University of Vienna.

Schafer, A (1998), "The global demand for motorized mobility", *Transportation Research Part A: Policy and Practice* Vol 32, No 6, pages 455–477.

Schafer, A (2000), "Regularities in travel demand: an international perspective", *Journal of Transportation and Statistics* Vol 3, No 3, pages 1–31, December.

Shoup, Donald (2005), *The High Cost of Free Parking*, Planners Press, American Planning Association, Chicago and Washington DC.

Spitzer, H, T Hettinger and G Kaminsky (1982), *Tafeln für den Energieumsatz be körperlicher Arbeit*, Beuth Verlag GmbH, Berlin and Cologne.

Whitelegg, J (2002), "Roles of soft measures in changing transport and other behaviour", Paper presented at the OECD Workshop on Environmental Sustainable Transport, Berlin, 5–6 December.

Zahavi, Y (1979), *The UMOT Project*, US Department of Transportation, Research and Special Programs Administration and the Federal Republic of Germany Ministry of Transport.