Modal Split Trends are the Result of Traffic Planning and Organisation

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ABSTRACT

Human behaviour depends on irritation from the environment. If the irritation is positive for cars the mobility will car mobility, if the irritation is positive for pedestrians, the create pedestrians. The same effect can be observed for public transport and cycles, theoretical and experimental based studies are supporting his findings.

Modal split-trends seem to be like a natural law if we follow figure 1 published by Voigt /1/. Apparently that increased motorization in all countries has reduced the rate of public transport in the same way. It seems that we can establish a hypothesis:
public transportation and the traffic system are decreasing as shown in figure 1 with increasing motorization.

A hypothesis is true as long as there is no contradictory observation. There are some contradictory observations:

1) Modal split for shopping in the city of Vienna.
The population of Austria has a motorization degree of about 400 cars/1000 inhabitants. For shopping in the city of Vienna the car is used by only 10 %. Figure 2 shows the modal split of shoppers in the city of Vienna. This observation is contradictory to the hypothesis above. It is the result of the traffic infrastructure in the city of Vienna, which is a combination of pedestrian zones with a good public transport system (Metro system) and cycle strips developed in the 80ies /2/.

Second Example: Increasing motorization has increased the number of trips per cars per person and day (figure 3). Since the number of trips per day per person has not changed very much over this period the increasing number of car trips results from decreasing pedestrian trips, cycle trips or public transport trips /3/.

In order to reduce car trips it is necessary to have a road network. The pre-assumption for diagram 3 is therefore a road network, which has not been mentioned in this relationship. If we

compare the specific equipment with cycle trips with the rate of cycle trips we get diagram 4. It shows that from the whole mobility of a person the amount of cycle trips is greater if we offer the person a greater amount of cycle strips. If we offer one meter cycle trips per person in a flat area (in a proper way) the people will use the cycle for about 30 % of daily trips. In Delft 50 % of all trips in the city center are made by cycles. This is the result of the extensive cycling program offering about 3 meters of cycle strips per person /4/.

Example 3: Comparing the behaviour of car owners having a parking place at the destination of their daily trips with car owners without a reserved parking place, it was found that car owners without reserved parking places in the city use 3 times more the public transportation system compared to the other group /5/.

There are several other examples which show that the hypothesis that increasing motorization leads to an increased use of cars is not at all a natural law. Modal split behaviour is obviously the result of infrastructure, traffic system organisation, costs, convenience and advertising.

All of these factors are manmade and the results of planning and traffic organisation.

What is the basis of this behaviour:
As it could be shown in the OECD-Symposium in 1981, the basis of human behaviour in traffic is the relationship between sensation and irritation /6/. This concept could be established by using the following studies:

1. The observation of Walther about time perception which is different depending on the kind of movement. The attractivity of trips decreases with increasing distance (in general). /7/

2. The author found a similar curve in the work of Frisch, observing the frequency of movements of bees informing other bees about distances to an attractive source of food, he found a curve similar to /8/.

As a result of the experiment a 3 to 4 meter long walking distance for bees is equal to an 80 meter long flight distance in energy consumption. Based on these findings a theory which describes the human behaviour in a traffic system in a rather precise way could be established. It is the balance between positive and negative irritation, which is the basis for the choise for a specific traffic mode. Based on the theory it can be shown that a nice environment changes the "elasticity for walkways" in a tremendous way. Pedestrians are willing to walk up to 70 % longer if the environment is nice compared to a car oriented environment /10/.

The basic law is the "Weber Fechner's sensation - irritation law" - which describes behaviour in general. The problem is how can we find the inputs for this law ? Studies in Vienna have shown that

the energy consumption for man is a key factor for modal split. Energy consumption is calculated against positive irritation. If the positive irritation is big enough, people are willing to invest a certain amount of energy to reach one's destination, it could be also an expectation for a positive irritation. Hope, expectations, also advertisements have a very strong influence on human behaviour. But how can it be measured ?

Energy consumption can be measured relatively simply by measuring the heart rate of a person, which has been done in studies in Vienna and in several ergonomic research works. Comparing the human body energy for walking and for driving or riding a bus, explains the observations from Walther and the "resistance-law" in traffic engineering in a very proper way. The practical application of this theory in calculating the acceptance of public transport shows that based on the theory the number of users of a public transport system can be calculated very precisely /6/.

What does traffic planning mean:

Intentional traffic planning means changing irritation of man by changing the environment. If we change the environment of human activities in such a way as it has been done during the last 7 decades in most countries we obviously create car traffic. Each "normal" person will try to get a car and use it since traffic planning has changed the former pedestrian adapted environment to a car oriented one. But not only the infrastructure has changed in such a way, that it has been optimized for the car driver, also laws, the information of people and settlements have been devoted to the priority of car traffic. The result is obvious - increasing car traffic. There is no unrealistic behaviour of mankind, there are only unrealistic assumptions among the planners and politicians. A "normal man" tends to a car in a car oriented environment. If we optimize the environment for pedestrians, for public transport or cycles, a normal man will walk, use public transportation or the bicycle /11/.

The question is now, how can we influence the modal split ?

The main mistake in all countries of the world is the organisation of the parking place, if the traffic policy wants to increase the rate for public transport. The car is normally parked in the house, near the house or in front of the house. The walking distance to the car is very short. The distance to the bus stop, railway stop or tram stop is much longer. Following diagram 1, the car will have at the origin of each trip 100 % attractivity compared to few percent of attractivity for the public transport. A man has no chance to escape from his car. Park and Ride and similar measures are reported as big progress in influencing the modal split /12/. These solution are really very nice, but they show only that planners and organizers of the traffic systems are rather helpless in looking through relationships in the system.

In most countries traffic policy is oriented towards pulic transport system. This public transport system should be supported and should have priority over the car traffic. This goal is a pure illusion for the "real man" under the prevailing circumstances, if we accept the man in reality and not as an immagination of planners or politicians. The minimum measure to help man to escape from the car and to give him a fair chance for a choice between public transport and car is: the same distance from the activity of man to the parked car as it is between his activities and the public transport - stop.

Today all cities are organized in a wrong way. Traffic system users have only a minimum of modal choice. To give them a chance to choose between public transport and cars, central garages at least as far away as the public transport stops are necessary. This means car free zones everywhere with connecting roads between garages. Everybody has to walk from his home or his working place, the same distance to the garages or to the public transports. When I say public transports, I mean a public transport system where about each 5 to 10 minutes a train, a bus or a tram is coming. This is the minimum demand to achieve a well-balanced infrastructure. This kind of infrastructure has a lot of advantages like more traffic safety, less air pollution, less noise, it gives all traffic users the same chance and at least it is much cheaper than todays infracstructure. This is an infrastructure for a civilized society, which takes care of man and not of the machine.

But this is not enough to bring the unbalanced traffic system into a balance. Furthermore the unbalance in costs between both systems cars and public transport (in European cities) has to be corrected. The car traffic pays only a part of its costs. The rest has to be paid by other sectors of economy. Deficits in motorized individual traffic is obviously in many countries greater than the deficit in public transport system. Officially the situation is quite opposite, which shows that the economical calculations are not appropriate to the effects of the system. The costs for hospitals, the costs for police, the costs for fire brigades, the infrastructure costs for noise, costs for illness by air pollution, costs for missing recreation area in the living quarter, etc. are not calculated. In Germany truck traffic pays only aout 11 to 23 % of its real costs /13/. A strong effect on the organisation of the traffic system have also the information media.

The periodical reports about long traffic jams of cars, with the conclusion that a new road has to be built are the normal daily example. Usually there are only 1.1 persons in the car. Queues are not the reslut of a lack in capacity of roads, they are the result of the misuse of the car. If the media would report that the daily trafafic jam in car traffic is the result of misuse of the cars by car drivers we would have different reactions of society. The irritation will change from a positive to a negative side. Crowded roadd are the effect of too big positive irritations for cardrivers compared to other modes. They are

privileged compared to other traffic users. If this were not the case we would have crowded public transport modes, crowded pedestrian zones and crowded cycle strips.

A responsible traffic planner or politician has therefore to reduce the positive irritation for cardrivers to bring them down or up to the same level of all the other traffic system users. There are several methods to do it in an effective way. As long as there are differences in irritation, specially if irritations are positive in one part of the system and negative in the other parts, the normal man will tend to optimize his positive irritation. So the planner and the politician is responsible for the modal split to establish conditions for a fair competition between pedestrians, cyclists, public transport users and cardrivers. There is no excuse anymore, that we don't know how to do it. We are now guilty as planners or as politicians, if the measures we are planning and organizing are contradictory to our programs.

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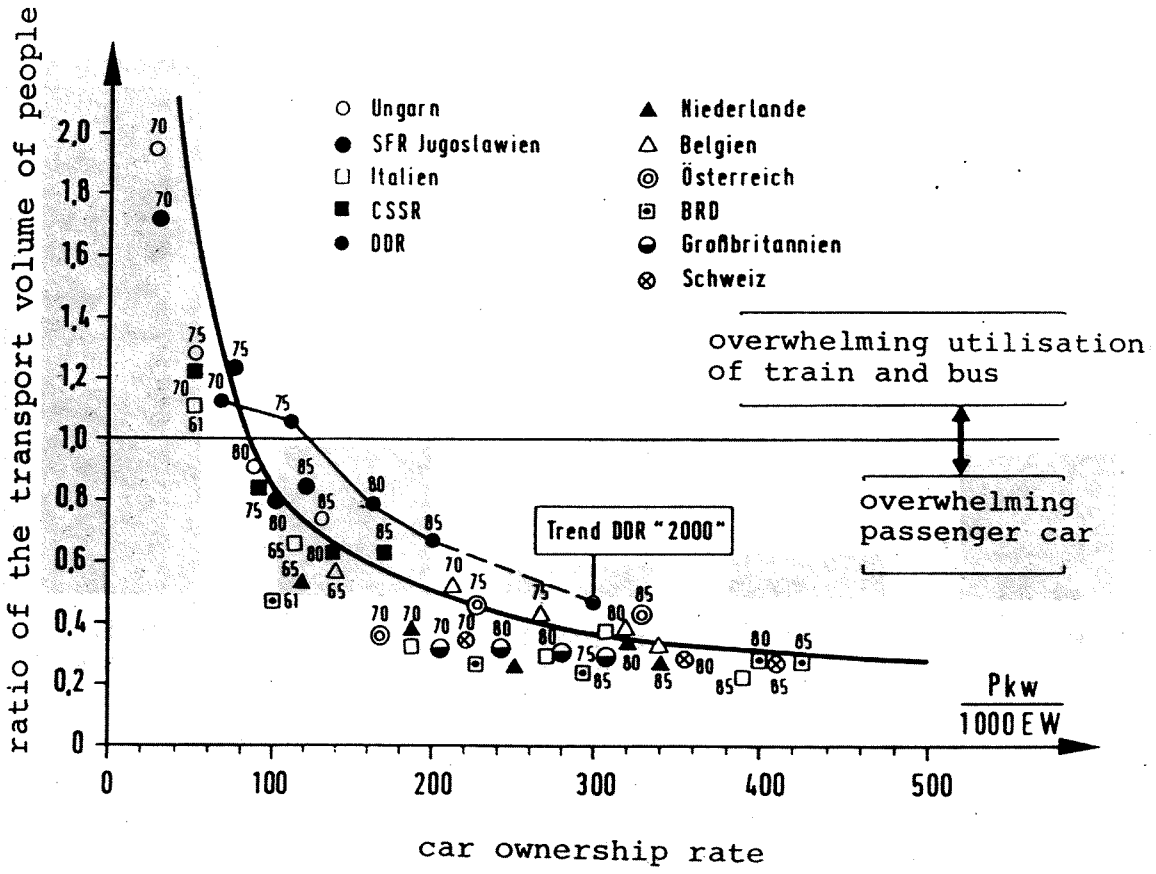

Fig.1 : Development of the ratio of the transport volume of people from public transport to private transpotation in mutual relationship of the car ownership rate

Source : Voigt, W.
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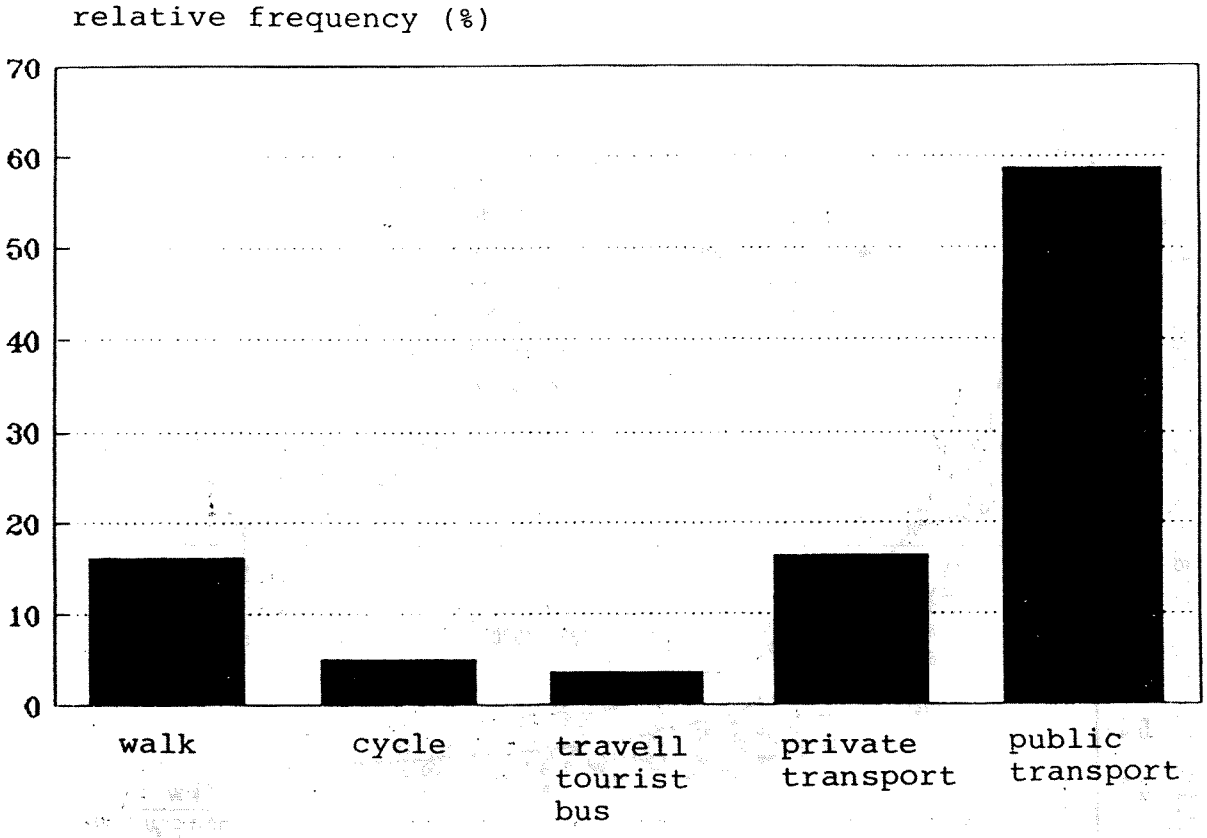

Fig.2 : Means of transport to reach the 1st district of Vienna

Source : Knoflacher, H.
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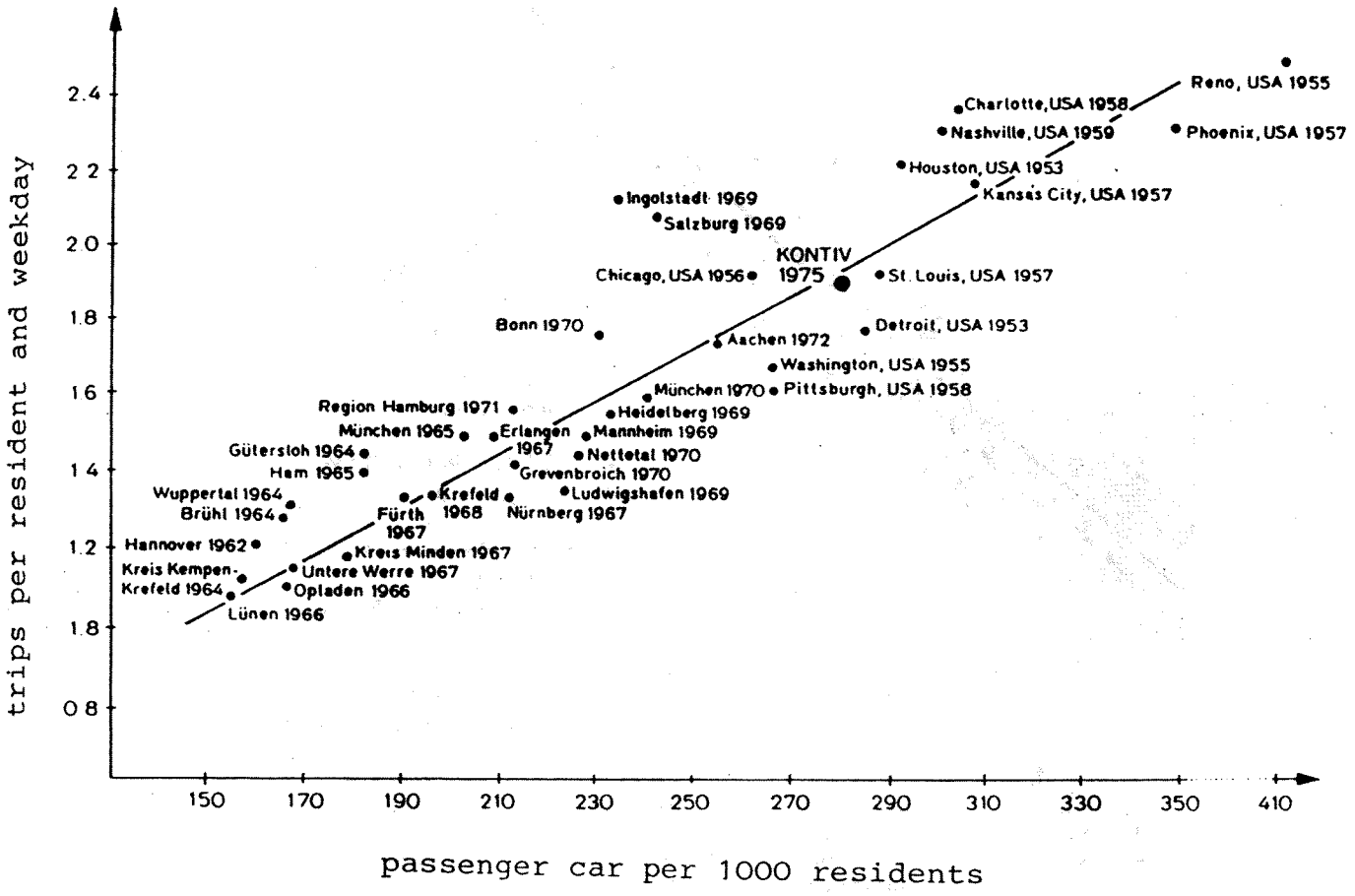
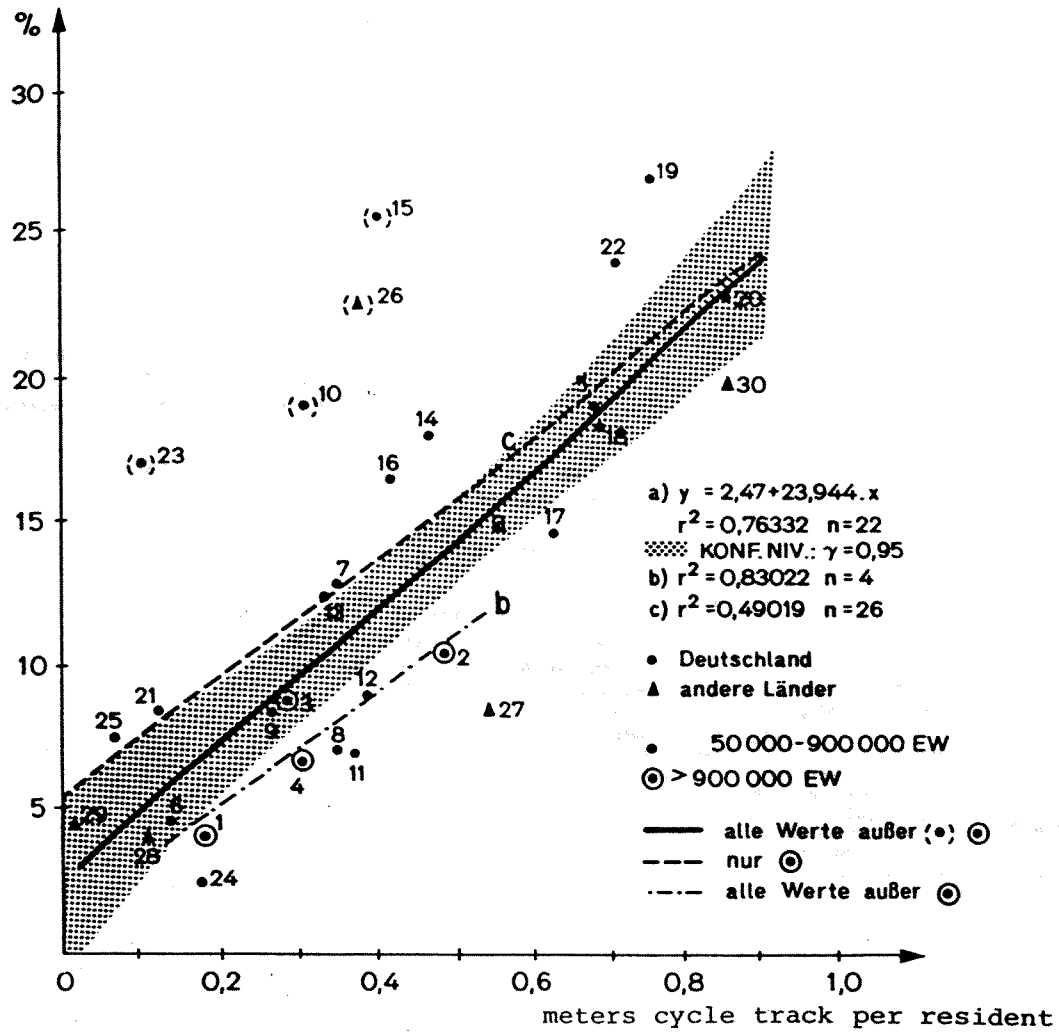


Fig.3 : Mutual relationship between the average wekdayly trips and the car ownership rate in 38 cities

Source : Hautzinger, H.; Kessel, P.
Mobilität im Personenverkehr. Forschung Straßen - bau und Straßenverkehrstechnik, Forschungsberichte herausgegeben vom Bundesminister für Verkehr, Abteilung Straßenbau - Heft 231; Bonn - Bad Godes - berg, 1977.



1	Berlin	6	Nürnberg	11	Krefeld	16	Bottrop
2	Hamburg	7	Bielefeld	12	Freiburg/Br.	17	Wilhelmshaven
3	München	8	Mannheim	13	Ludwigshafen	18	Erlangen
4	Köln	9	Karlsruhe	14	Leverkusen	19	Marl
5	Bremen	10	Augsburg	15	Bremerhaven	20	Gütersloh

21	Herford	26	Uppsala
22	Rüsselsheim	27	Stevenage
23	Tübingen	28	Dresden
24	Bayreuth	29	Zürich
25	Troisdorf	30	Wels

Fig.4 : Mutual relationship between the choice of transport mode - cycle - and the meters cycle track per resident

Source : Knoflacher, H.; Kloss, H.P.
Verkehrskonzeption für Wien, Teil C : Konsulenten - gutachten - Radverkehr. Magistrat der Stadt Wien, Geshäftsgruppe Stadtplanung, MA 18 - Stadtstruktur - planung; Wien, 1980.

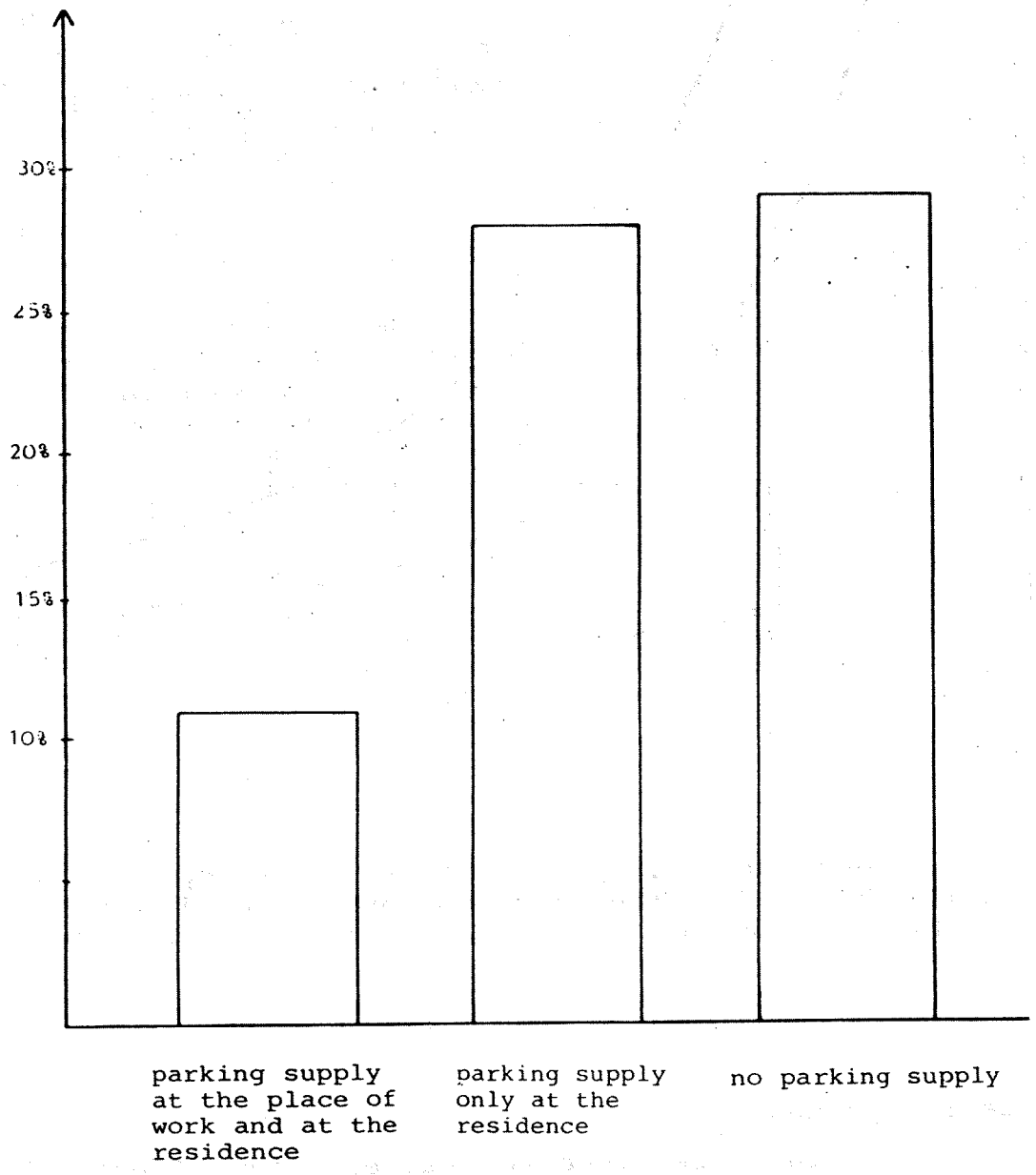
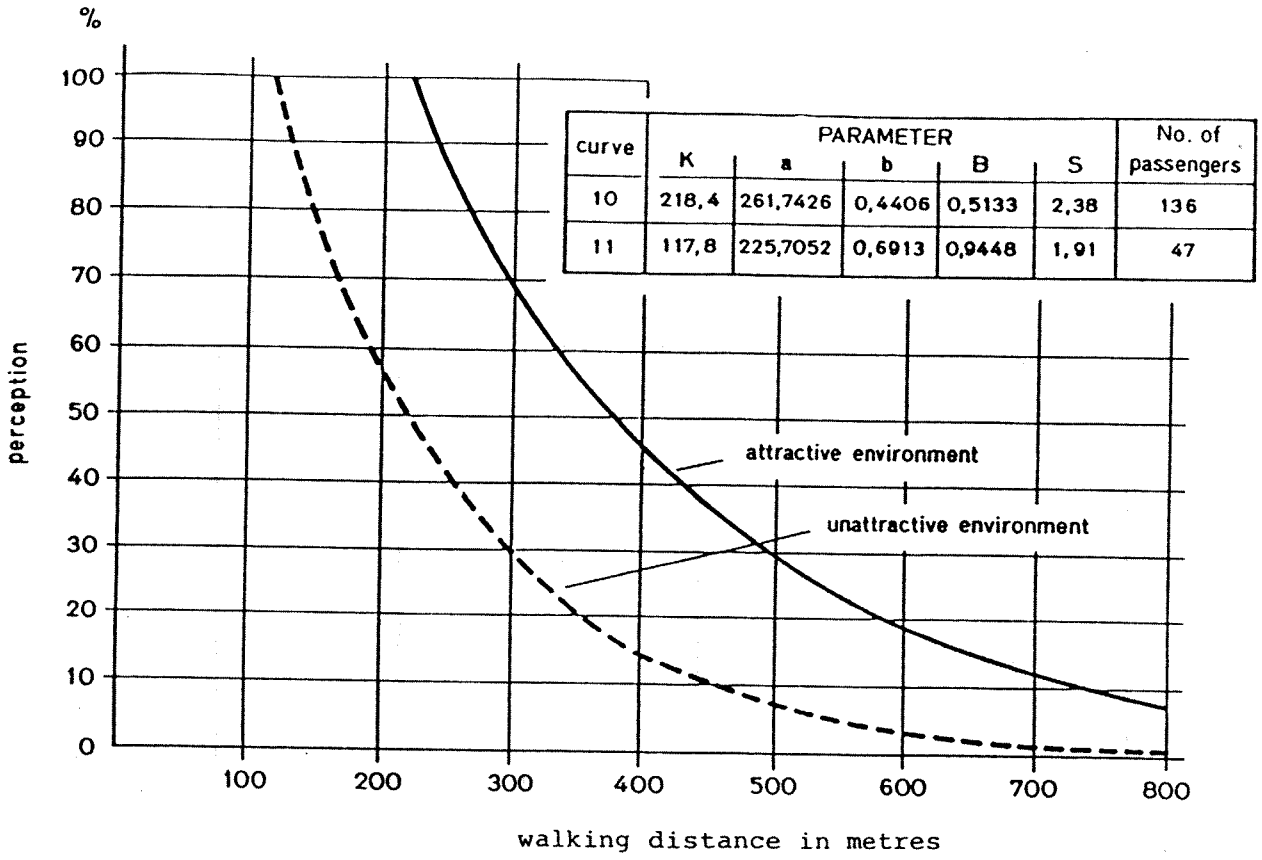


Fig.5 : Participation of the season-ticket user

Source : Knoflacher, H.
Verkehrskonzept Klosterneuburg, durchgeführt im Auftrag der Stadtgemeinde Klosterneuburg. Wien, 1987.

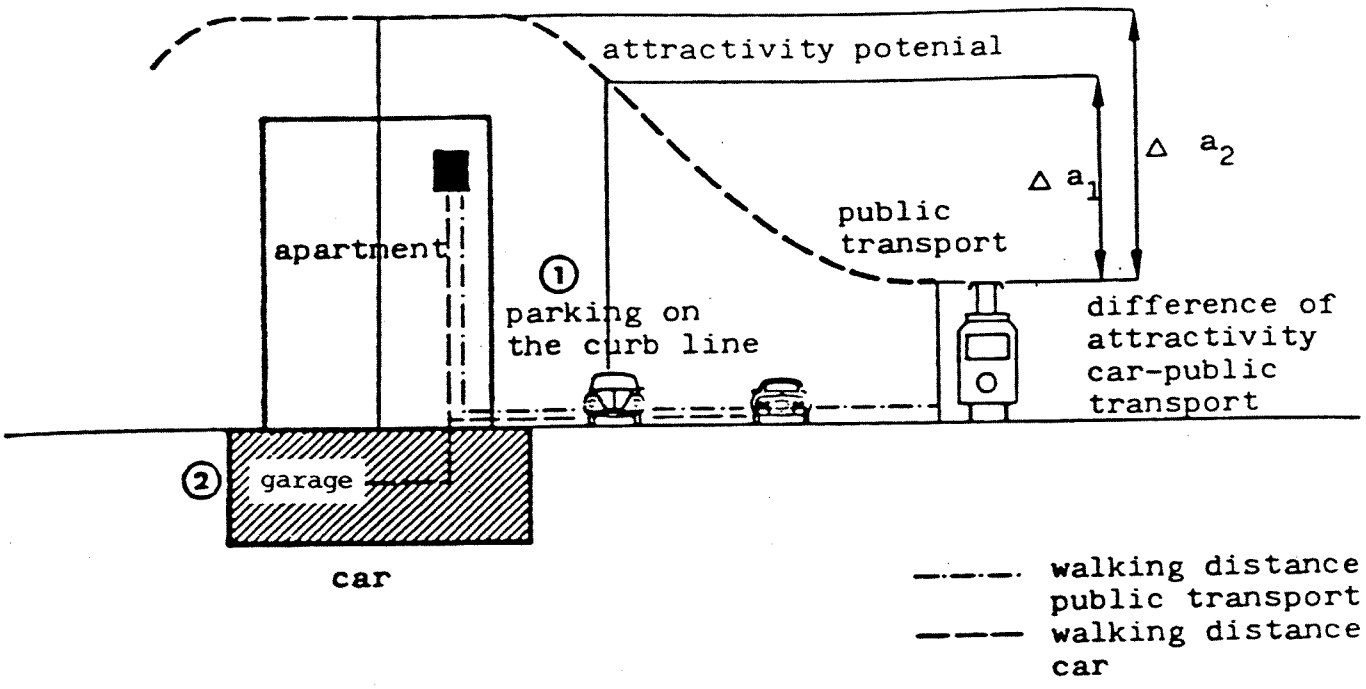


curve	PARAMETER K	a	b	B	S	No. of passengers
10	218,4	261,7426	0,4406	0,5133	2,38	136
11	117,8	225,7052	0,6913	0,9448	1,91	47

Fig.6 : Influence of municipal structure on perception travelling aim: traffic to the place of work, free alternative means of communication

Source : Peperna, O.
Die Einzugsbereiche von Haltestellen öffentlicher Nahverkehrsmittel im Straßenbahn - und Busverkehr. Diplomarbeit am Institut für Verkehrsplanung der Technischen Universität Wien, Mai 1982.

Existing Situation



Proposed System

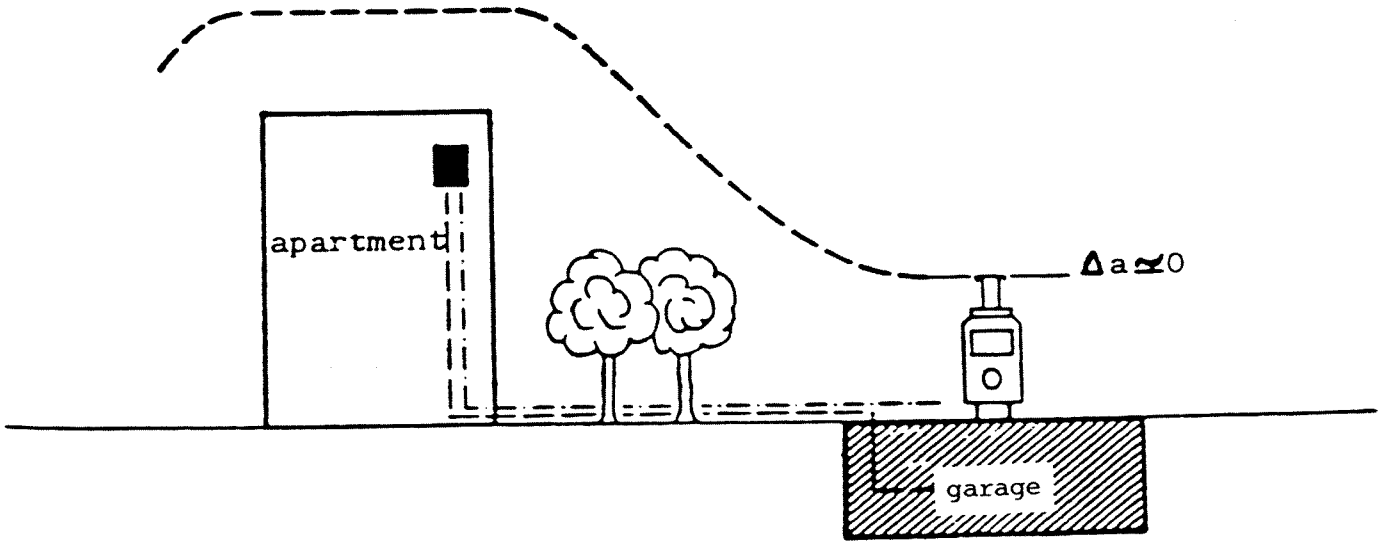


Fig.7

Source : Knoflacher,H.: Zur Frage des Modal Split
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