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FOLLOWS MOBILITY IN TRAFFIC A REGULARITY?

It seems obvous that mobility in the traffic system is following a certain tendency we can say it this following a certain regularity. But if it is following the regularity, mobility patterns can be changed, if we were able to decode this regularity and if we can implement measures influencing factors of this regularity.

Existing trends - prevailing view

With increasing motorization the rate of public transport is decreasing as it was shown by Voigt in Fig. 1. This tendency can be observed on the existing data basis in all countries independent from social economic and political conditions. The traffic policy has opposite goals in all countries. It seems that mobility patterns follow a kind of natural law, if motorization is increasing. The prevailing traffic policy as well as traffic planning are based on the assumption of "increasing mobility with increasing motorization". This is a basic hpothesis of traffic policy and traffic planning. A hypothesis is valid as long as we don't find any contradictory observation.

Examination of the hypothesis.

Modal split of shoppers in the city center of Vienna. Diagram 3 shows the result of a survey made the city center of Vienna. The degree of motorization is about 380 cars per 1000 inhabitants but we can see that only 15% of customers are using the car for shopping in the city. The majority is using the public transport or are pedestrians. Vienna has an excellent public trasnport system in the city center (subways) and a very nice pedestrian zone. We can recognize that the hypothesis is not valid for customers in the city center of Vienna.

Modal split of commuters depended on parking places

Car owners commuting to the city of Vienna use the public transport only with a rate of 10% if they have areserved parking place at their destination in the city. If the don't have a reserved parking place, they use the public transport regularly with a rate of about 30%. (The parking policy in Vienna is not very strict. It is not so difficult to get a parking place.)

This is the second observation, which is contradictory to the above hypotheses.

Effect of improved supply on public transport on modal choice

Traffic flow on radial roads to Vienna was increasing with the same rate or even faster than on Austrian roads. In the 70ies a Schnellbahn-system (trains with a half hour or quarter of a hour time table) were introduced parallel to some roads. We can see that the growth of road traffic was influenced in the very strong way. The traffic volume at the end of the 80ies was not greater as it was at the beginning of the 70ies, although the traffic grow rate on Austrian road was continuing as it can be seen in Fig. 5. We have now three observation which are in contradiction with the hypothesis. This obversation shows us that the infrastructure as well as the quality of the traffic system has presumabely strong effects on the modal solit and therefore also on mobility patterns.

Question of mobility

Car mobility is only part of physical mobility of people. Fig. 6 shows a cross-section of mobility of people with an age between 6 and 90 years for a typical middle size city in Austria. The absolute number of trips per person and day is changing with the age as we know. This diagram shows the relative distribution of mobility. Only a part of the whole mobility is covered by car traffic. The relatively greater part is pedestrian mobility, cycles and public transport. If we are discussing mobility we have to recognice that this is not only physical mobility but also mental, social and mobility in housing. All three kinds of mobility are important for the amount of physical mobility. Social mobility can replace physical mobility as well as mental mobility can do it. It is therefore useful to refer mobility not only to transport modes but to the man and his number of trips per day. Studies show worldwide that this so-called mobility is not depended on the development of technical traffic system. This mobility rate is increasing during the last decades but due to social demographic changes. Decreasing number of people per household is one of the reasons. A-one-person household has to produce external mobility also for social contacts. We have to accept that the number of trips per day and person is not changing with changing transport modes very much. Several studies shows that this mobility rate seems to be a constant figure. The length of trips is changing, but not the number. The extension of trip length is the result of the constancy of average travel time, with increassing traffic speeds. Therefore there is no possibility of time-saving by increasing speeds in the traffic system. We can not support traffic system by calculating time-savings, since there is no time-saving in the transport system, as far as individual mobility is concerned.

What kind of regularities are influencing the modal split

In 1975 a survey among german cities was carried out, asking them about cycle tracks and rate of cyclists. The result is shown in figure 7. The increasing supply of cycle tracks to the public increases the rate of cyclists. This diagramm shows a relationship between human behavior and infrastructure, in this case cycle tracks. With this diagram we can recognize the figure 2 shows a hypocritical appearant correlation. To make car trips it is necessary to have roads. If there is no road network available no car mobility will appear even the people will have cars.

If we look to the limited public space in cities and compare it with the basic space demands for different kind of modes it becomes obvious what kind of priority we have to follow. How can we change human behaviour in this direction?

Human behaviour as a results of evolution

Road and city planning are planned in scales for length and time. Meters, kilometers, seconds, minutes and hours are the scales used. If planning measures don't produce the human behaviour expected from planners and traffic politicians this two groups of our society are talking about irrational. Each man is behaving in a rational and logical way as he see the situation. This behaviour possibly might be wrong in relation to the needs of the whole system but not to the existing situation as the man see it. We have therefore to accept that not the man is irrational but the assumptions of politicians and planners.

Since we know that the traffic system is not following the simple calculations of time-savings which are the assumptions of traffic planning and traffic economy, we have to question now, whether the perception of time is in the same way as the measurement of time with the watch.

In 1972 Walther make an interesting study in Bielefeld. He asked the users of public transport about there estimation of walking-time in relation to the whole travel time. Than he compared the estimations with the real walking time. If the time estimation for walking would be the same as for the whole travel time, the people would estimate time like a watch. One minute travelling in a bus would be the same as one minute walking. If we divide the estimated time by the measure time, we would get always 1. But the observations were quite different, Fig. 8. We can see an overestimation of walking time compared to the travel time with increasing walking distance. This result was called "time value factor". The reziproke of the time value factor can be defined as "attractivity". The attractivity of a walking distance is very sharp decreasing with increasing distance. A walkway of 300 m length is only about 20% of the attractivity of a 50 m long walkway.

This studies were repeated in Vienna. The results supported Walther's results.

Bees are following the same regularity

Karl von Frisch observed that the frequency of dances of bees used for distance information are decreasing with increasing distance to the feeding place. We see that Frisch has got a similar curve compared to the observations of Walther in Bielefeld.

What is the reason for this community?

I think I can explain the community by the following analysis:

In 1956 Karl von Frisch make an interesting experiments with bees which can be taken also as a key experiment for traffic planning. Bees have the possibility of modal split since they exist. They can walk and they can fly. The experiment was made by modifying the environment and building a channel from the bees stock to the feeding place. So the bees could't fly they had to walk. Frisch and his colleagues observed what information the bees gave at home, when the channel was extended. It was interesting to find that after the channel wa extended to the lengths of 3 to 4 m the bees informed at home about a feeding place in a distance of about 80 m (flight distance). This means that the bees lie or they do not know the physical system for measuring length on the international convention. Frisch discovered that for both distances, 4 m walking or 80 m flying, the energy consumption was the same. This was the reason for me to look to the energy consumption of man for walking or using a car or public transport and compare the effects.

How do we calculate energy consumptions?

Frisch found a right mathematical description or the function in figure 10, but I don't think he has found the right explanation.

In the beginning of the 19th century Weber and Fechner discovered a fundemental law for organismus how they react on external irritations. This law was called "Weber-Fechner's sensation law" sensation(s) = logarithmus naturalis intensity of irritation.(I)

$$S = \ln I$$

What is traffic planning? Traffic planning is nothing else than chancing of external irritations and therefore sensations. If we use the human body energy demand for the description of traffic behaviour, we should find a way to explain and modify human traffic behaviour.

The sensation of a daily walkway to work or shops or other not very interesting things, is perceived as resistance. Resistance is recognized as negative. If we introduce in to Weber-Fechner's law a negative sensation we get the negative e-function, which can be found in most functions describing the resistance law of the traffic system. But this explanation gives us a much deeper insight into the problem compared to a formal description. We can now explain the traffic resistance law on the basis of the "inner mechanism of man".

The function is twofold. External irritation can also create positive sensation. It was therefore interesting to check whether this twofold function can be observed empirically. A diplomawork was given a student to observe the differences between public transport users going through a normal environment (car oriented environment) and a human oriented environment, (walkway through parks or pedestrian zones) to reach the public transport stop.

The conditions were defined as

a) an unattractive environment, car oriented

b) attractive environment, pedestrian zones and parks.

The results are shown in figure 11. The curves are parallel but the attractive environment "extend" the attractivity of a walkway up to 70% and more. In an unattractive environment the amn tends much more to prevent walkways and use a car if possible.

The man is captured by his car, the result of this own human attitude

Balances of energy and irritation are taking place in the brain probably in very deep evolution levels. Probably far below the levels of concussiones?

Therefore it was also interesting to observe how long car users are searching for parking places before they accept a certain walking distance. This task was given to another student for his diplomawork. Results are shown in figure 12. We see that a distance 100 m or less between the destination and parking place is accepted by the car drivers immediately. If the distance is increasing to 300 m the car drivers are searching for a parking place closer to the destinations in average for 12 minutes and if the distance is 400 m the searching time for a closer parking place is 28 minutes. This function as well as the attreactivity function in diagram 12 to 15 can be very easily calculated by Weber-Fechner's law and energy balances.
We are captured by the famous construction of our cars by many reasons. The body energy consumption for sitting is much lower than for the upright standing position. The "power of the leggs" is increasing about 600 to 700 times if we use a car compared to walking but the brain has not grown in the same amount at the same time. The brain give the information that we need less body energy compared to walking.

As cardrivers we are leaving the human society since we are leaving the society of two - legg. Car drivers are four-leggers when they are moving. The space of activity is grow similar to the sitting position on a branch in a tree having a "steering branch" in one hand, a "gear branch" in the other hand and for the leggs we have a "breaking branch", "eccelerating branch" and a "clutch-pedal-branch" - and the whole tree is moving - really a fascinating thing. This are reasons is enough to change a lot of values specially the inconvenient values of the human society. The car is aliied with our subconstitution levels of our brain. The captivity is nearly perfect.

Consequences for our question

In all countries of the world we observe the same basic mistakes in the organisation of traffic system. The control mechnism are not working efficient or they do not exist. Traffic policy and traffic planning is oriented toward the big elements like roads, computerized signalisation, railways, etc. But is not directed toward the small elements the cells of the traffics system. We can define as the cell of the traffic system the household or the individual.

We will look now to the individual and his position to different traffic modes. Today the situation worldwide is the same. The car is parked in front of the house or in the house in a garage. The walking distance to the parked car has therefore about 100% attractivity. The public transport stops are far away, some times 700 m and more. The remaining attractivity to use public transport is therefore only few percent. The public transport has under this circumstances no chance at all. With increasing motorization the amount of public transport must therefore decrease following a negative e-function as the result of the prevailing traffic organisation and the position of cars to human activities compared to public transport stops.

What Voigt has observed is nothing else than the realisation of the Weber-Fechner's law in this man made environment. The key for changing the system is therefore not the planning of "big elements" but much more a propper organisation of the "small elements". This means the propper organisation of parked cars and taking care of the real human behaviour, which is oriented on the maximisation of positive irritation (convenience) and minimisation of negative irritation (amount of a body energy).

Solution of the problems

If we accept the man as a reality and not as a fiction of planers and politicians, we have to take care on his fundemental abilities. This means that we have to take into account his real behaviour and not his behaviour as we like to have it. If traffic policy is asking for same chances for public transport (moost political programmes are promising priority for public transport) than this has becomes now a real meaning. This political goal has the consequence that we have to intriduce the same distance between all activities of the man like living, working, leisure, shopping, etc. and the parked car as it is between the activities and the stop of the public transport, fig. 13. This means in reality that our settlements have to be cleaned from cars on the surface. The cars must be stored in central garages at least as far away as the next public transport stop. The results are: car free zones, settlements with pedestrians, possibilities for cycling, possibilities for social contacts, for leisure, etc. This organisation will create a massive change in our society and our economy. The result of this kind of organisation are obviously extremely positive, we get more stabile high developed, settlements, which fulfill also ecological needs. This kind of organisation takes care on human needs how they are but not how we would like to have them. This consequences are a tremendous challenge for all kinds of policy and techniques. But we have no chance to prevent these consequences or this solution, if we except on the one side man as reality and traffic policy or traffic policy programs as serious on the other side.

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Pictures (see supplement)

1) Entwicklung des Verhältnisses der Personenbeförderungsleistungen von öffentlichen zu individuellen Verkehrsmitteln in Abhängigkeit von der Motorisierungskennziffer. Quelle: Voigt, W., Ausgewählte Aspekte zur Situation im Verkehrswesen der DDR: Straßenverkehrstechnik, Heft 3/1990

2) Mittlere werktägliche Fahrtenzahl und Motorisierungsgrad in 38 Städten und Regionen. Hier wird Mobilität mit Fahrtenzahl verwechselt. Quelle: Hautzinger, H.; Kessel, P., Mobilität im Personenverkehr: Forschung Straßenbau und Straßenverkehrstechnik; Forschungsberichte herausgegeben vom Bundesminister für Verkehr, Abteilung Straßenbau, Heft 231; Bonn-Bad Godesberg, 1977.

3) Verkehrsmittelwahl in Abhängigkeit vom Alter; Quelle: Knoflacher, H., Generalverkehrsplan Ried im Innkreis: Wien, März 1983.

4) Abhängigkeit der Verkehrsmittelwahl Fahrrad von dem Radwegeanteil/Einwohner; Quelle: Knoflacher, H.; Kloss, H.P., Radverkehrsanlagen: Ergebnisse einer Erhebung, Straßenverkehrstechnik, Heft 4, Wien 1979.

5) Einfluß der Stadtstruktur auf die Ansprechbarkeit, Reisezeck: Arbeitsstättenverkehr t_B=10 Min., freie Verkehrsmittelwahl Quelle: Peperna, O., Die Einzugsbereiche von Haltestellen öffentlicher Nahverkehrsmittel im Straßenbahn- und Busverkehr: Diplomarbeit am Institut für Verkehrsplanung der Technischen Universität Wien, Mai 1982.

6) Unterschiedliches Verhalten bei unterschiedlicher Struktur. Quelle: Knoflacher, H., Zur Frage des Modal Split: Straßenverkehrstechnik, Heft 5/1981,

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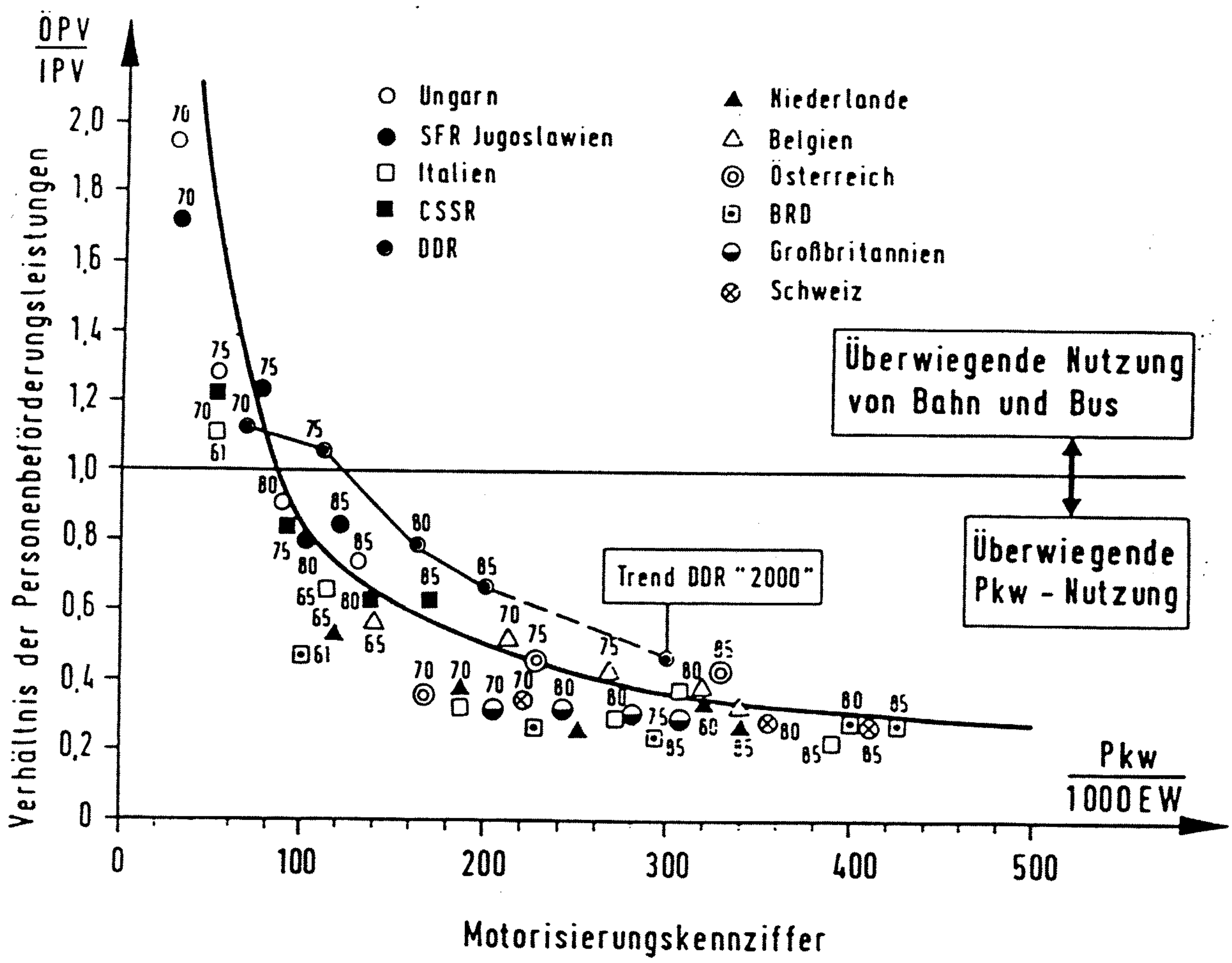


Figure 1: Entwicklung des Verhältnisses der Personenbeförderungsleistungen von öffentlichen zu individuellen Verkehrsmitteln in Abhängigkeit von der Motorisierungskennziffer. Quelle: Voigt, W., Ausgewählte Aspekte zur Situation im Verkehrswesen der DDR: Straßenverkehrstechnik, Heft 3/1990.

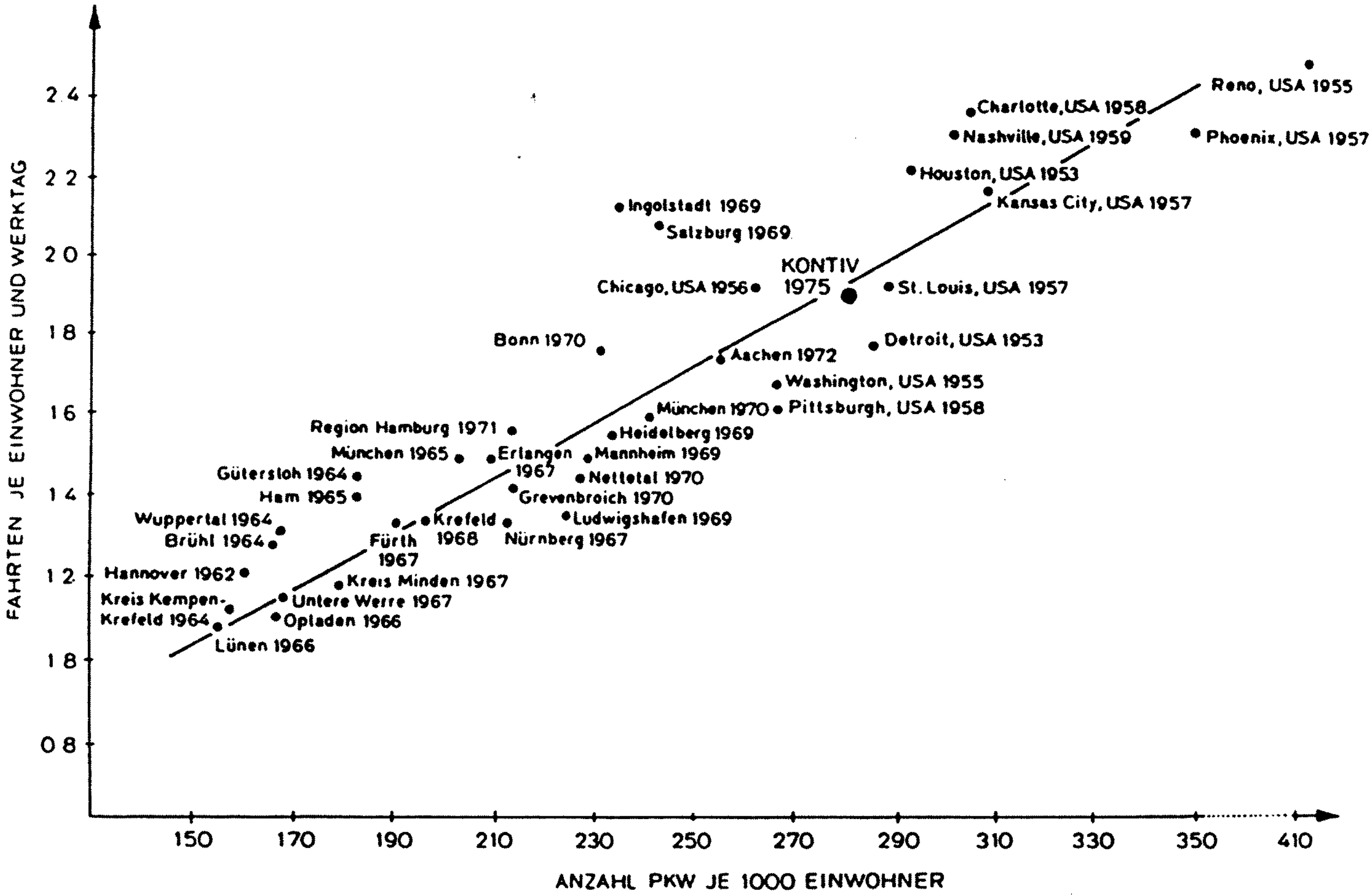


Figure 2: Mittlere werktägliche Fahrtenzahl und Motorisierungsgrad in 38 Städten und Regionen. Hier wird Mobilität mit Fahrtenzahl verwechselt. Quelle: Hautzinger, H.; Kessel, P., Mobilität im Personenverkehr: Forschung Straßenbau und Straßenverkehrstechnik; Forschungsberichte herausgegeben vom Bundesminister für Verkehr, Abteilung Straßenbau, Heft 231; Bonn-Bad Godesberg, 1977.

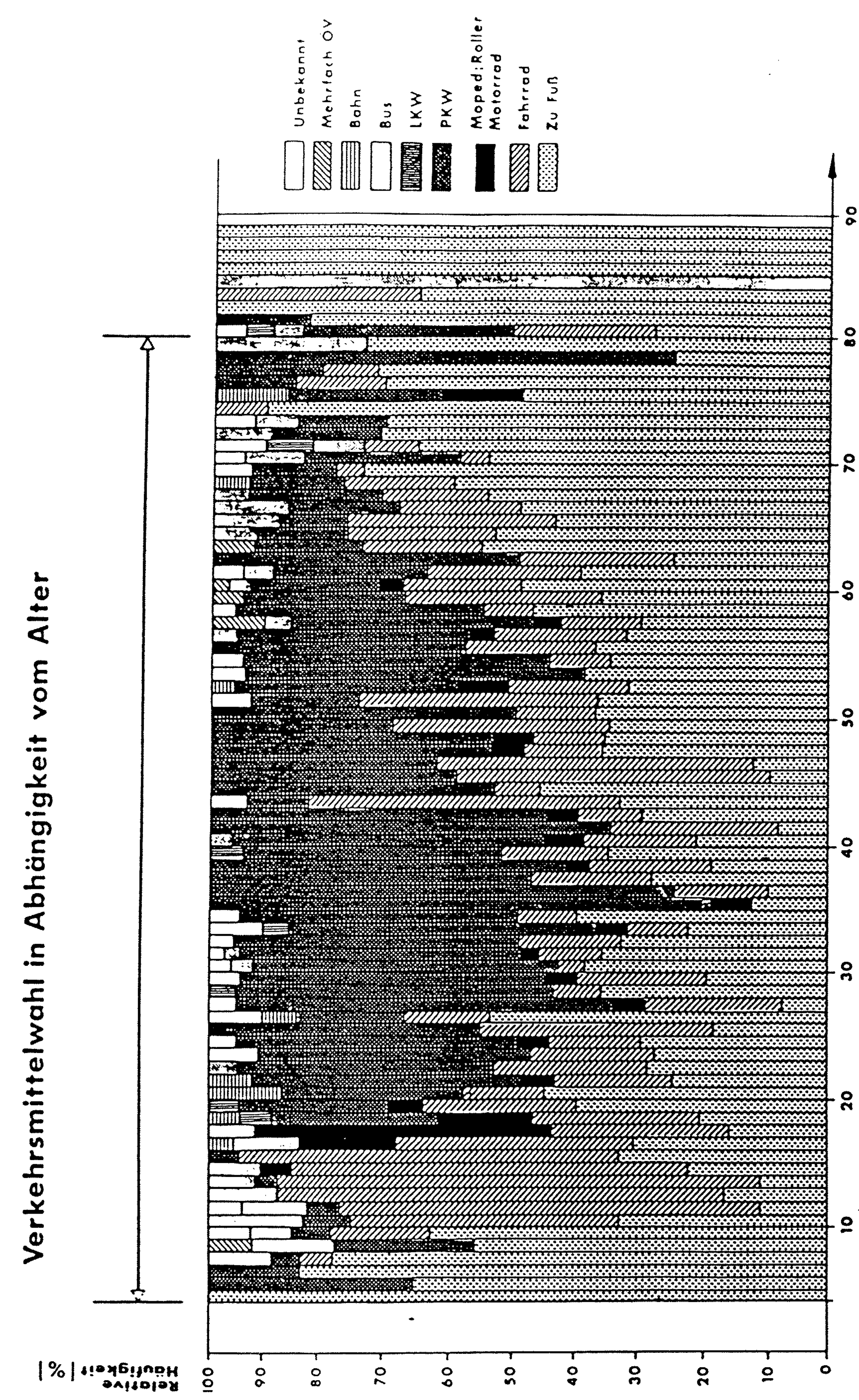
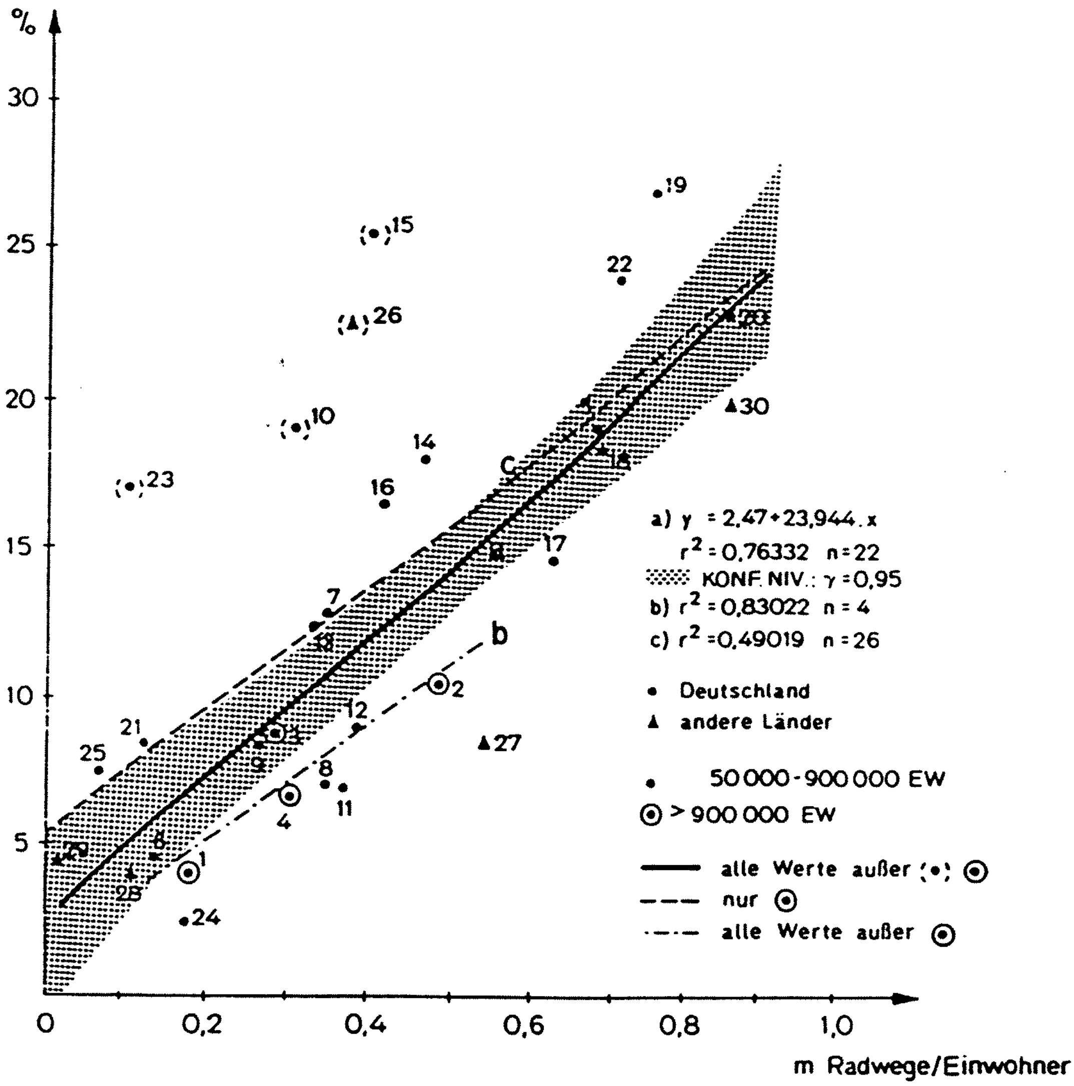
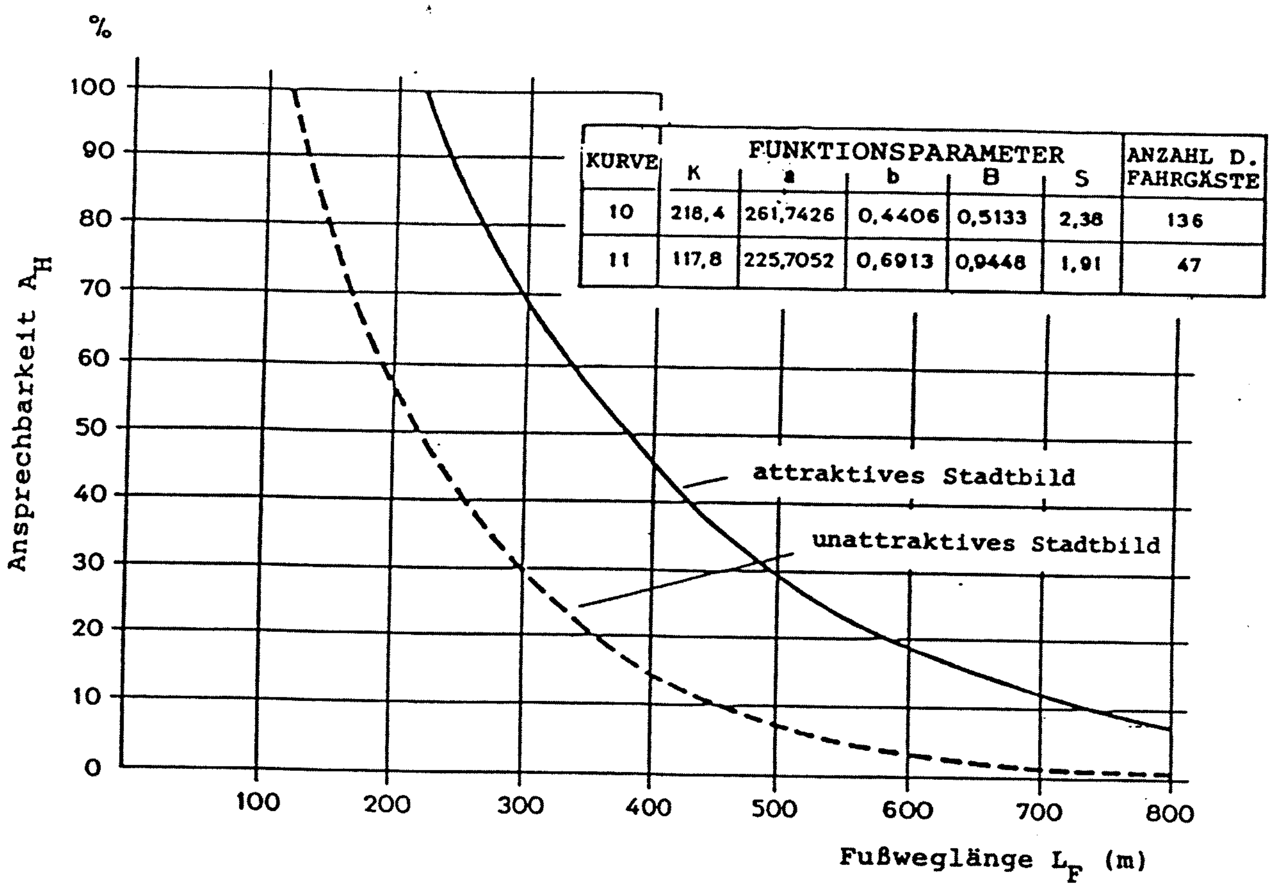


Figure 3: Verkehrsmittelwahl in Abhängigkeit vom Alter. Quelle: Knoflacher, H., Generalverkehrsplan Ried im Innkreis: Wien, März 1983.



1 Berlin
2 Hamburg
3 München
4 Köln
5 Bremen
6 Nürnberg
7 Bielefeld
8 Mannheim
9 Karlsruhe
10 Augsburg
11 Krefeld
12 Freiburg/Br.
13 Ludwigshafen
14 Leverkusen
15 Bremerhaven
16 Bottrop
17 Wilhelmshaven
18 Erlangen
19 Marl
20 Gütersloh
21 Herford
22 Rüsselsheim
23 Tübingen
24 Bayreuth
25 Troisdorf
26 Uppsala
27 Stevenage
28 Dresden
29 Zürich
30 Wels

Figure 4: Abhängigkeit der Verkehrsmittelwahl Fahrrad von dem Radwegeanteil/ Einwohner. Quelle: Knoflacher, H.; Kloss, H.P., Radverkehrsanlagen: Ergebnisse einer Erhebung, Straßenverkehrstechnik, Heft 4, Wien 1979.



KURVE	FUNKTIONSPARAMETER K	a	b	B	S	ANZAHL D. FAHRGÄSTE
10	218,4	261,7426	0,4406	0,5133	2,38	136
11	117,8	225,7052	0,6913	0,9448	1,91	47

Figure 5: Einfluß der Stadtstruktur auf die Ansprechbarkeit, Reisezweck: Arbeitsstättenverkehr $t_B = 10$ Min., freie Verkehrsmittelwahl. Quelle: Peperna, O., Die Einzugsbereiche von Haltestellen öffentlicher Nahverkehrsmittel im Straßenbahn- und Busverkehr: Diplomarbeit am Institut für Verkehrsplanung der Technischen Universität Wien, Mai 1982.

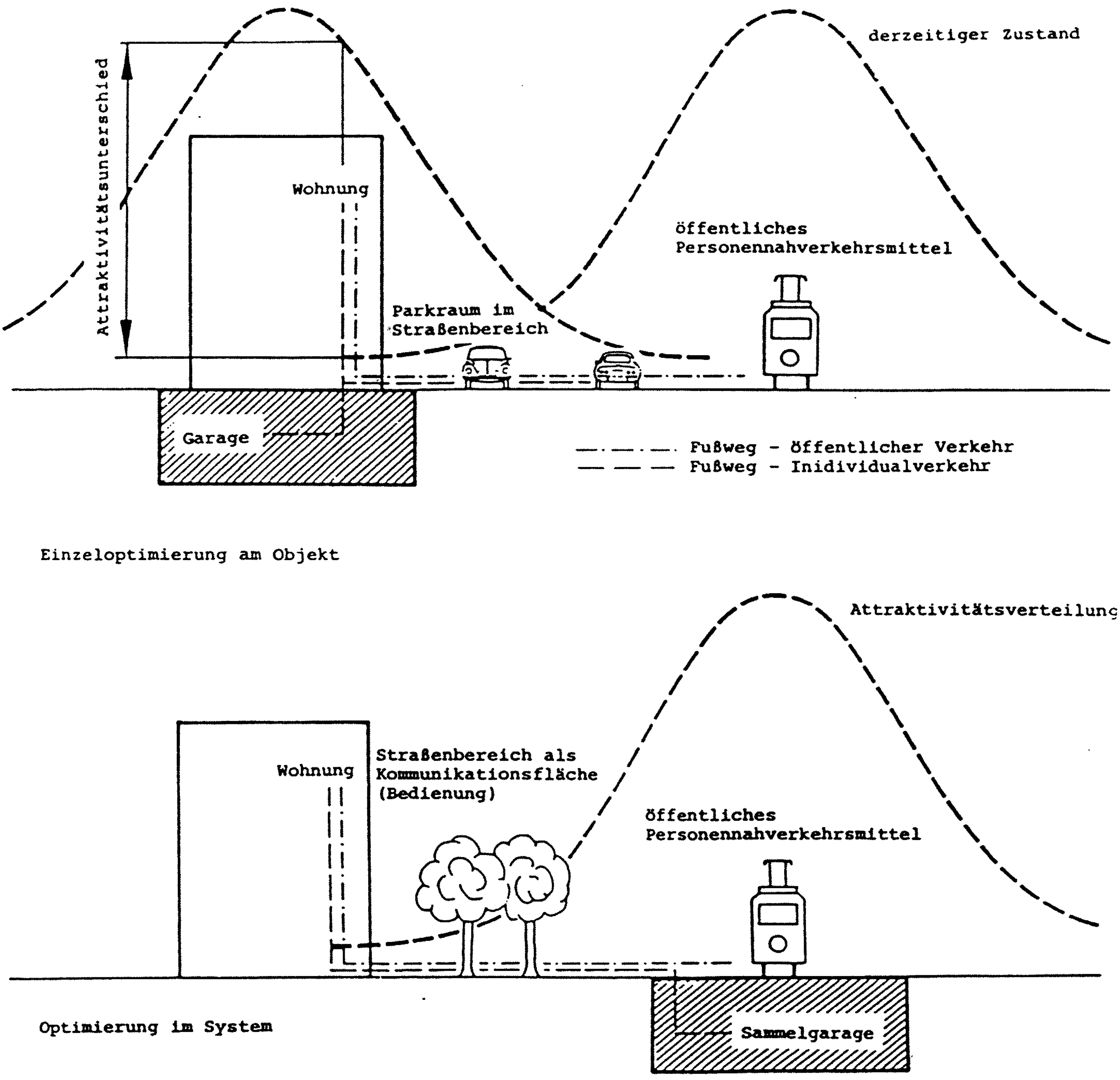


Figure 6: Unterschiedliches Verhalten bei unterschiedlicher Struktur. Quelle: Knoflacher, H., Zur Frage des Modal Split: Straßenverkehrstechnik, Heft 5/1981.