THE SITUATIONAL APPROACH - AN ALTERNATIVE MODEL CONCEPT
- Theoretical Foundations and Practical Applications -

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ABSTRACT: *New model concepts are being intensively discussed in transport planning. Although the belief was once widespread that the so-called disaggregate models were the only promising approaches for the future, it has since been proven in a number of empirical studies, that the assumptions concerning behaviour which are made in these models do not always stand up to the test of reality. On the other hand, although it was generally accepted that the more qualitatively oriented modelling attempts could better explain behaviour, one frequently heard the argument that it was difficult to apply these models for practical planning problems. However, if these approaches are able to explain behaviour realistically, then one "simply" needs an appropriate model concept in order to integrate this improved understanding in practical planning. The situational approach is a concept of this sort; it has also proven its ability to be practically applied in the various concrete situations where it was used. Were this model approach to be more widely applied, one could gain important insights as to how it might be further improved.*

THE DEVELOPMENT OF MODELS OF INDIVIDUAL BEHAVIOUR

By the mid 70s, an international discontent had arisen with the models generally used for transportation planning. New, behaviourally oriented approaches started to dominate the discussion among people involved in transportation research. While the standard four stage transportation demand models had depicted the locational change of the individual as the "basic transportation situation", and statistically combined these into trip patterns, the new approach focused on the individual as being empedded in a complex social and material environment. The notion that out-of-house mobility is not an end in itself, but rather serves as a means for individuals to participate in activities which cannot or should not take place in their direct neighborhoods was of far-reaching consequences for further research. It made it necessary to change from a mobility or trip survey to a method of determining out-of-house activity patterns. Since the analysis of activity patterns quickly showed that an individual's activity pattern is not only influenced by his own autonomous decisions, but also by the other members of the household within which an individual lives, it became necessary to include entire households in empirical surveys.

While researchers tried to include more up-to-date insights concerning reasons for out-of-house mobility in the conception and implementation of empirical surveys, attempts were simultaneously made to better understand out-of-house behaviour, its origin and variability. The degree to which a model was able to explain behaviour became a criteria with which to judge the quality of a model.

This development not only led to new interpretations of the widespread model philosophies, but also led to a greater variety of the conceptual approaches used. A confusion of terminology quickly resulted. The term "disaggregate models" was initially used to refer to the entire new development - as contrasted with the "aggregate models" which had been used up until then. Nowadays, the prior term is generally used only when referring to a particular type of approach within the new development. In a thorough review of these problems, WERMUTH (1) tried to untangle this Babylonian confusion. He classified the terms under the heading of "individual behavioural models". Wermuth claimed that the explanatory value of models using an "econometric approach" and the "concept of behaviourally homogeneous groups" are inferior to the models which use the so-called "situational approach" (2).

BASIC ASPECTS OF THE SITUATIONAL APPROACH

To put it somewhat simplistically, this approach assumes that the individual is given a certain number of options by his environment; this is the objective situation. The options which an individual has to choose from are determined by:

- the material supply of the transport infrastructure;
- the constraints and options of the individual and his household which can be sociodemographically deduced;
- the social values, norms and opinions relevant to transport behaviour.

Each individual experiences these "objective" situations uniquely. Thus, individually differing subjective situations result. These subjective situations include variables from each of the three areas referred to above. They differ from objective situations in that the individual's perception is either consciously or unconsciously distorted. An individual's decisions are always made in subjective situations.

The situational approach not only assumes that individual (behavioural) situations determine individual options, but also that individual decisions concerning behaviour are made by using a subjective logic which is very different from that of the researcher or politician. However, this does not mean that individuals act irrationally - only that rationality is subjective. Furthermore, the mechanisms of this subjective rationality are highly complex and have not yet been studied in depth (3).

If one wants to understand transportation behaviour, it is necessary to re-instate the chain of "objective situation - personal perception - subjective situation - individual decision - behaviour". In order to influence transportation behaviour, every link of this chain can be altered - by using different methods.

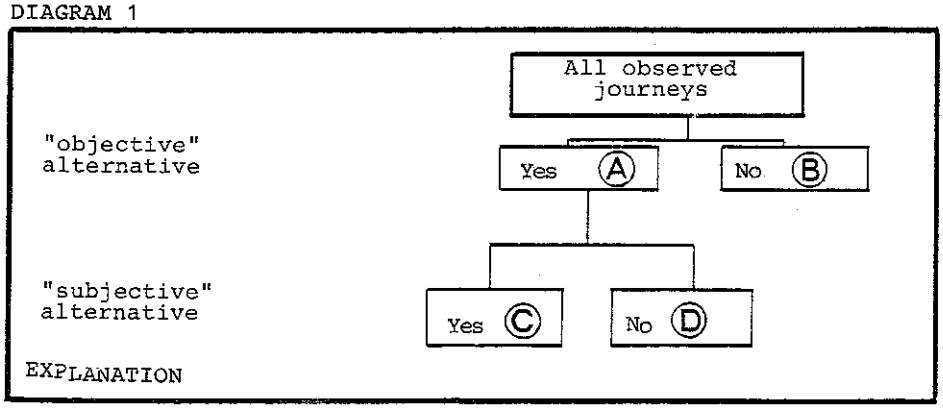
SITUATIONAL APPROACH AND MODE CHOICE

If one analyzes mode choice using the situational analysis (4), then one can, to over-simplify a bit, differentiate between three different groups of users:

- Persons unable to change to a different mode due to a lack of "objective" possibilities or due to constraints which are difficult to alter ("externally determined").
- Persons who can basically use another alternative, but for whom these alternatives do not seem to be actual subjective options, since the persons are either insufficiently informed as to their options, perceive the alternative modes poorly or have a negative attitude toward these modes ("subjectively determined").
- Persons who subjectively consider the available alternatives to be real options, but nevertheless, do not use the alternatives ("persons with options").

By using this simplified model structure, it is possible to construct an initial important instrument of analysis - the so-called explanatory tree, which as depicted below, shows behaviour on a concrete sampling day:

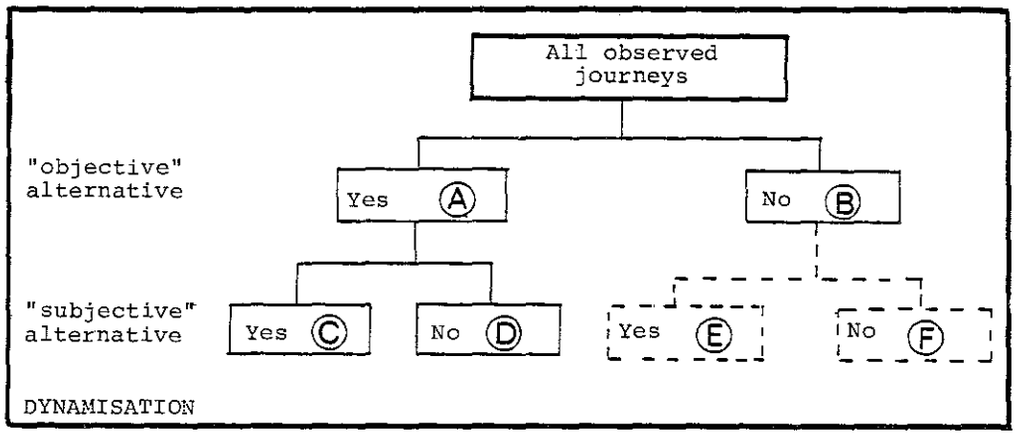
DIAGRAM 1



This structure explains the observed mode choice in the case of groupsB, C and D; by means of "objective" variables for group B and "subjective" for groups C and D. The simplified model structure shown is thus capable of establishing beyond any doubt the factors determining the choice made on the specific day that behaviour was measured; in this form, however, it is not very suitable for demonstrating individual behavioural scope should a change occur in the given situation (through planned measures, for example). Some measure might be imagined, although admittedly utopian, whereby all people who had no "objective options" on the day of sampling would be offered such options. Such a measure would not, however, increase the number of options for all individuals, but only for those individuals who do not reject the new alternatives for subjective reasons.

In order to build a model which is really sensitive to measures, all the situational dimensions in their entirety must be taken into consideration for each individual, even if they are irrelevant or only marginally relevant to behaviour observed on the survey day. When the explanatory tree of the situational groups is made dynamic, the following diagram results:

DIAGRAM 2



Such a structure only makes it possible to forecast behavioural changes when the number of objective options is increased. Measures never affect behaviour directly but only the pertinent situational groups and thereby exercise only an indirect influence on any behavioural changes. The measure discussed here, for instance, only affects situational group B and here only members of the sub-group E would actually be influenced in their behaviour.

A more detailed analysis of the individual situations that determine specific behaviour very quickly reveals that the determination of situations as described does, in fact, satisfactorily explain survey day behaviour, but cannot be generalised to cover all situations. That is, yes and no categories are insufficient. One must allow such categories as, "Yes, under certain circumstances ..." or "Not unless ...". This step, which is known as "sensitisation", is necessary because the situation given on the day of sampling frequently reflects only a fraction of his general range of options. The external conditions affecting this intermediate group are subject to change since they are of

temporary nature or different at different times. People in such situations are referred to as "threshold value groups".

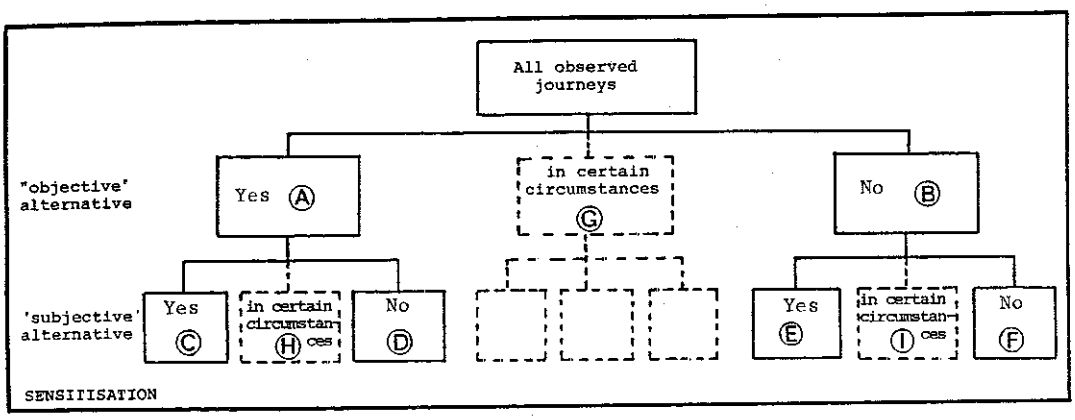
There are quite a number of such threshold values that can constitute different options according to current conditions. For example:

- o "objective alternatives" can change from day to day since the family car is not always available;
- o "subjective alternatives" can depend upon such factors as the weather or if a person is in a rush.

Classification in one or more of these threshold value groups thus means that an alternative mode can only be used for a concrete trip under specific conditions.

Diagram 3, which depicts a more detailed situational tree, takes the fact into consideration that the mode choice of the members of groups G, H and I is not firmly determined, but depends upon the specific conditions pertaining on particular days. When only empirically measured status quo data are included, this "sensibilisation potential" cannot be identified.

DIAGRAM 3



APPLICATION OF THE SITUATIONAL APPROACH

When using the situational approach, individual out-of-house activities must be combined to form activity patterns and these must be reflected in the situational context of the given households. HEGGIE, JONES, DIX and others working for the TSU did much of the initial research in this area for the field of transportation. They established the idea of a household-oriented activity pattern and improved the approach by using such terms as substitution, reorganisation and flexibility. (5) Travel behaviour could thus be better understood and explained.

If activity-oriented thinking is to be integrated in the situational approach to design a behavioural model for mode choice, then a number of very specific problems must be solved. (6) The solutions presented in the present paper are still imperfect and are by no means comprehensive. More research is needed. Since transportation planners

require data which deal with trips, the basic unit of a model for mode choice must be the specific trip made by the individual.

The Individual Trip as a Derived Demand

Trips cannot be viewed in isolation, but must always be seen in relationship to trip chains, activity patterns and the activity programs of individuals and their households.

The Situational Context

Trips are not made in a vacuum. If mobility is to be properly understood, then all those factors must be identified which contribute to determining behaviour in situational contexts. It is never sufficient to simply use sociodemographic variables even if these variables are interpreted in relationship to some of the characteristics of the given infrastructure.

Perception of the Situational Context

Persons perceive their situations subjectively and not objectively. (7) But since subjectively experienced situations determine behaviour, a realistic model must also (be able to) include subjectively perceived variables. This means that one must always study the macrostructure to see how it is reflected in the individual microstructure. Therefore, perception is one of the keys with which to relate the macrostructure to the microstructure. However, one should not forget that perception has not yet been comprehensively enough studied to explain it sufficiently.

Explaining Observed Behaviour

If one wishes to explain the mobility behaviour which has been observed, it is necessary to classify the given subjective behavioural situations into those dimensions which are responsible for determining behaviour. However, since the reasons causing out-of-house mobility are highly complex, (8) different dimensions must be selected taking the feasability of their application into consideration. It presently seems (9) that seven dimensions are sufficient to design an individual-oriented behavioural model for mode choice. These dimensions are:

- existence of objective option of choosing an alternative mode;
- constraints which do (not) permit use of alternatives;
- degree to which informed about alternatives;
- importance of travel time for mode choice; perception of travel time with mode used and with alternative modes;
- importance of travel costs for mode choice; perception of travel costs with mode used and with alternative modes;
- importance of service and comfort; perception of this for mode used and for alternative modes;

o (other) attitudes toward alternative modes.

If each trip and the activities related to this trip is properly analyzed in relationship to the activity pattern and the activity program, then the result is that the pertinent behaviour - in this case, mode choice - can be accurately explained. It is thus obvious that the dimensions referred to above consist of a large number of single variables.

"Generalized" Behaviour

Behaviour is not temporally constant. This means that the behaviour observed on one day will not necessarily be repeated on the following day. Although this has long been recognized as a problem by persons involved in transportation research, it is a problem which has yet to be solved. Usually, one attempts to circumvent this problem by collecting information on variables which are of importance over a longer period of time. However, this is not only costly, but methodologically difficult. Although the latter problem is perhaps even more important than the former, it is rarely considered. "Sensitisation", which was developed for use in the situational approach offers an alternative solution which is of almost equal value. By defining threshold groups, those trips in each dimension can be identified for which the factors influencing mode choice differ at different times. The behaviour is thereby "generalized".

The "Individualisation" of the Decision-Making Situation

At this point, it becomes clear that such an approach is only possible if each situation is individually considered and is not synthesized in the models. This is important because it is the individual interrelationship of the different categories and threshold values which makes it possible to identify those options which are actually available. An "individualized" approach of this sort also makes it possible to identify those persons whose decision-making situations are comparable. These decision-making situations are the first key to aggregation - which is naturally also necessary in this type of model approach.

Forming Situational Groups

Situational groups are the basis for this type of aggregation. Situational groups and situational contexts are comparable. They have to do with trip categories, not persons. Situational groups have a deterministic nature if certain types of behaviour are impossible due to the given conditions - irrespective of whether or not individuals might "wish" to use a certain mode to make their trips. Most of the decisions made by persons in the different situational groups are determined either by objective reasons (no alternative), personal reasons (car needed at work), or by subjective reasons (persons insufficiently informed or "dislike" a specific mode). But usually, the use of an alternative mode is subjectively as well as objectively possible for at least a number of the remaining trips. The persons in this latter situational group (the group with options) define the maximum potential for changed behaviour given status quo conditions.

The Impact of Measures

Situational groups not only explain behaviour, but also give one a basis upon which measures can be planned and their effects estimated. This is possible because the effect of all dimensions is determined for each trip. Since a changed transportation supply always only directly influences the decision-making situation, while it influences the resulting behaviour only indirectly, such a method makes it possible to identify those situations which can be changed for particular trips by implementing certain measures - or, to put this more concretely - which trips in the situational group with no options can be transferred into the group with options. The so-called "dynamisation" which is necessary here, tells one how large the maximum potential for reaction is for a planned measure which is to be studied.

Individual Responsiveness

Persons who have options can change their behaviour. However, this far from means that they will, in fact, change their behaviour. Thus, it is important to know how likely it is that a person with an option will actually change his behaviour. Therefore, the model structure combines probabilistic approaches with deterministic approach However, since behavioural changes are a result of subjective rationality, they cannot be compared with the use of utility functions in an econometric approach, for example.

Inclusion of All Possible Reactions

When trips are related to activity patterns and activity programs, then it is not only possible to register changes in mode used, but also changes in destination, the fact that a trip is simply not made, and the possible effects on the activity patterns of the other members of the household. This is done for all of the different situational groups.

The Multi-Effects of Measures

Many different types of measures can influence the various dimensions in the situational groups. Thus, a new public transit system can offer service which is not only more comfortable, but also faster. Wise planning will insure that these advantages are well advertised. It is possible to identify the effect which this bundle of measures has on a situational group, as well as the effect which an isolated measure has on the situational group. Thus, it is possible to at least roughly forecast the impact which a PR campaign, for instance would have on ridership.

Longer-Term Adaptations

Measures of different sorts frequently influence not only the status quo conditions, but also have a more long term impact. Although no model makes it possible to definitively identify the long term impact of a measure, the situational approach makes it possible to at least estimate the scope of potential changes (such as the maximum effect which a change in attitude is likely to have on behaviour) and can thus make it possible to suggest the types of measures which should be introduced in the future.

Collecting Concrete Data for Transportation Planning

Two comments are to complete this discussion. First, one must emphasize the fact that, up until now, behavioural models have been most important as better analytical instruments. In order to forecast the number of persons using transport networks in concrete situations - such as, for example, the population structure in the year 2000 - behavioural models will always need to work with more "conventional" approaches. Furthermore, they have their limits as do all methods of forecasting - unfortunately, they are not clairvoyant. However, if one sees forecasting as a method to reduce uncertainties, then it would be wise to better explain the reasons which cause persons to act as they do, and to make this information available to planners.

However, such newer model approaches are only possible if the canon of empirical survey methods which has been used up until now is considerably expanded. (10)

A NEW WAY OF THINKING

It is obvious that the arguments presented above are overly simplified. But this paper does not wish to describe a perfected theory, but rather, a basic way of thinking. This new "philosophy" is characterized by the reflection that expected changes in behaviour cannot be calculated by using aggregates and aggregate segments, but must rather take account of individual behavioural changes in light of actual circumstances. This is possible because this approach maintains the individual as the basic unit and considers his formal and informal, objective and subjective options without using a model structure which assumes that a person's behaviour is predetermined. "Man is no longer considered to be an economic machine", in this philosophy, "but rather an interacting and communicating subject...whose values are not fixed but can be influenced and changed." (11) Or, to put it differently, the "performing" subject is deemed to be a unique individual.

This identity cannot be adequately understood by simply using the sociodemographic variables so frequently offered in secondary statistics; the "widespread practice of developing and empirically testing hypotheses relating certain sociological variables such as class, education, etc., to human behaviour" (12) is a fail-proof method of misinterpreting human behaviour.

Simultaneously, the decision-making behaviour of the individual retains its original, human dimension, a dimension which is usually lost in the widespread econometric models. "The behavioural suppositions which are the basis for the calculation of quantitative variables have their origin in the extreme reduction of human psychology to the one norm of maximum utlization. Man has become...nothing more than a rationalizing, decision frantic caricature of himself concerned only with maximum utilization." (13)

As a result, when the situational approach is used, the quality and contents of the concrete model structure must always be improved. "The most important argument here is that the methods of counting, constructing models and statistical calculations are not the most natural and important methods which can be used by scientific research to show human interaction." (14)

TRENDS IN EMPIRICAL SOCIAL RESEARCH

The above criticism of the state of the art is by no means limited only to a criticism of those scientific disciplines involved in transport policy making. There has been a trend to fundamentally reevaluate the manner in which social reality can be recorded at all in empirical social research as a whole. For many years, social scientific research methods adhered as closely as possible to the methods used in the natural sciences; this was blindly accepted. However, in recent years, this approach has been widely criticized. One critic stated the problem well and concisely when he said that , "When we attempted to attain the status of a natural science, we accepted the latter's theory of cognition, its assumptions about the nature of knowledge, proper methods to collect data, and the rules of the scientific methods. However, our acceptance of the natural scientific model resulted in problems, for the manner in which this model divided human behaviour was artificial and did not agree with the manner in which behaviour was actually observed." (15)

"The artificial interpretation of reality" induced by this manner of thinking, "which is represented in the currently common theoretical, methodological and abstract approaches, leads to the scarcity of models which are able to explain human behaviour." (16) As a result, it can be certified that "sociology increasingly withdrew from the social world and constructed a 'sociological world' whose relationship to the actually existing social world is so questionable. (17)

Social researchers have realized this and are now increasingly trying to return to the "real" object of research - the actual social world. "For empirical science, reality exists only in the empirical world and can only be sought and verified in this empirical world." (1 However, the empirical world is highly complex. It "consists of the group life of individuals - their personal and collective experiences and actions when they become active within their given life styles. I includes the broad scope of their interrelated activities which arises when the activities of one individual influence the actions of others. And the world includes a great variety of relationships among differen persons...To summarize this: the empirical social world is a world of everyday experiences, in which we can recognize the surface levels in our own lives and in the lives of other persons. The life of a human society or any of its parts or any human organization within the society or its members consists of the actions and the experiences of persons when they experience the situations which occur in their given environments." (19)

If one wishes to study this empirical world, then one needs a very special kind of research methodology. The "classic" scientific approach, in which specific hypotheses are usually tested, is usually not very successful in its analysis of the empirical world. This classic scientific approach "is based on an 'as if' concept; i.e., one approaches the empirical world as if it has this or that appearance, and then one draws specific, limiting conclusions about what one should observe if the empirical world were really as one had thought it to be, and then one checks to see if the conclusions one has drawn are really to be found in the empirical world." (20)

This approach is all too obviously wrong. Social scientists should "design a method which makes it possible for them to take the inner as well as the outer structure of the subject which they are investigating into consideration. Qualitative methodology makes this possible...it is an approach which is designed to give verifiable data on the empirical social world. In order to forecast behaviour, sociologists must understand the complex processes which cause human interaction. However, in order to understand these complex processes, sociologists must gather information on such diverse factors as attitude, circumstances and environment - for these are the factors which make up the respondent's real world...To summarize; qualitative methodology advocates an approach to study the empirical social world which requires that the researcher interpret the actual world from the perspective of the subjects being studied." (21)

However, the introduction of these new concepts into empirical social research is not as unproblematical as it may appear to be in the above discussion. The proponents of the new developments discussed in this paper are still clearly in the minority. On the other hand, or perhaps precisely because of this, these concepts give one the opportunity to reach an understanding with those persons responsible for making transport policies. Since the approach presented in this paper concentrates upon those persons actually performing out-of-house activities and their present and future behaviour (which is also of central interest to transport policy makers), it makes it easier for the researcher to communicate with the policy maker. (22)

However, communication of this type can only be fruitful if the empirical social scientist acquaints himself with the problems and needs of the policy maker and vice versa. For this purpose, it is necessary to achieve some kind of harmony among the different basic concepts which deal with an understanding of out-of-house behaviour and the processing of this behaviour in the model structure. The social scientific trends discussed above could most definetly be a step in the right direction.

THE PRACTICAL APPLICATION OF THE SITUATIONAL APPROACH

The researcher was hardly given the opportunity to use such new model concepts as the situational approach during the early 1970s. However, in recent years, researchers have had many opportunities to actually test such models practically. Quite a number of research and planning projects have thus already used the model structure described in this paper, so that results are available. The present section of the paper therefore presents the most important results of such research projects in order to show how the situational approach can be applied to deal with concrete problems. However, the following discussion is simply meant to be a summary - a detailed discussion of all of the results of the studies would be impossible within the confines of the present paper. The following discussion will also discuss a number of areas which have not yet been dealt with. These are areas in which further basic research is urgently needed.

Further Development of an Urban Public Transport System

The first example of a situation in which the approach described above was applied is a study which was done in Hannover in which all of the procedures described in the present paper were stringently adhered to. The vicinity of Hannover, which supported the project, has approximately 1.1 million inhabitants and is thus one of the densely populated areas in the Federal Republic of Germany. The existence of and further development of a functioning transport infrastructure is of fundamental importance to the further economic development of Hannover. Hannover therefore contracted SOCIALDATA to do a study on the "Transportation Analysis and Forecasting of the Urban Rapid Train System in the Vicinity of Hannover." (23) SOCIALDA used two "scenarios" to study the potential increase in the number of passengers using public transportation in Hannover. The time "scenari showed the potential when travel time with public transportation (door to door) decreased by 10%, 20% and 40%. The cost "scenario" showed the reactions which were likely if the price for petrol climbed by 50%, 100% and 150%.

The study was limited to an investigation of weekday travel within the specific region dealt with by the study. This means, for instance, that long distance travel was excluded from the study. The section of the study presently being discussed concluded by determinin the likely reactions and identified responsiveness for the different steps of the "scenarios". The overall effects of different measures and the reactions which can be expected to specific combinations of measures will be discussed in the model for transporation planning.

All of the results presented here refer to trips made by car drivers and take the fact into consideration that these trips are part of the individuals' activity patterns (24). For this purpose, data on the activity patterns of 10,000 persons was collected in a survey of households. Since it was the goal of the survey to determin the potential for public transportation, a subsample of households usi individualized modes was selected. In this subsample, in-depth interviews were done of 700 households which included about 1,500 persons. The different variables which influence behaviour were combined in a qualitative processing procedure. The seven different dimensions which are especially important for determining such behaviour (discusse and listed at the beginning of this paper) were used. An aggregate interpretation of these dimensions for the behaviour which was actually observed and for its generalization is depicted in Table 1 which appear on the following page.

This analysis (Table 1) show how the number of given options increases if one generalizes behaviour. In an aggregate consideration, one can assume that almost every second car driver trip could potentially be made with public transportation when one considers the positive attitudes of the car drivers toward public transportation. (This is precisely what results when demoscopic methods are used in studies. However, an "individualisation" of actual options shows that the prese public transportation potential - if planned measures which change the situation have not been introduced - is very much smaller. This is shown by Table 2 which is depicted on the following page.

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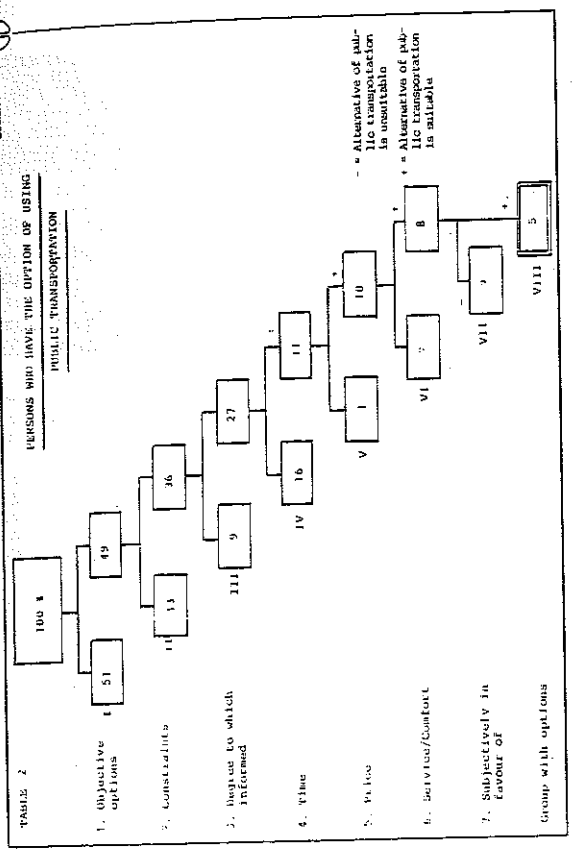
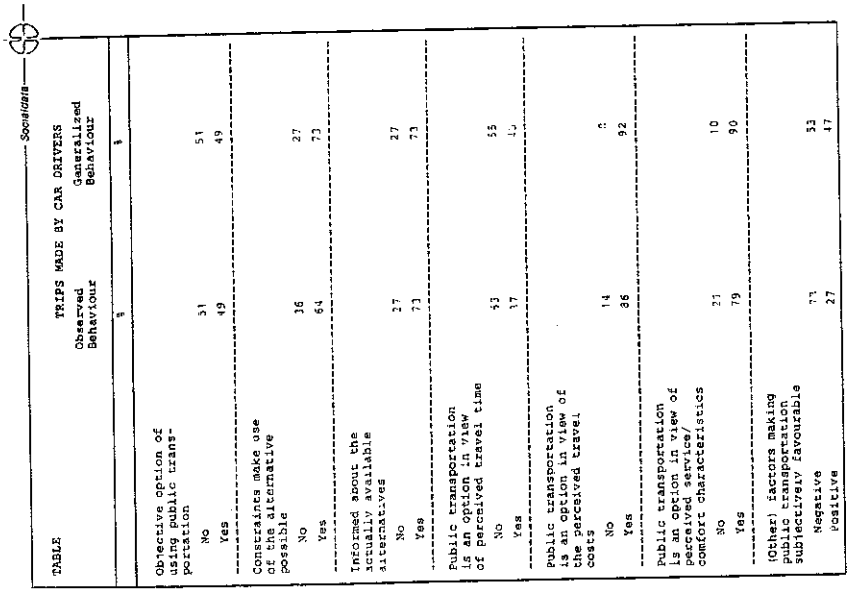




The subdivision used in Table 2 permits one to differentiate between eight situational groups. The groups are symbolized by Roman numerals. The groups I-VII have a deterministic character in the ("generalized") status quo. However, every twentieth trip can usually not always be made with public transportation. This latter group is the group with options, represented by Roman numeral VIII.

The measures which were to be studied pertained to travel time and travel costs, which - this must once again be emphasized - were reflected in the model structure as they were perceived. If one examines the isolated effect of measures on the pertinent dimensions, then, by using the "dynamisation", one can determine the maximum potential for change and estimate the equivalent responsiveness for this group. See Table 3 and Table 4 below.

TABLE 3

Responsiveness in the TIME "Scenario" toward public transportation by car drivers	Potential %	Reactive %	Elasticity coefficient
o When the time needed to travel with public transportation is reduced by 10%	8,8	1,6	0,18
o When the time is reduced by 20%	9,4	0,9 (2,5) *)	0,27
o When the time is reduced by 40%	11,6	2,3 (4,8)	0,41

*) Cumulative values (some of which have been rounded off)

TABLE 4

Responsiveness in the COSTS "Scenario" toward public transportation by car drivers	Potential %	Reactive %	Elasticity coefficient
o If petrol prices are increased by 50%	5,4	1,6	0.30
o If petrol prices are increased by 100%	5,4	0,3 (1,9) *)	0,35
o If petrol prices are increased by 150%	5,4	0,6 (2,6)	0,48

*) Cumulative values (some of which have been rounded off)

It can be shown that reducing travel time results in a much greater potential for change than increased petrol prices. In the analysis of the comparatively small potential, especially in the price "scenario", one must once again refer to the limitations referred to at the beginning of this section. However, the proportionate increase in the elasticity coefficients does show that when it becomes increasingly difficult to use a car, the number of trips made with public transportation will increase considerably.

But the cost "scenario" also shows that there are other ways of reacting. These can be deduced by using the model structure for every single car trip within the context of the given activity patterns and for all situational groups. (Shown in Table 5 below.)

TABLE 5 ALL USERS OF INDIVIDUAL MODES +)

Ways of reacting to increased petrol costs	..... by 50%	... by 100%	... by 150%
	%	%	%
o Switch to public transportation while destination remains the same	1,1	1,5	2,2
o Switch to public transportation and change destination	0,1	0,1	0,1
o Other modal chances			
- walking	1,1 ++)	1,1 ++)	0,0 ++)
- bicycle	1,8	2,7	3,0
- individual modes	0,1	0,2	0,2
o Other destination with same mode	0,4	0,6	1,2
o Other reactions	0,5	1,1	1,3
o Trip not made	0,3	0,4	0,8
o No reactions	94,7	92,3	90,4
	100,0	100,0	100,0
(Extreme difficulties with adapting)	(2,0)	(6,1)	(11,8)

+) For technical reasons car drivers and car passengers are considered as one group here.

++) Imprecisions caused by rounding off

+++) Sub-group of "unbalanced trips", in which larger scale changes in living conditions of the households can be expected which indirectly cause changes in behaviour. This sub-group is not included in the above depictions of ways of reacting.

Thus, it becomes clear that "changing to public transportation" is only one, and a minor, way of reacting. One should also not forget that this depiction pertains to trips - i.e., it affects a much larger number of persons and households. This also applies to trips of "households in imbalance" which affects households which cannot adapt to the new situation given their current circumstances. The situational context of these households must be comprehensively changed - e.g., they must move to a different neighborhood - if the transit situation of these households is to be changed. Such changes will ultimately appear in changes in transport behaviour, as well.

Nonetheless, the ways of reacting which have been depicted may seem to be trivial. When one compares the results of the study discussed above with the results of a comparable study dealing with long-distance travel, one clearly sees that one can expect much more significant reactions to increases in the price of petrol for those trips which were excluded in the Hannover study - especially for weekend trips. (See the next part of this section.)

The Hannover study is a perfect example of how the different types of results which a measure would have can be forecast by using the situational approach. The results of combinations of different sorts of measures is naturally also shown with the situational approach. Different measures can be combined in a large variety of ways. Table 6 shows only a few examples of the results of combining different measures, since the present paper only wishes to discuss the possible uses of the situational approach and not all of the results which can be attained. The increase in the maximum potential which results when persons are better informed can, for example, show the approximate scope of the possible adaptability of persons and the learning processes which will always result when a planned policy is introduced. Furthermore, one can thus estimate the extent to which, for example, longer term changes could have an impact on behaviour.

TABLE 6

Potentials for change in public transport	Car driver		
	Maximum Potential	Maximum Potential with improved information	Maximum Potential with improved information and long term attitudinal changes
	%	%	%
- Status-quo	5		
- When travel time with public transport is decreased by 40%	12	14	
- By equalizing the perceived values of the dimensions time, cost and level of service	16	19	35

When one evaluates these results, one should not forget that if one wishes to use them for forecasting, then the given responsiveness must be determined for the different potentials. However, as can be sho this can be done at any time.

Processing Personal Long Distance Travel in the Federal Republic of Germany in a Model Structure

Compared with the amount of information on mobility in urban areas which is available in the Federal Republic of Germany, the data available on long distance travel are comparatively sparse. However, since such important and expensive decisions are still to be made concerning network construction for long distance travel, the Minister of Transport authorized a comprehensive study to be done on personal long distance travel (25) in 1979/1980.

In the second, qualitative part of this project, the (actual) reasons for making long distance trips with the mode used was to be explained and the likely reactions to changed external conditions was to be forecast. (26) The situational groups were differentiated on hand of the seven dimensions listed at the beginning of this paper and also referred to in the study done in Hannover.

The individual combination of the dimensions is used to construct the explanatory tree. For persons travelling by car (divided into two groups according to travel purpose), a comparatively minimal potential for change is possible given status quo conditions. (See Table 7)

However, a sensitisation of these explanatory trees clearly showed that the general potential for change is greater. (See Table 8)

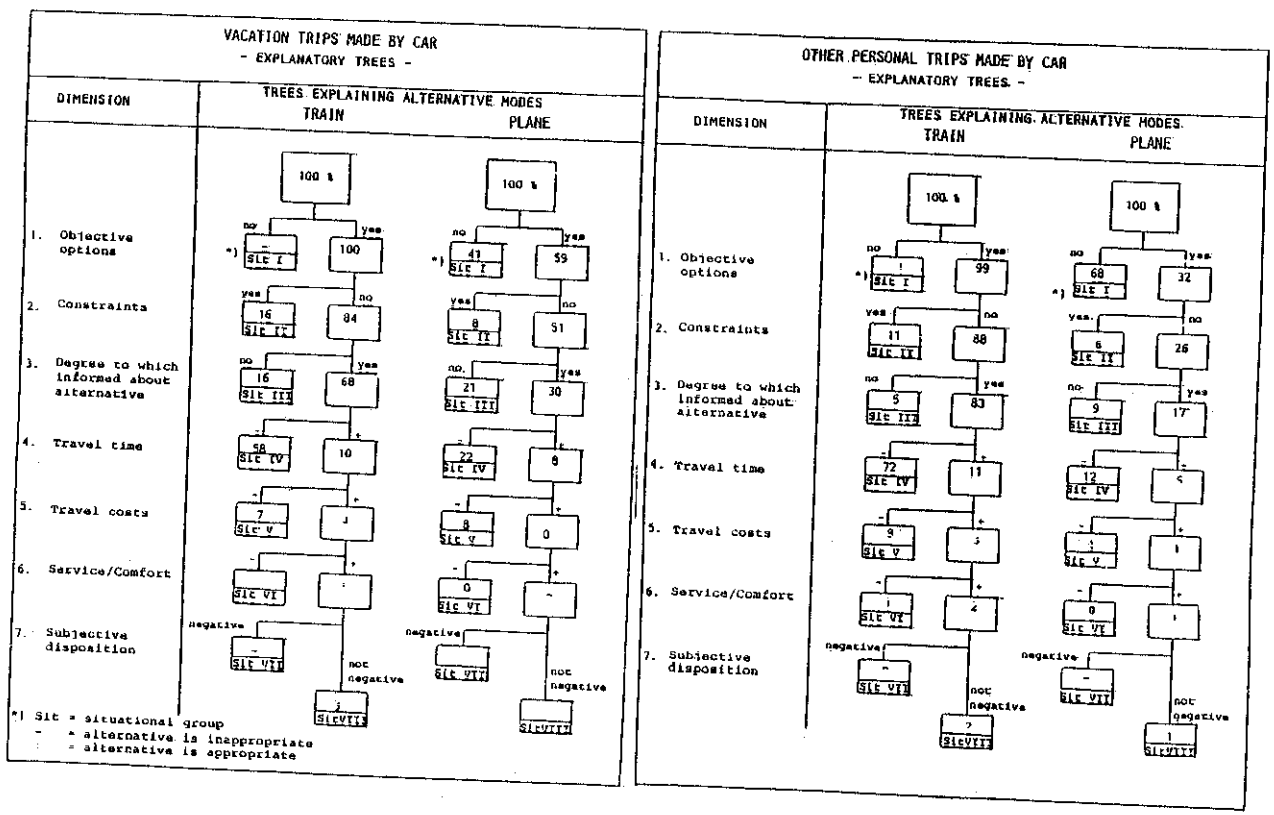
This general potential for change is not yet related to a specific planned measure. In further steps of the study, however, one can determine the share of travellers who would generally react to changes in travel time or travel costs. However, identifying these rather theoretical maximums is not the main goal of this step of the study. Much more important is the fact that by identifying those travellers who do not belong to the maximum potential, those persons are identified who would definetly not respond to measures affecting travel time and travel cost by changing mode.

The present study was to identify the impact which the following measures would have on personal long distance travel:

- The relative amount of time spent travelling with the different modes was to be changed by 20% and 40%.
- The relative price for travel between train and plane was to be altered by 25% and 50% and the relative price of travel between public modes and car was to be altered by 50%, 100% and 200%.

Since the goal of the study was to determine market shares, it was initially irrelevant if these relative changes were caused by the fact that one mode became cheaper/faster or the other mode became more expensive/slower.

TABLE 7


VACATION TRIPS MADE BY CAR
- EXPLANATORY TREES -
DIMENSION
TREES EXPLAINING ALTERNATIVE MODES
TRAIN
PLANE
1. Objective options
2. Constraints
3. Degree to which informed about alternative
4. Travel time
5. Travel costs
6. Service/Comfort
7. Subjective disposition
100 %
Sit I
Sit II
Sit III
Sit IV
Sit V
Sit VI
Sit VII
Sit VIII
negative
not negative
*) Sit = situational group
- = alternative is inappropriate
: = alternative is appropriate
OTHER PERSONAL TRIPS MADE BY CAR
- EXPLANATORY TREES -
DIMENSION
TREES EXPLAINING ALTERNATIVE MODES
TRAIN
PLANE
1. Objective options
2. Constraints
3. Degree to which informed about alternative
4. Travel time
5. Travel costs
6. Service/Comfort
7. Subjective disposition
100 %
Sit I
Sit II
Sit III
Sit IV
Sit V
Sit VI
Sit VII
Sit VIII
negative
not negative

*) Sit = situational group
- = alternative is inappropriate
+ = alternative is appropriate

TABLE 8

VACATION TRIPS MADE BY CAR
- SENSITISATION -

DIMENSION	ALTERNATIVE MODES: TRAIN	PLANE
1. Objective options	100% → no: 0 / yes: 100 (threshold groups)	100% → no: 41 / yes: 59 (threshold groups)
2. Constraints	yes: 2 / 14 / no: 84	yes: 1 / 7 / no: 51
3. Degree to which informed about alternative	no: - / 19 / yes: 79	no: - / 25 / yes: 33
4. Travel time	39 / 45 / 14	23 / 21 / 14
5. Travel costs	7 / 30 / 22	6 / 22 / 7
6. Service/Comfort	10 / 10 / 32	6 / 8 / 15
7. Subjective disposition	negative: 1 / not negative: 41	negative: 2 / not negative: 21

- = alternative is inappropriate
+ = alternative is appropriate

OTHER PERSONAL TRIPS MADE BY CAR
- SENSITISATION -

DIMENSION	ALTERNATIVE MODES: TRAIN	PLANE
1. Objective options	100% → no: 1 / yes: 99 (threshold groups)	100% → no: 68 / yes: 32 (threshold groups)
2. Constraints	yes: 3 / 9 / no: 88	yes: 1 / - / no: 26
3. Degree to which informed about alternative	no: - / 7 / yes: 90	no: - / 12 / yes: 19
4. Travel time	32 / 52 / 13	11 / 12 / 8
5. Travel costs	5 / 40 / 20	4 / 12 / 4
6. Service/Comfort	13 / 11 / 36	7 / 4 / 10
7. Subjective disposition	negative: 1 / not negative: 46	negative: 1 / not negative: 13

With the help of the situational analysis, four different potentials for mode change could be identified:

a) The general potential for change irrespective of the implementation of any specific measures.

b) The general potential for change when restrictions in one dimension were done away with (e.g., it was assumed that perceived travel time for mode used and its alternative would be the same.)

c) The current potential for change as the result of a specific measure pertaining to one dimension (e.g., travel time of alternative mode was reduced by 20%, then by 40%).

d) The current potential for change given status quo conditions (i.e., the group with options).

Table 9 summarizes the different potentials for mode change of persons travelling by car when the relative amount of time spent travelling with different modes is altered. (Group C is subdivided according to the different measures to be studied.) If one looks at "other" personal long distance trips, then one sees that 87% of these trips are made by car and 8% are made by train. (Potential A) If the perceived travel costs are hypothetically equalized for train and car, only a maximum of 14% of the car travellers would be willing and or able to respond. (Potential B) This potential shrinks when the travel duration by train is reduced by 40%, then by 20% and finally by 5% (Potential C1) or 4% (Potential C2). Given status quo conditions, the maximum potential was already 2% of all persons travelling by car. (Potential D) (See Table 9)

The maximum potential for change is similar when the relative price for different modes is changed. This clearly indicates that the most important way of responding to changed external conditions affecting personal long distance travel is not by changing mode. (See Table 10)

Initially, this analysis disregards the numbers of persons who use different modes for their personal long distance trips. However, when the relative number of travellers using the different modes is considered, then the maximum share per mode for each planned measure can be given. However, these figures should be used to identify the relative number of persons using the modes and not to exactly forecast the market share - since it is more or less impossible to do this. Thus, it is appropriate to compute these values as indexes. This was done in Table 11.

All in all, the proportion of travellers using different modes defines a realistic upper limit which shows the extent to which a re-orientation of the long distance travellers to other modes can take place in specific situations. However, one should not forget that this upper limit will not be reached in normal situations.

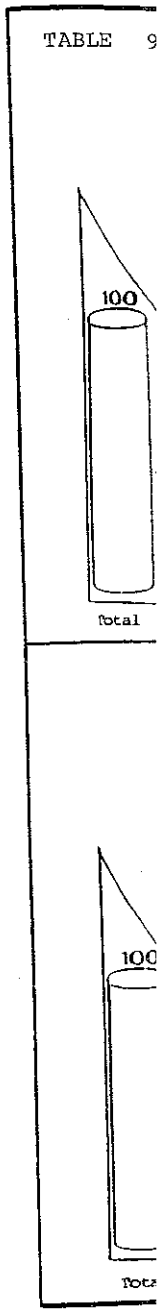


TABLE 9

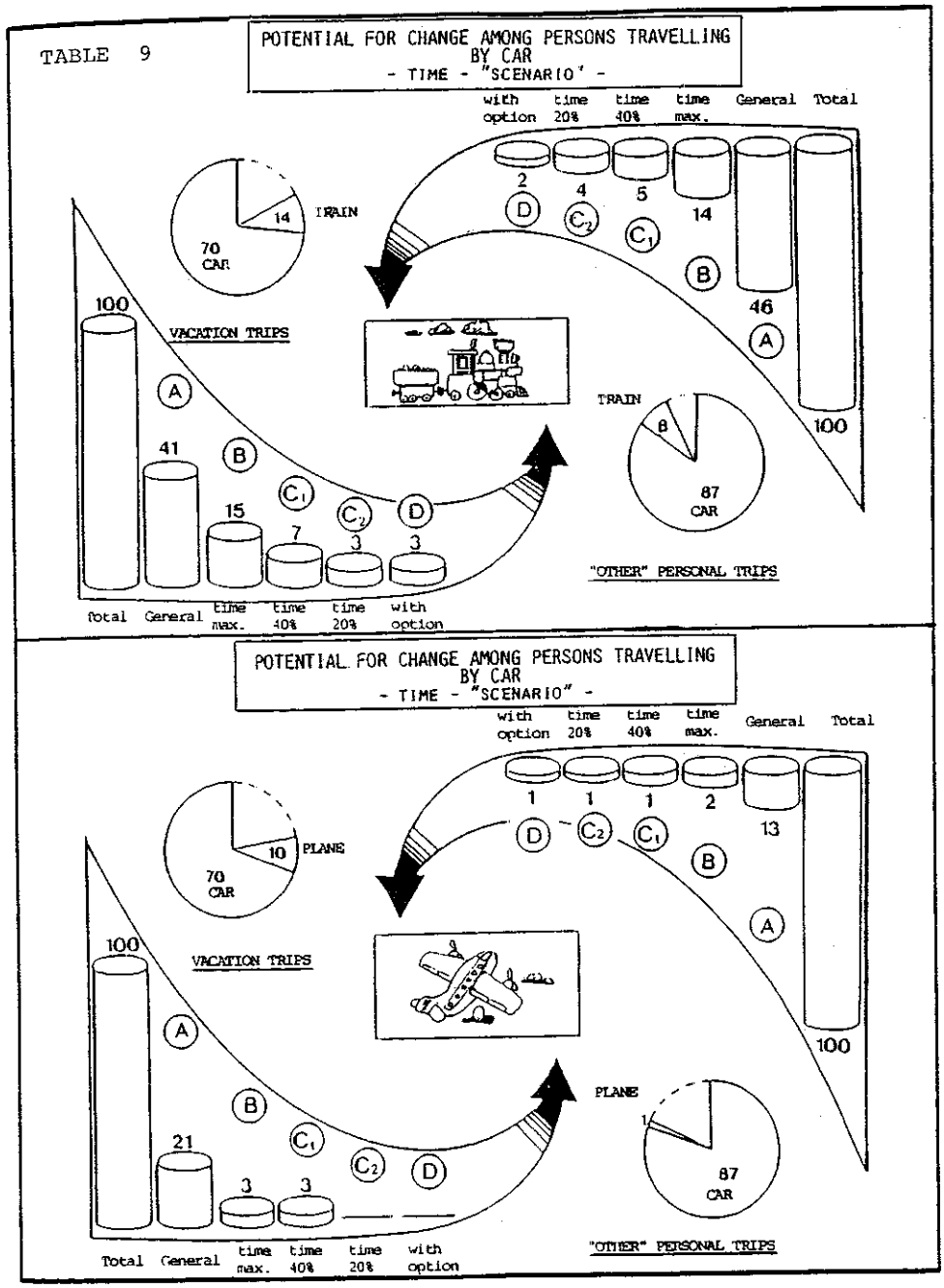

POTENTIAL FOR CHANGE AMONG PERSONS TRAVELLING
BY CAR
- TIME - "SCENARIO" -
with option
time 20%
time 40%
time max.
General
Total
TRAIN
70 CAR
14
VACATION TRIPS
100
41
15
7
3
3
2
4
5
14
46
100
87 CAR
8
"OTHER" PERSONAL TRIPS
POTENTIAL FOR CHANGE AMONG PERSONS TRAVELLING
BY CAR
- TIME - "SCENARIO" -
PLANE
70 CAR
10
VACATION TRIPS
100
21
3
3
1
1
1
2
13
100
87 CAR
1
"OTHER" PERSONAL TRIPS

TABLE 10

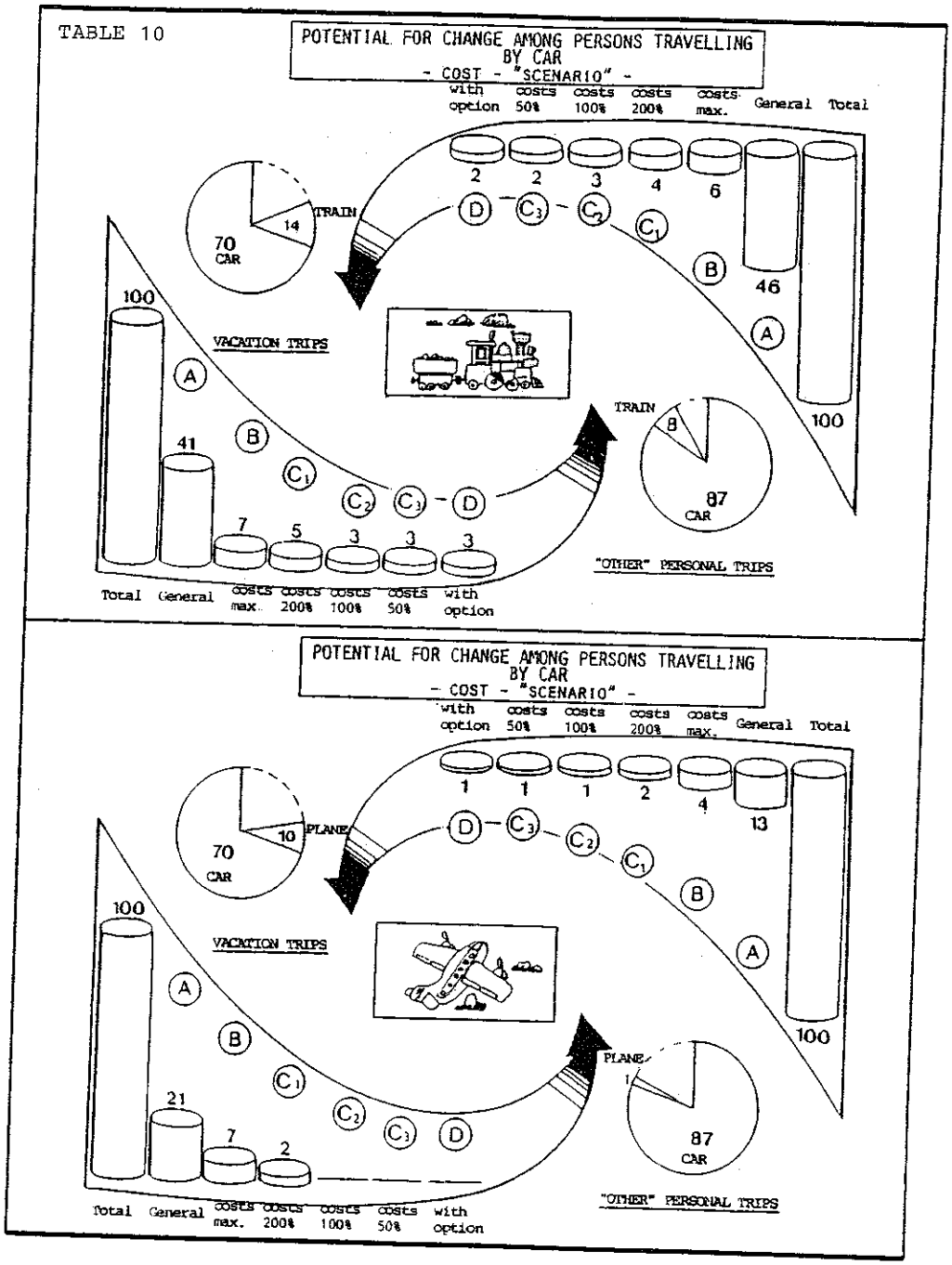


TABLE 11

Altered TIME-relations

- diff. options[1]
- time 20%[2]
- time 40%[2]

Altered COST-relation

- diff. options[1]
- costs 25%[3]
- costs 50%[4]
- costs 100%[5]
- costs 200%[6]

Basis (present sit.)

1) Maximum share
2) Maximum share
3) Maximum share
- car versus
- train versus
- plane versus

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Table 13
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TABLE 11

Altered TIME-relations	POSSIBLE SHARE OF USERS FOR CAR: total personal long distance travel	CAR: vacation trips	CAR: "other" personal trips	TRAIN: total personal long distance travel	TRAIN: vacation trips	TRAIN: "other" personal trips	PLANE: total personal long distance travel	PLANE: vacation trips	PLANE: "other" personal trips
o with options[1]	101	101	101	122	117	123	124	107	237
o time 20%[2]	101	101	101	135	117	141	124	107	237
o time 40%[2]	101	101	101	148	134	152	141	127	237
Altered COST-relations									
o with options[1]	101	101	101	122	117	123	124	107	237
o costs 25%[3]	101	101	101	122	117	123	124	107	237
o costs 50%[4]	101	102	101	122	117	123	124	107	237
o costs 100%[5]	x	x	x	128	117	132	124	107	237
o costs 200%[6]	x	x	x	136	128	138	155	117	287
Base (present share)	85.2% = 100	69.8% = 100	87.1% = 100	9.5% = 100	11.4% = 100	8.2% = 100	2.9% = 100	10.3% = 100	0.8% = 100

1) Maximum share with no further measures (group with options)
2) Maximum share when travel time improved by 20% 40%
3) Maximum share if costs are improved:
   - car versus both alternatives, by 25%
   - train versus plane, by 25%
   - plane versus train, by 25%
4) Maximum share if costs are relatively improved towards both alternatives, by 50%
5) Maximum share if costs are relatively improved towards car by 100% and towards train/plane by 50%
6) Maximum share if costs are relatively improved towards car by 200% and towards train/plane by 50%

These changes in external conditions which are referred to in this paper, deal with time and cost; time, as well as cost were studied by using two different "scenarios".

The time "scenario" assumed that the total travel time for the alternative train was reduced by 20%, and then assumed that the time needed to travel by car was simultaneously increased by 20%. This was then compared to a situation in which car travel time was increased by 40% while the time it took to travel by train remained the same.

The cost "scenario" assumed that the price of travelling by car went up by 50%, 100% and 200%, while the relative price of travelling with train and plane remained the same. (Simultaneous fare increases for plane trips were disregarded here.)

The likely responses to the three stages of the time "scenario" are summarized in Table 12. The potential increase in demand for trains when travel time is simply reduced is rather moderate. When car travel time increases, persons tend to respond by reducing trip frequency or travelling to a nearer destination. (See Table 12)

The time "scenario" showed that restrictive measures pertaining to car travel are much more effective than reducing train travel time. Table 13 shows the relative changes in modes choice which could be expected.

In studying car travellers' responses to the price of personal long distance travel, only such expenses as gas and oil, etc. were taken into consideration. The more drastic price increases would have a considerable impact on personal long distance travel. This is shown in Table 14.

The travellers would go to almost any extent in order to be able to make their vacation trips - even if these have to be somewhat altered. The vacation trips which are eliminated tend to be the second and third yearly vacation trips which have become so popular in Germany in recent years. On the other hand, it is difficult to similarly modify "other" personal long distance trips since the destination of these trips is frequently fixed - e.g., trips to visit a weekend house or relatives who live in another city. Thus, the number of these trips can easily be reduced, but it is difficult to "modify" them. This resulted in the relative changes depicted in Table 15.

The situations which have been depicted above did not deal with the economic and social changes which would simultaneously have occured had external conditions changed in the manner described above. Therefore, the term "scenario", which refers to a specific interview technique must be used with reservation. On the other hand, it is obvious that if the relative price for gas triples, this will have an economic impact which is greater than the behavioural changes which have been discussed here. Therefore, the results presented here "only" help to explain the mechanisms of personal long distance travel and make it possible to forecast the individual behavioural changes which would result under certain conditions.

However, the findings of this study clearly show that the existence and actualization of personal long distance travel is the result of highly complex decision-making processes within private households. Although travel time and travel costs involved in using different modes are important, it is the subjective perception of these factors which influence decision-making. In concrete situations, other factors besides only travel costs and travel time are important in influencing behaviour. Thus, changes in costs and time have only a limited effect on mode choice. The question of trip generation is much more important. When it becomes difficult to make personal long-distance trips, a change of mode is not the most likely response. It is more frequent for persons taking vacation trips, to travel to a nearer destination and for persons making "other" personal trips to reduce the frequency with which they make these trips.

TABLE 13 TIME-"SCENARIO"

TABLE 12

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other hand, it is
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presented here
long distance travel
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involved in using
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rip generation is
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personal trips
trips.

TABLE 13

"TIME - "SCENARIO"

MODE	Vacation trips						"Other" personal trips					
	Starting base %	Stage A Relative change	Stage B Relative change	Stage C Relative change	Starting base %	Stage A Relative change	Stage B Relative change	Stage C Relative change
Car	69.8	± 0%	./. 2%	./. 14%	87.1	./. 1%	./. 3%	./. 13%
Train	13.6	± 0%	+ 10%	+ 10%	8.2	+ 11%	+ 24%	+ 24%
Plane	10.3	± 0%	± 0%	+ 18%	0.8	± 0%	± 0%	± 0%
Reduction in total travel	-	-	± 0%	./. 7%	-	-	./. 1%	./. 9%
(other)	(6.3)				(3.9)			
TOTAL	100.0				100.0			

TABLE 12

TABLE 14

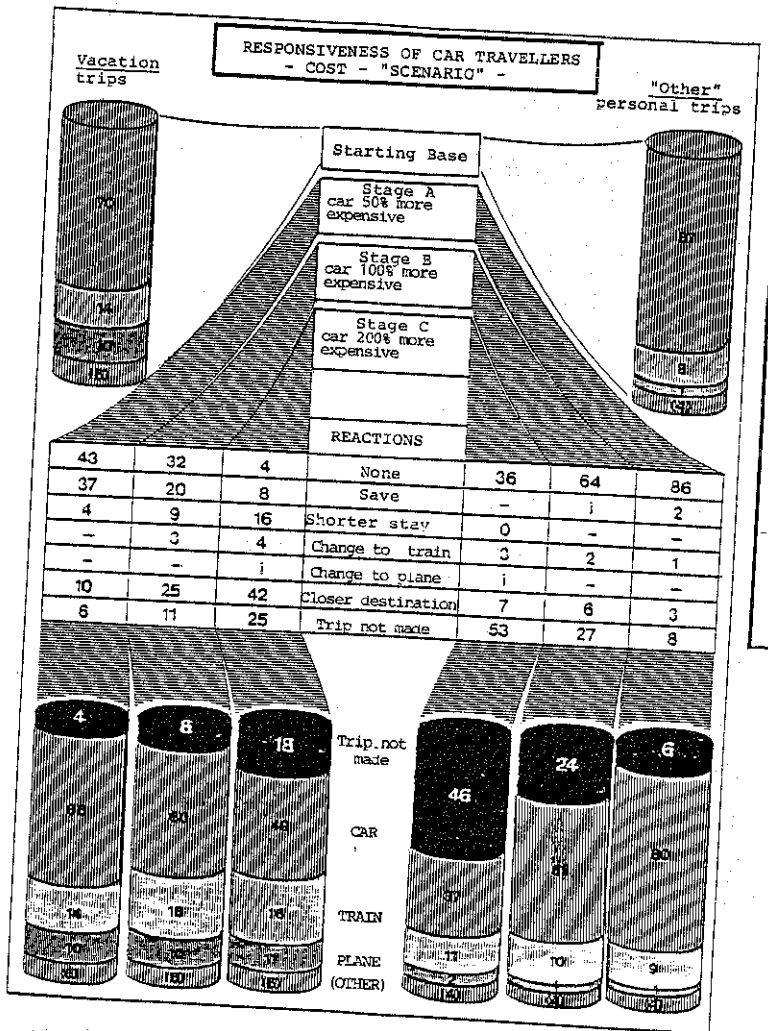


TABLE 15

COST - "SCENARIO"

MODE	Vacation trips: Starting base %	Vacation trips: Stage A Relative change	Vacation trips: Stage B Relative change	Vacation trips: Stage C Relative change	"Other" personal trips: Starting base %	"Other" personal trips: Stage A Relative change	"Other" personal trips: Stage B Relative change	"Other" personal trips: Stage C Relative change
Car	69.8	./. 6%	./.14%	./.30%	87,1	./. 8%	./.30%	./.56%
Train	13.6	± 0%	+ 13%	+ 18%	8.2	+ 4%	+ 27%	+ 29%
Plane	10.3	± 0%	± 0%	± 6%	0.8	± 0%	± 0%	+ 75%
Reduction in total travel	-	./. 4%	./. 8%	./.18%	-	./. 7%	./.24%	./.46%
(other)	(6,3)				(3,9)			
TOTAL	100.0				100,0			

Determining Price Sensitivity in Urban Public Transport

The results of a study on price sensitivity in Munich, which was done for the Munich Integrated Transportation System (27), are included in this review because these results so clearly show how the situational approach makes it possible to differentiate between very varied types of reactions, and does not only show a change of mode. (28) The situational groups were identified here using five different dimensions. (Since the topic being studied here was different from the topics previously discussed, five dimensions were sufficient.) The combination of these different dimensions for the situation on the day of sampling and the general situation is shown in Table 16 and Table 17. Depending upon the situational group to which they belong, the urban public transportation users can react to an increase in fares by changing to other modes or by reducing the frequency with which they use public transportation. This relationship between situational groups and the types of possible reactions, which was determined by using interactive measurement techniques, is summarized in Table 18.

When the urban public transportation system has a relatively differentiated fare structure (special rates, weekly or monthly passes, etc.) it repeatedly occurs that users of public transportation do not purchase those types of tickets which would be least expensive for them to use. However, when the fares are increased, persons often consciously decide (if frequently only temporarily) to use those types of tickets for which they have to pay the least. The situational approach also makes it possible to depict reactions of this sort. This is shown in Table 19.

Different kinds of reactions for the various types of categories (mode, trip purpose, sociodemographic characteristics, etc.), can naturally also be shown. Since such tables have been discussed at length elsewhere (29), however, they are not to be repeated here.

Finally, it is not only behavioural reactions which are of importance when decisions are to be made concerning increases in fares for public transportation. Other types of reactions are also important. Table 20, for example, differentiates between those persons whose household budgets would actually be adversely affected by fare increases and those persons who simply complain about fare increases. A correlation of these reactions shows how demand might actually change, the actual meaning of "protests" and also shows the cases of social hardship which would result if fares were to be increased. Table 21 illustrates this.

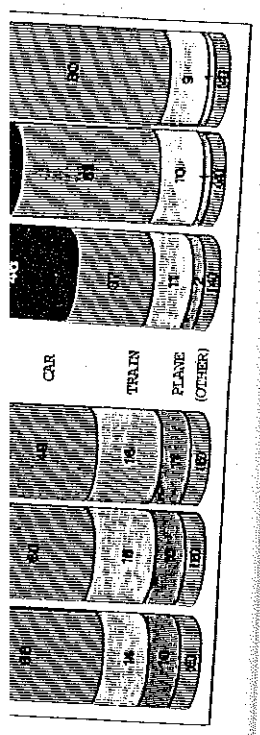


TABLE 16

EXPLANATION OF THE OBSERVED TRAFFIC BEHAVIOUR

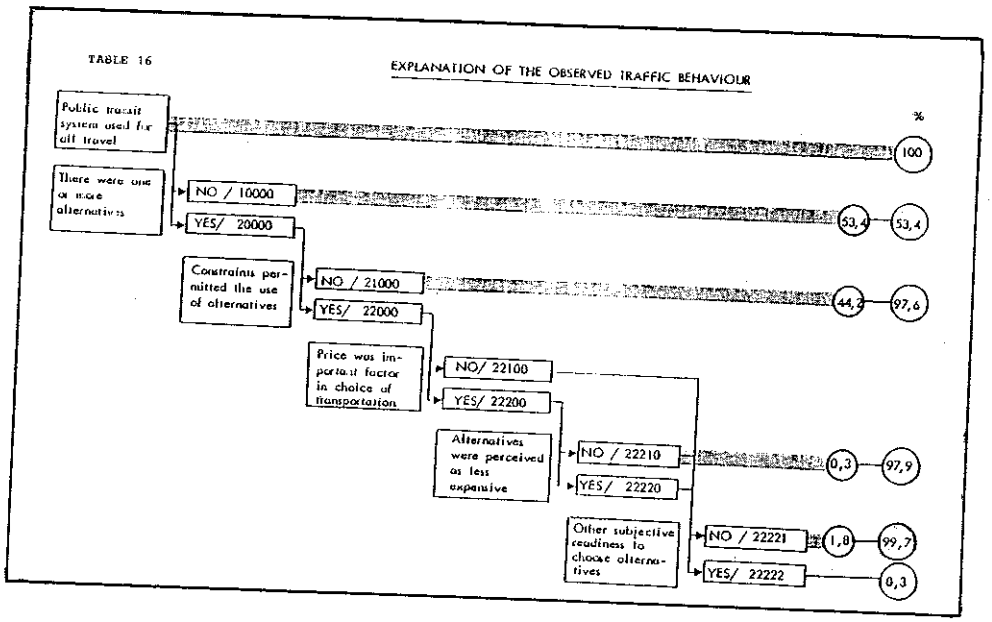
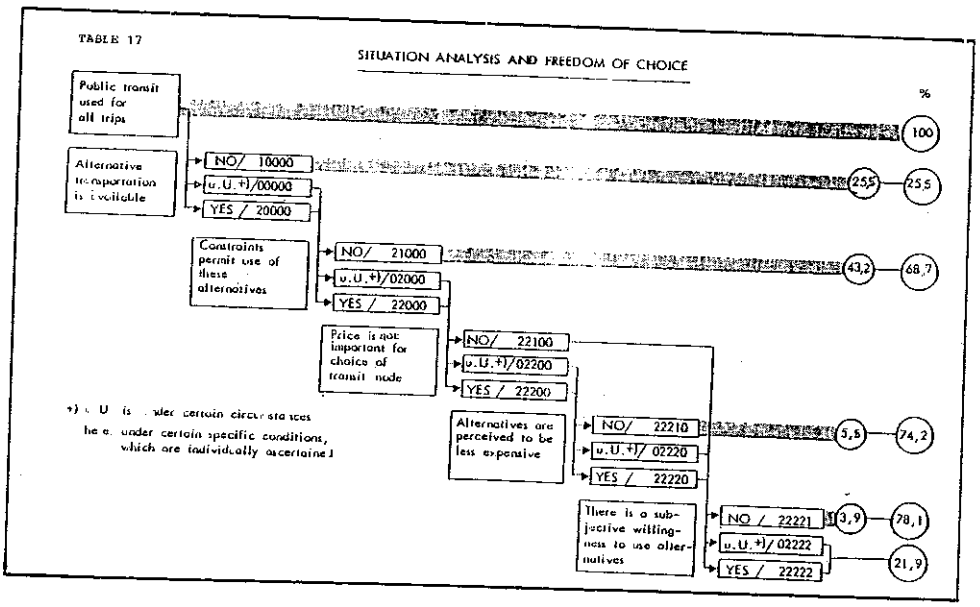


TABLE 17

SITUATION ANALYSIS AND FREEDOM OF CHOICE



+) u.U. is ... under certain circumstances
i.e. under certain specific conditions,
which are individually ascertained

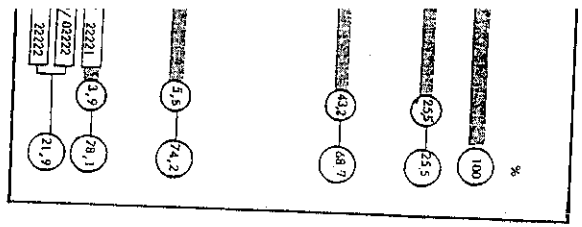
TABLE 18

SUSCEPTIBILITY AND REACTION TO PRICE

TABLE 19

CHANGE IN TRANSIT BEHAVIOR WHICH CAN ACTUALLY BE EXPECTED

Increased use of public transportation to be expected	thereof from	Decreased use of public transportation not expected	thereof from



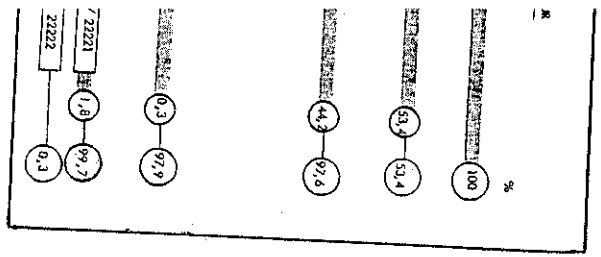


TABLE 18 SUSCEPTIBILITY AND REACTION TO PRICE

Table 1a Situations on sample days

Non-reacting (situations 10000, 21000, 22210, 22221, chart II) 99,7 %

Reacting (situation 22222, chart II) 0,3 %

Percentage which is

not price sensitive	0,3%
sensitive when increased between 26 - 30%	-
sensitive when increased between 21 - 25%	-
sensitive when increased between 16 - 20%	-
sensitive when increased between 11 - 15%	-
sensitive when increased between 6 - 10%	-
sensitive to every increase	-

Table 1b General situations

Non-reacting (situations 10000, 21000, 22210, 22221, chart III) 78, 1%

Reacting (situation 02222, 22222, chart III) 21,9 %

Percentage which is

not price sensitive	13,6%
sensitive when increased between 26 - 30%	0,1%
sensitive when increased between 21 - 25%	2,0%
sensitive when increased between 16 - 20%	0,9%
sensitive when increased between 11 - 15%	4,6%
sensitive when increased between 6 - 10%	0,4%
sensitive to every increase	0,3%

Table 1c Situations with restrictions

Generally reacting (situations 02222, 22222, chart III) 21,9 %

Reacting only in form of restrictions (situations 10000, 21000, 22221, chart III) 78,1 %

Percentage which is

not price sensitive	72,0%
sensitive when increased between 26 - 30%	0,8%
sensitive when increased between 21 - 25%	2,5%
sensitive when increased between 16 - 20%	0,2%
sensitive when increased between 11 - 15%	1,8%
sensitive when increased between 6 - 10%	0,0%
sensitive toevery increase	0,8%

TABLE 19 CHANGE IN TRANSIT BEHAVIOR WHICH CAN ACTUALLY BE EXPECTED

	Decreased use of public transportation to be expected			Decreased use of public transportation not expected		
		therefrom			therefrom	
	WHOLE	by changing	by reducing	WHOLE	without changing type of ticket	with change of ticket
	1	2	3	4	5	6
• If prices are raised by 1 - 10%	0,0 - 1,5%	0,0 - 0,7%	0,0 - 0,8%	98,5 - 100,0%	98,2 - 100,0%	0,0 - 0,3%
• If prices are raised by 11 - 15%	1,5 - 7,9%	0,7 - 5,3%	0,8 - 2,6%	92,0 - 98,5%	91,6 - 98,2%	0,3 - 0,4%
• If prices are raised by 16 - 20%	7,9 - 9,0%	5,3 - 6,2%	2,6 - 2,8%	90,9 - 92,0%	89,3 - 91,6%	0,4 - 1,6%
• If prices are raised by 21 - 25%	9,0 - 13,5%	6,2 - 8,2%	2,8 - 5,3%	86,5 - 90,9%	84,5 - 89,3%	1,6 - 2,0%
• If prices are raised by 26 - 30%	13,5 - 14,4%	8,2 - 8,3%	5,3 - 6,1%	85,6 - 86,5%	83,7 - 84,5%	1,9 - 1,9%

IABLE 20

COMPLETE REACTION AREA

	Number of trips taken by persons really susceptible to price and reacting to price	Number of trips taken by persons really affected in their financial budgets	Number of trips taken by persons who plan negative athmospherical reactions
For price increase up to 10 %	0,0 % - 1,5 %	0,0 % - 1,3 %	0,0 % - 5,3 %
For price increase between 11 % and 20 %	1,6 % - 9,0 %	1,9 % - 3,7 %	5,4 % - 32,1 %
For price increase between 21 % and 30 %	9,1 % -14,4 %	3,8 % - 7,5 %	32,2 % - 43,5 %

TABLE 21

CORRELATION OF REACTIONS

	WHOLE	SENSITIVITY				HARDSHIP CASES				ATMOSPHERIC REACTION			
		Reaction is possible if fares are increased by			Reaction is not to be expect	Effected if fares are increased by			Not effected	Reaction if fares are increased by			No reaction
		1-10 %	11-20 %	21-30 %		1-10 %	11-20 %	21-30 %		1-10 %	11-20 %	21-30 %	
	1	2	3	4		5	6	7	8	9	10	11	12
Base	2.409	36	218	349	2060	38	76	156	1928	111	679	919	1196
	%	%	%	%	%	%	%	%	%	%	%	%	%
SENSITIVITY													
- Reaction possible	14	100	100	100	-	-	1	13	12	18	30	36	0
- Reaction is not to be expected	86	-	-	-	100	100	99	87	88	82	70	64	100
HARDSHIP CASES													
- Effected	7	-	1	9	7	100	100	100	-	-	1	5	8
- Not effected	93	100	99	91	93	-	-	-	100	100	99	95	92
ATMOSPHERIC REACTION													
- Rejection	43	77	99	99	33	-	13	34	44	100	100	100	-
- Acceptance	57	23	1	1	67	100	87	66	56	-	-	-	100

The Effects of Extending a Subway Route on the Out-of-House Activity Pattern

A further pilot project was to try to win the trust of "classic" transport planners who are still doubtful of the validity of such qualitatively oriented models (30). The example which was chosen was the extension of an existing subway route in Spandau, Berlin (West).

Situational groups were identified using the seven dimensions which have already repeatedly been referred to in this paper. The groups were also differentiated according to the type of mode used. The general options which resulted are depicted in Tables 22 through 26.

In relationship to all of the trips which were made, 7% of the users of individualised and non-motorised modes subjectively considered the available urban public transportation system to be an option for them even if they did not make use of this option. On the other hand, 5% of those persons who used public transportation had the option of using an alternative mode of transportation. This was important in the given planning situation, since one could assume that the planned improvement of the urban public transportation system would lead to a stabilisation of this latter group and would insure that they would not change over to other alternative modes.

TABLE 22

GENERAL OPTION OF USING PUBLIC TRANSPORTATION

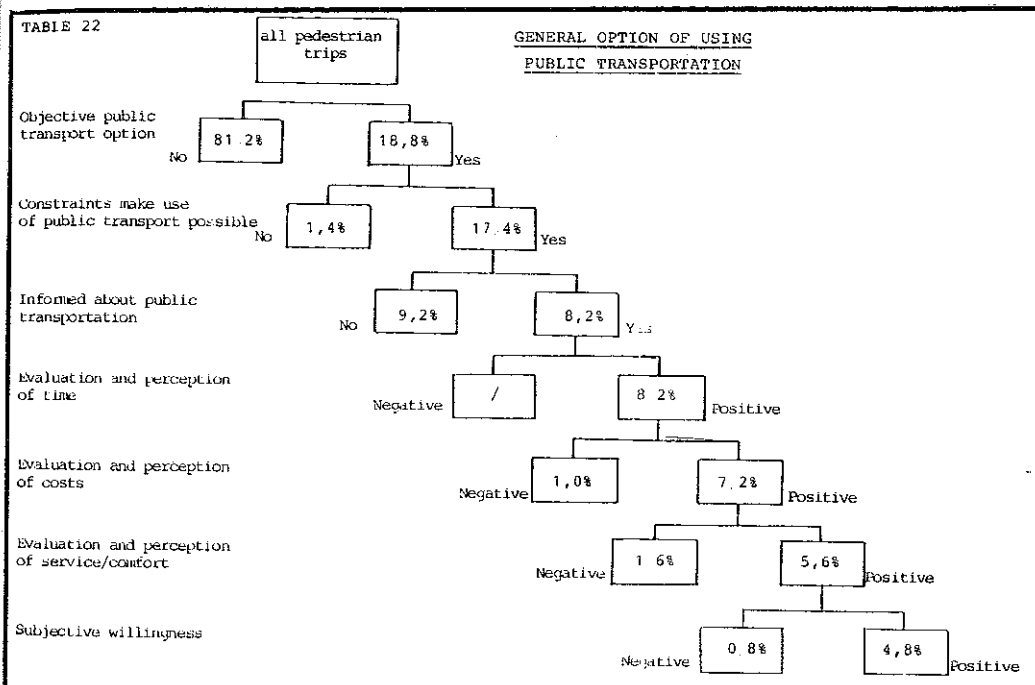


TABLE 23

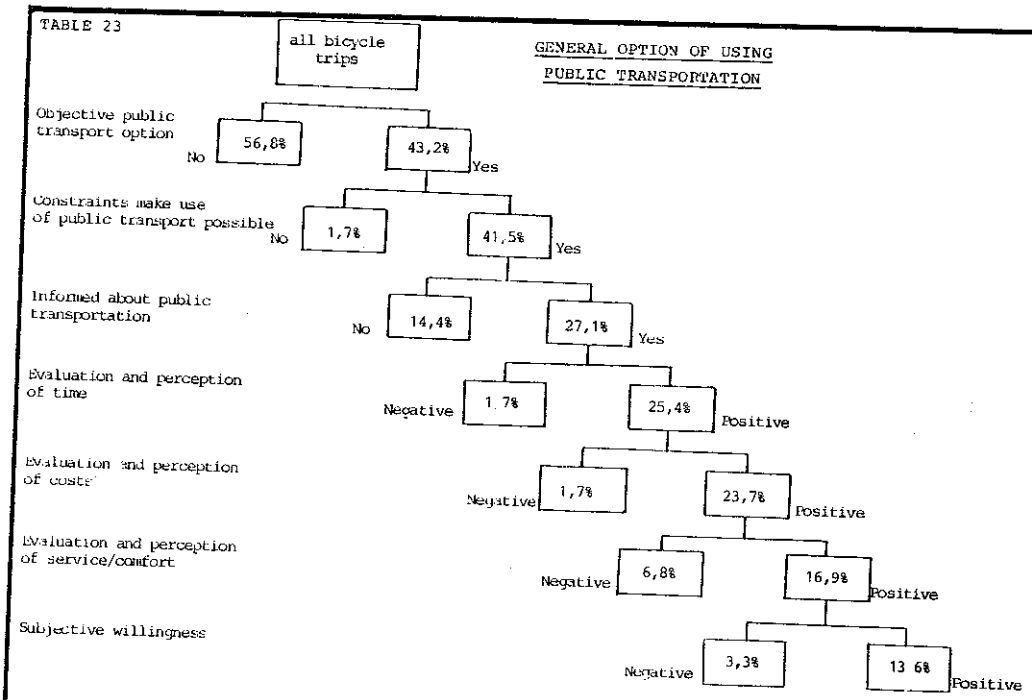


TABLE 24

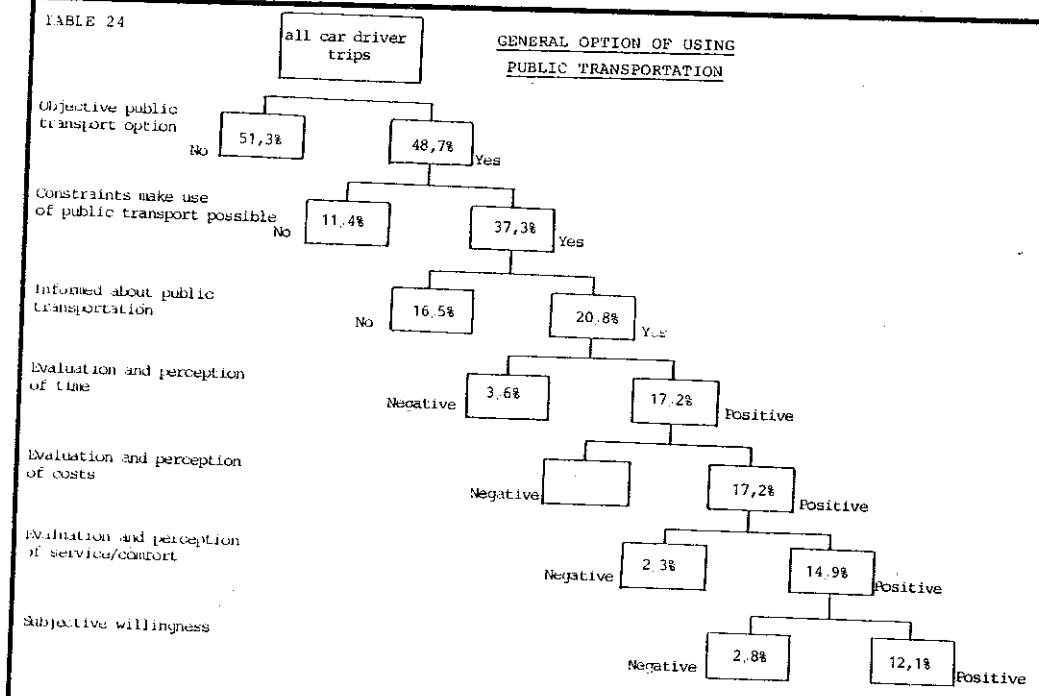


TABLE 25

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TABLE 26

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TABLE 25

GENERAL OPTION OF USING PUBLIC TRANSPORTATION

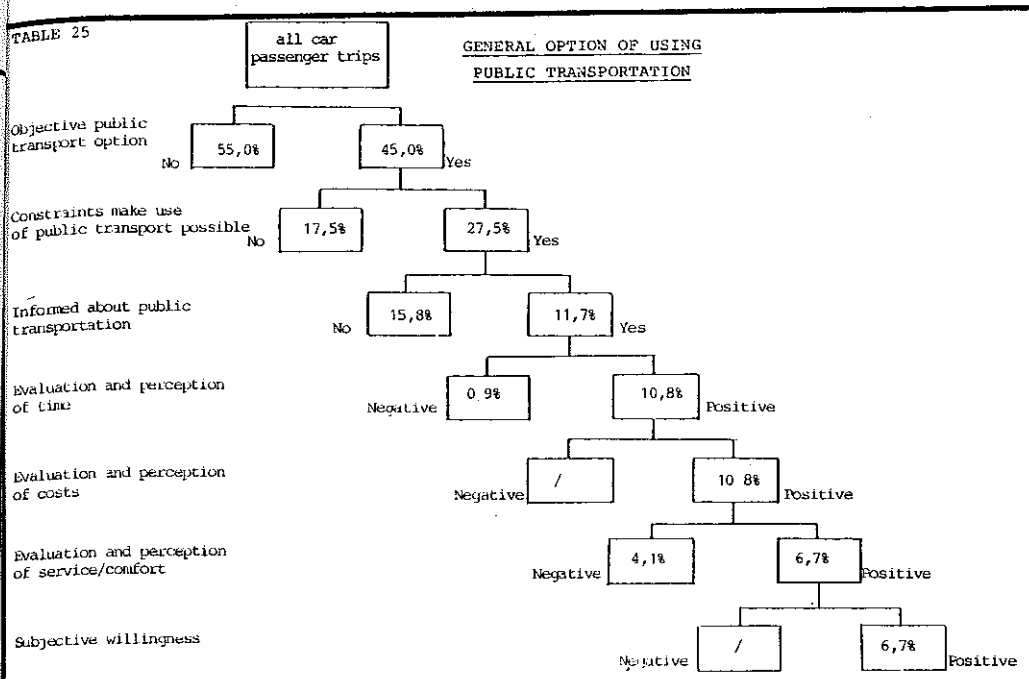
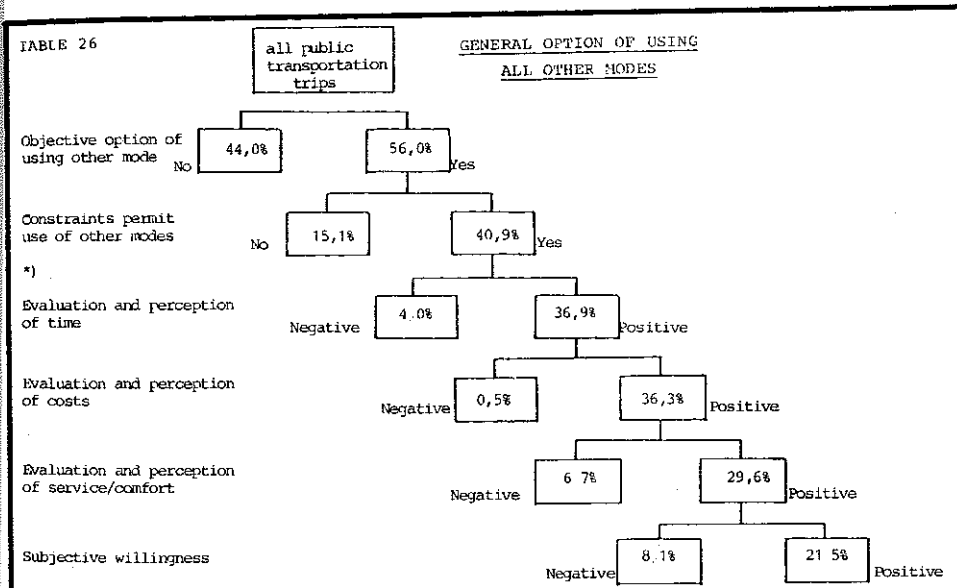


TABLE 26

GENERAL OPTION OF USING ALL OTHER MODES



*) Dimension 'information' not included, since one can assume that persons are informed about modes referred to here.

If modal supply is changed, possible behavioural changes are further limited by spatial and time-related conditions in the activity patterns. Thus, possible changes are intimately interrelated with (31):

- the given "actor" in the situation;
- the destination;
- the manner in which time is organized within the framework of the daily activity pattern.

TABLE 27

ALLOCATION OF TIMES FOR ACTIVITIES

The beginning of the activity is ...

	percentage
... externally determined	36
... determined by the household	7
... determined by interpersonal considerations	6
... not fixed	50
no response	1
	100

Basis: 1,666 trips

Half of the times for all daily activities are pre-determined (time when work begins, appointments, available time budget), while the other times are flexible (Table 27). Tables 28 and 29 show that activities are usually bound either to a specific person or a specific destination - i.e., they cannot be changed by improving the modal supply.

TABLE 28

ACTIVITIES INTIMATELY CONNECTED TO ANOTHER PERSON

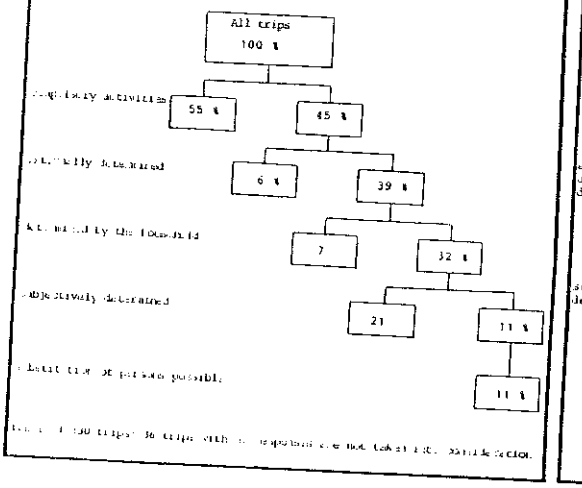
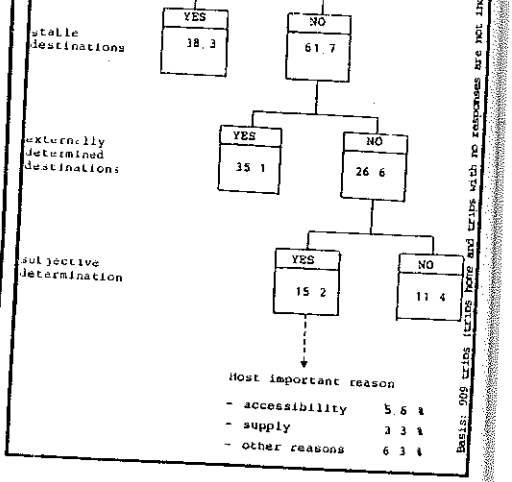


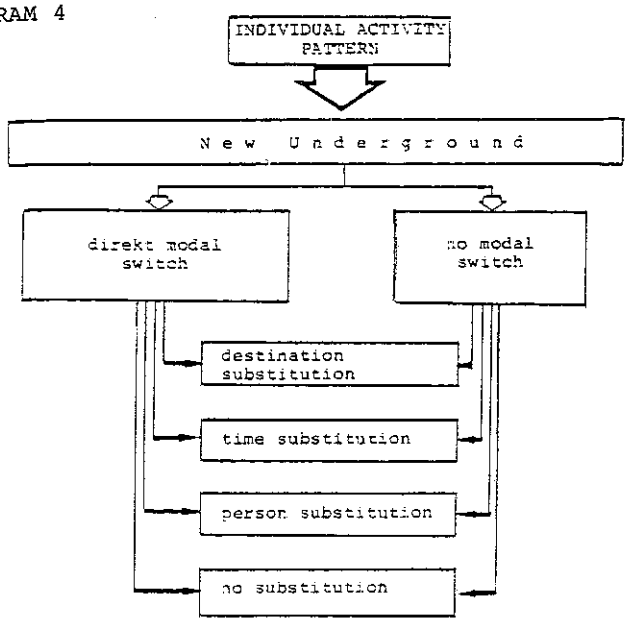
TABLE 29

ACTIVITIES INTIMATELY CONNECTED TO A SPECIFIC PLACE



The new subway line therefore influences the individual activity pattern. This can be schematically shown as follows:

DIAGRAM 4



POSSIBLE EFFECTS OF A NEW UNDERGROUND LINE

The direct modal switch determines the size of the potential number of users of the new subway line. This can go hand in hand with substitutions in the hitherto existing activity pattern characteristics.

However, in an interpersonal observation of the behavioural unit "household", a reorganisation of the activity pattern is very possible. Thus, a policy pertaining to public transit can change the activity patterns of persons who neither previously used public transit, nor will use it in the future.

With the aid of the situational concept, the potential number of persons with options open to them is determined for the new subway route. This includes that group of persons which has the option of using the subway, but due to its subjective preferences, is only conditionally willing to use the subway. When this group is taken into account, the subway potential can be depicted as a spread - i.e., as a proportion of possible users in relationship to the total number of travellers. The dimension "degree to which informed" can be first viewed as a behavioural regularity for planning, in the subjective attitudinal dimension. On the one hand, this is represented as a constant, while, on the other hand, one assumes that this information barrier can be broken. The following potential for the new subway results:

TABLE 30 SHARE OF SUBWAY POTENTIAL FOR ALL TRIPS

	no PR measures	with PR measures
non motorised travel	1,0% - 1,2%	1,5% - 1,9%
individual travel	5,2% - 7,7%	6,9% - 10,2%
public transit	33,6% - 34,9%	33,6% - 34,9%

The proportionately smallest number of persons changing modes is to be expected for non-motorised travel. This should not be surprising for in the given case, most of the pedestrian trips do not have their destinations within the area served by the new subway - i.e., the modal change must go hand in hand with destination substitutions.

For individual travel modes, a proportionately larger potential for the new subway line can be expected. This can be increased by additional public relations policies. Relatively many car users choose to use the modes which they use due to "soft" arguments - i.e., degree to which information about the alternative is inadequate, convenience factors, attitudes, image aspects, etc. This means that these persons can be viewed as a group which is comparatively easy to mobilize as public transit patrons.

Of those persons who already use public transit, a good third will use the new subway line. For all trips made within the area which it serves, the subway offers an equivalent which is particularly attractive because it helps save time. In the concrete situation, it also makes the central business district easier to reach; this will cause changes in destination to result.

Altered travel behaviour as a result of the new subway coverage in the area studied influences the spatial and time-related organisation of the activity pattern. And the identification of activity patterns was an important aspect of this study. 11% of the trips, 13% of the activity patterns, and 28% of the households in which 35% of the mobile persons live are affected by changes which are brought on by the new subway sup These figures show that the effect of the new subway line is greater th a simple observation of the number of individual trips would show.

Table 31 shows the reorganisation in the activity patterns which takes place when the new policy is instituted. It is differentiated according to current modal split. (Table 31 is depicted on the following page).

One can describe the observable tendencies as follows:

- A new destination is visited for every tenth trip affected by the change. Most destination switches are in the direction of the more accessible central business district.
- The "length of trip" changes in every 4 out of 5 reorganized trips. Average travel time is considerably reduced.
- For almost every 2nd reorganized trip, the length of time spent at the destination is altered. Time gained with the new mode is predominantly used to spend more time at destination.

These results make it possible to re-evaluate or modify traditional but insufficiently analyzed assumptions about behavioural regularities - such as the concept of a constant travel time-budget.

TABLE 31

All trips:
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- o reorganized

All reorganized
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TABLE 31

REORGANISATION AND ACTIVITY PATTERN CHANGES

Mode:	Total	Pedestrian	Bicycle	Car driver	Car passenger	Public transit
Base:	1666	610	118	437	120	381
All trips:	%	%	%	%	%	%
o not reorganized	88.5	98.9	94.9	90.6	95.8	65.9
o reorganized	11.5	1,1	5,1	9.4	4,2	34,1
	100.0	100,0	100.0	100,0	100,0	100.0
All reorganized trips:*)						
o reorganisation with destination change	10,5	85,7	0.0	2,4	20,0	9,5
o reorganisation with no destination change	89,5	14,3	100.0	97,6	80,0	90.5
	100.0	100.0	100.0	100.0	100.0	100.0
o reorganisation of travel time	81.7	14.3	66,7	78.0	60.0	90.6
o no reorganisation of travel time	18.3	85,7	33,3	22.0	40.0	9.4
	100.0	100,0	100.0	100.0	100.0	100,0
o reorganisation of length of time spent at destination	44,0	42,9	66.7	41.5	0.0	47.2
o no reorganisation of length of time spent at destination	56.0	57,1	33,3	58.5	100.0	52,8
	100,0	100.0	100.0	100.0	100.0	100,0

*) Change of basis

Forecasting Future Bicycle Use

It is obvious that the majority of mobile persons are basically free to use bicycles if they wish to do so. The fact that they do not do so is caused, to a large extent, by their personal attitudes toward the use of bikes. This insight clearly shows the limitations of forecasting modal split with conventional methods. Forecasting models which have been used in transport planning up until now are not adequately able to depict subjective attitudes and possible changes.

Therefore, in order to forecast the possible bicycle potential, a special study on potential was done (32) in communities which had up to 80,000 inhabitants. Data was collected for three areas of the Federal Republic of Germany - one had a good, one a medium, and one a poor cycling infrastructure. The survey was done in two steps. In the first step, present travel behaviour was determined on a specific sampling day in the spring of 1980 for the population which was surveyed. 16.4% of all trips were made by bicycle on this day. The percentage of individualized modes of transportation, which was 55% in the survey on potential, was extraordinarily high. As a result, the percentage of persons using public transit was only 6%. This was due to the size of the communities which were chosen to be included in the survey. Also important is the fact that when target persons were chosen, middle aged persons were given preference and immobile persons were partially excluded; since the survey was a pilot study, it wanted predominantly to deal with persons who might use bicycles rather than with persons (older people, immobiles) unlikely to use bicycles.

Situational Approach

The second part of the survey dealt with the 84% of the trips which had not been made with bicycles. Reasons for non-use of bicycles were analyzed in intensive interviews in which all household members wer present. Interactive measurement methods were used.

Five specific dimensions were selected here to identify the situ tional groups (33):

DIAGRAM 5

DIMENSION	DESCRIPTION
OBJECTIVE OPTION OF USING BICYCIES	- Bicycle available - Trip less than 15 kilometers
CONSTRAINTS AGAINSI USING BICYCIES OR REQUIRING USE OF SPECIFIC MODE	e.g. - Baggage transport - Weather conditions - Health reasons - Car needed at work
PERCEPTION OF ROUTE	e.g. - No bicycle paths - Too many hills - Dangerous intersections
PERCEPTION OF RIDING AND TIME REQUIRED	e.g. - Too slow - Too tiring - Clothes get dirty
SUBJECTIVE WILLINGNESS	Personally willing to use the mode bicycle

LIST OF THE DIMENSIONS

As a first step in the analysis, all trips which were made with other modes were excluded if the distance to the destination (return tri not included) was more than 15 kilometers. For these trips (a total of 24%), cycling would be a viable alternative only in borderline cases. It was shown that, given the concrete conditions which applied to the samp ling day, only 3% (situational group VI) of the trips which had been made could have been made per bicycle. Two-thirds of the trips (situatio nal group II) made on the sampling day were restricted to use of the mod actually used due to constraints; the alternative bicycle was not possib le (Table 32).

However, in order to estimate whether a modal change is possible and how high this potential is, an analysis of the specific situation on the sampling day is insufficient. In order to forecast modal split chang situational groups must be freed from all temporary constraints - that i conditions, such as bad weather, which are variable. The overall option of using a bicycle, which is 30%, is comparatively large (Table 32). Thu our initial assumption that bicycle use is frequently possible, was prov to be correct. The use of bicycles is primarily inhibited by constraints and, in spite of the generally positive attitude toward cycling, by the difficulty of transforming subjective insights into actual behaviour.

A classification of this potential according to the modes which had been used (Table 33) shows that the likelihood of substituting public transportation trips with cycling trips is the greatest, while it is least likely that a car trip be substituted with a cycling trip. If one assumes that most cities do not wish to lose urban public transit patronage to cycling, and realizes that an important reason for encouraging bicycle use is to reduce automobile traffic, then it is obvious that although breaking down subjective barriers to cycling may rapidly increase the volume of cycling traffic, this increase in cycling may frequently be at the expense of the "wrong" modes.

TABLE 32

OPTION OF USING BICYCLE

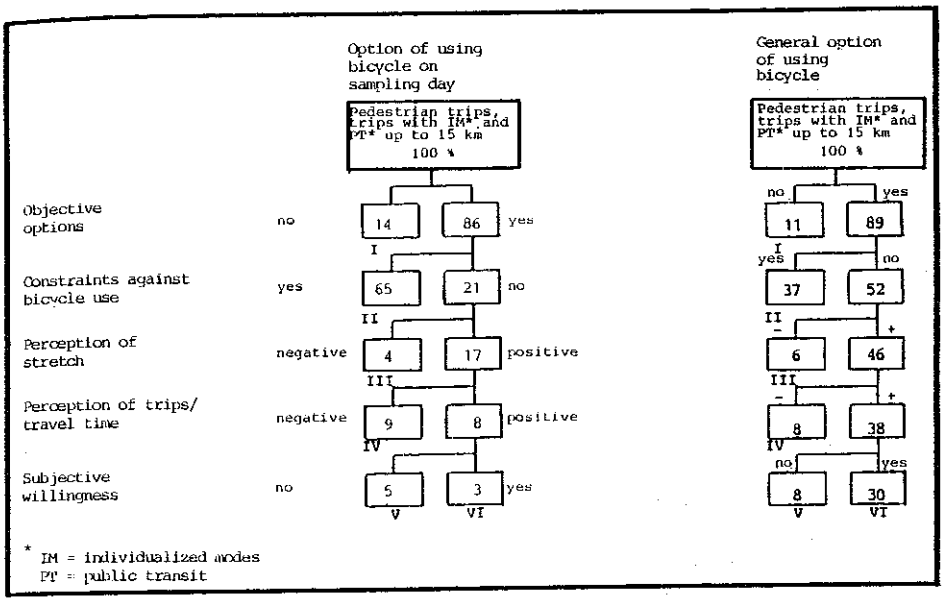
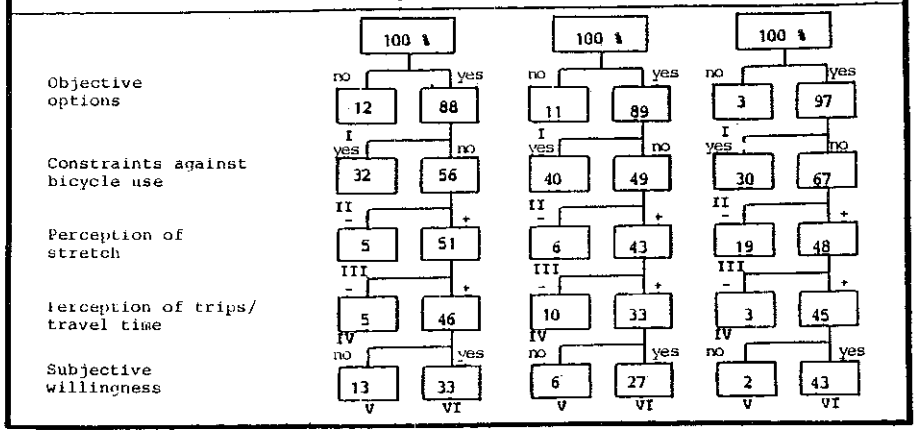


TABLE 33

GENERAL OPTIONS ACCORDING TO MODE



The structuralisation of the individual (decision-making) situation offers one the possibility to determine the likely potentials for different areas of measures - and thus, the acceptance of measures in these areas. The different areas of measures are identical with the five dimensions, and in relationship to possible measures, they can be roughly formulated as follows:

- o Dimension "objective option":
  Basic availability of bicycles (e.g., making it possible to rent bicycles;
- o Dimension "constraints":
  Only constraints pertaining to bicycle itself (baggage transport needed, weather conditions) are referred to here, since other constraints (e.g. passengers, car needed at work, complex trip chains) cannot be dealt with by the measures discussed in the present paper;
- o Dimension "routes":
  Improvement of bicycle infrastructure;
- o Dimension "riding bicycles":
  Public relations work geared at clarifying misconceptions and incorrect perceptions;
- o Dimension "subjective willingness":
  Increase in the number of persons willing to change to use of bicycle by creating a climate of opinion in the community which is favourably disposed to bicycles.

For each of these areas of measures, it is possible to determin the maximum potential for change, which is the upper limit for possible reactions when all the necessary measures have been adapted (from the point of view of the individuals affected) in this area (Table 33). However, this upper limit is a more or less theoretical value which wil never, in fact, be attained. Those reactions which are actually to be expected can be estimated using the responsiveness coefficients which are interactively determined. This coefficient shows how high the percentage of likely mode change is from the given potential.

When determining the number of persons who react, one should no forget that the values in percentages of the given potentials only pertain to a limited group of travellers - i.e., non-bicycle trips of 15 kilometers or less. For this reason, the potentials in Table 33 are als calculated for all trips (including bicycle trips); with the help of th responsiveness coefficients, the behavioural changes were determined (as a percentage of all trips).

This calculation - which is of great value for purposes of fore casting - serves here, however, as the basis to estimate the acceptance of measures (34). An acceptance index was established for this purpose. It relates the bicycle use which can be expected when a policy has been introduced, to the present share of bicycle trips. The present share of 16.4% was set equal to 1.00. An acceptance index of 2.00 would then mea that twice as many persons would use bicycles, while an acceptance inde of 1.00 would indicate that no change had taken place (Table 33).

The different acceptance indexes show that even if no new measures were adapted, an increase in cycling would still occur. This is predominantly due to the fact that the current climate of opinion in Germany is pro-bicycle. Due to further developments since the study was done (especially since the price of gas keeps going up), one can assume that the general acceptance of the bicycle at present will increase eve more in the future.

TABLE 33

Areas of

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TABLE 33

MAXIMUM POTENTIAL AND ACCEPTANCE OF DIFFERENT TYPES OF MEASURES

Areas of measures	Potential A (in relationship to all other modes up to 15 km)	Responsiveness-Coefficient	Potential B (in relationship to all trips with all modes)	Likely reactions	Acceptance-Index
	%	1)	%	%	4)
(Status quo) 5)	(30)	(0,03)	(18)	(0,5)	(1,03)
Availability of bicycle	32	0,13	19	2,5	1,15
Bicycle (baggage, weather)	34	0,21	20	4,2	1,26
Infrastructure	34	0,14	20	2,8	1,17
Public relations work (clarifying misconceptions)	33	0,16	20	3,1	1,19
Community climate	38	0,14	23	3,2	1,20

1) Percentage of likely responses from potential A
2) Including bicycle
3) From potential B
4) Likely reactions out of potential B in relationship to the present bicycle share (16,4% = 1,00)
5) Status quo included in the following areas of measure

TABLE 34

MAXIMUM POTENTIAL AND ACCEPTANCE OF DIFFERENT TYPES OF MEASURES WHEN THE CLIMATE OF OPINION IN THE COMMUNITY IS POSITIVE

Aereas of measure (in combination with positive climate of opinion) 5)	Potential A (in relationship to all other modes up to 15 km)	Responsiveness-Coefficient	Potential B (in relationship to all trips with all modes) 2)	Likely reactions 3)	Acceptance-Index
	%	1)	%	%	4)
Availability of bicycle	42	0,27	25	6,7	1,41
Bicycle (baggage, weather)	56	0,25	33	8,3	1,51
Infrastructure	43	0,23	26	5,9	1,36
Public relations work (clarifying misconceptions)	46	0,30	27	8,2	1,53

1) Percentage of likely responses from potential A
2) Including bicycle
3) From potential B
4) Likely reactions out of potential B in relationship to the present bicycle share (16,4% = 1,00)
5) Status quo included in the following areas of measure

One can assume that it can no longer be the goal of well considered community planning to implement specific policies in isolation. Thus, it is the goal of the project "A Town for Cyclists" to also improve the climate of opinion in the communities in favour of cycling in order to increase the effectiveness of any other measures. This concept can be demonstrated using the figures which are available. If one wishes to pinpoint the acceptance of specific types of measures when combining them with positively influencing the climate of opinion within communities, then the potential grows considerably and the responsiveness; thus the acceptance indexes grow cumulatively (Table 34). Measures dealing with the bicycle itself (baggage loading facilities, weather protection etc.) and public relations work (clarifying misconceptions and correcting negative perceptions) are more important than improving the infrastructure.

However, one should be careful not to come to a false conclusion here. The responsiveness and acceptance of measures presented here deal with the possible use of the bicycle - i.e. with the mode change. Irrespective of the fact that other aspects are not taken into consideration here (improvement of neighborhood quality, for instance), this does not mean that an improvement in the bicycle infrastructure does not also play an important - if not decisive - role in stabilizing the new potential of those persons who change mode. This becomes clear if one considers the cumulative effect of all of the different areas of measures (Table 35). This evaluation also shows that in the towns studied (with populations ranging from 50,000 - 80,000), almost three-fourths of all trips made by the mobile population (for the most part between 20 and 60 years of age) could possibly be made by bicycle and that the share of trips made by bicycle could, at least in the long run, almost double. These upper limits, of course, cannot be attained, or only over a longer period of time, given conditions as they are at present. Previous experiences with comparable studies (35) show, however, that almost half of this maximum potential can be attained - when the appropriate measures are taken - in the not too distant future. For "A Town for Cyclists" this means that one can assume that the acceptance index will be approximately 1.40. This acceptance index only pertains to the willingness to change mode if measures are taken to encourage cycling. A number of studies, however, have shown that a comparable effect could result (perhaps even more quickly) if restrictive measures pertaining to car use are taken. In this case, even in larger cities with good public transportation, the number of car drivers who would change over to bicycles is about twice as large as the number of car drivers who would change over to public transportation.

TABLE 35 MAXIMUM POTENTIAL AND ACCEPTANCE OF THE DIFFERENT TYPES OF MEASURES WHEN THEIR EFFECTS ARE VIEWED CUMULATIVELY

Areas of measures	Potential A (in relationship to all other modes up to 15 km)	Responsiveness-Coefficient	Potential B (in relationship to all trips with all modes) 2)	Likely reactions 3)	Acceptance-Index
	%	1)	%	%	4)
a) Status quo	30	0,03	18	0,5	1,03
a) + b) Climate of opinion in community	38	0,14	23	3,2	1,20
a) + b) + c) Public relations work (clarifying misconceptions)	46	0,30	27	8,2	1,50
a) + b) + c) + d) Infrastructure	52	0,35	31	10 8	1,66
a) + b) + c) + d) + e) Bicycle (baggage, weather)	64	0,33	38	12,6	1,77
a) + b) + c) + d) + e) + f) Availability of bicycle	73	0 32	43	13,9	1,85
a) + b) + c) + d) + e) + f) + Long term effects on all other persons	100	0,24	60	14,3	1,87

1) Percentage of likely responses from potential A
2) Including bicycle
3) From potential B
4) Likely reactions out of potential B in relationship to the present bicycle share (16.4% = 1,00)
5) Status quo included in the following areas of measure

CONCLUSIONS

Individual decision-making behaviour is generally subject to regularities other than those claimed by behavioural models - disaggragate models as well.

One of the reasons for this is that the whole situational background pertinent for decision-making is inadequately reflected in these models. Since the different models emphasize different factors, the inaccuracies differ.

If "disaggregate" is to mean that the model structure is actually to be geared to the individual "actors" in transportation, then the goal of these models has not been reached yet (36). Up until now, the internal model structure has been too strongly emphasized, as has the algorithm used for the purpose. However, one must not forget that individuals do not necessarily behave according to the pattern called for by the given model structure. Therefore, the advantage of using the present disaggregate approaches lies in the fact that these more accurately describe behaviour from a mathematical/statistical point of view. But the disaggregate models are not much better at explaining than the mature aggregate approaches. One of the reasons for this is the evident lack of basic research which has been done on the problem. However, basic re-

search can be of use only if it goes considerably beyond merely recordi realized outdoor activities. Basic research must develop approaches whi are able to realistically depict the actual reasons which cause behavio and the decision-making process which results in given behaviour (37). (There are encouraging signs that this is being done).

WERMUTH's approach (38) shows that even the generally available data on transportation behaviour allow one to make certain inferences and improve the model structure. Here, the mathematically much improved probit approach is used to determine the regularities according to whic individuals are most likely to make their decisions. But the most important advantage of this apprach lies less in its improved mathematical model structure than in its improved model philosophy.

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