ACCEPTANCE OF LOCAL TRANSPORT SYSTEMS
INTERDISCIPLINARY RESEARCH PROJECT
- THE EFFECTS OF A TRAFFIC RESTRAINT POLICY ON THE INTENDED TRANSPORT MODE USAGE -

by
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1. CONCEPTION OF THE STUDY

1.1 PRACTICAL IMPLICATIONS OF THE BEHAVIOURAL SIMULATION

In recent years the transport research concentrates among others on the questions, how the population's behavioural reactions on the transport's level of service can be estimated. In some other respects we have already emphasized, that this question can only be answered in a reasonable way, if in addition to the characteristics of the level of service and of the behaviour itself the subjective processes and their results will be taken into account (see Martens, Verron 1983 a, 1983 b, 1983 c; Brög 19B3; Kutter 1983; Louviere, Wilson and Piccolo 1979).

In order to investigate the processes anteceding the behaviour, at the universities of Iowa and Wyoming (U.S.A.), a simulation technique has been developed and tested on the basis of Anderson's theory of information integration (see Levin 1978; Louviere, Wilson and Piccolo 1979, Anderson 1974). This technique allows to analyse the human processing of environmental information to a subjective overall judgement, their combination and their weights. The reasoning of the information integration underlying the simulation technique allows also for its application to the analysis of actual behaviour in a meaningful and useful way (see Martens 1981, 1983; Martens Verron 1983 a, 1983 b, 1983 c).

The following comments and research results demonstrate that the simulation technique is able to answer questions of direct practical relevance. For the following reasons such a technique appears to be desirable for practical purposes:

1. The conditions of the environment, e.g. the existing supply of transport services being available for observing the behaviour of interest, are often too much constrained in nature. The simulation technique is not bound to adapt to these constraints.

2. In consequence, it is possible to estimate the travellers' reactions to proposed changes, prior to implementation of transport investment or policies.

3. Prior to implementation of a proposed policy, the simulation technique allows for its application in the direct environmental setting of the policy itself. By this method it is possible to take into consideration

the specific local conditions. Therefore the procedure of the behavioural simulation should be preferred to a transfer of behavioural studies from different localities.

1.2 DEFINITION: BEHAVIOURAL INTENTION

The simulation technique does not use the behaviour - being observable as reaction to the existing environment - but instead it uses the behavioural intention, as reaction to proposed and presented environmental designs being adequately described and easily conceivable. Which now is the role the behavioural process ascribes to the behavioural intention?

The human behaviour is goal oriented and full of plans (see Miller, Galanter and Pribram 1960). The plan of action represents a design of the action, in which the goals of action and the conditions of the environment do meet each other. Depending on the complexity and on the flexibility of the action the plan may well be prepared before starting the activity, or it may be reconsidered and modified during the activity. The plan of action also contains the intention of action or the behavioural intention.

Normally the plans of action are closely related to the concerning actions. Even in every day life, however, there may exist long term plans, for which the implementation will be performed in a future time being more or less far off. Additionally, in an analysis of intention, the direct relationship to the behaviour does not exist. In the period of time between stated intention and the potential behaviour, new aspects may arise modifying the behavioural intention, which very often occurs with long term plans.
Furthermore, the experience of the action is left out as the ultimate instance of control being able to tell if the plan of action is really subserving the goal of action or not.

In the latter case, this will be the more important, the more the conditions of the environment presented in the simulation design are far off an environment in which one is living.

And finally the consistency between intention and overt behaviour will depend on the degree of which the environmental dimensions being relevant for the specific situation from the point of the respondents have been sucessfully identified and presented. There will be no consistency with such environmental dimensions being ignored in the every day life at all.

1.3 BEHAVIOURAL INTENTION AND BEHAVIOUR

The essential point for the practical usefulness of the simulation method should be highlighted as such that the behavioural intentions allow for statements on the actual behaviour. In theoretical terms, this question can to date not sufficiently be clarified, because there is still some deficit in scientific knowledges of the processes of the cognitive elaboration of action up to overt behaviour.
From the empirical point of view, there are encouraging aspects in the structural identity of the formation of behaviour and intention respectively. With Louviere and Wilson, e.g. a multiplicative combination of the dimensions "price", "variety" and "distance" provides the best model for the evaluation of shopping opportunities in an experiment. With the same model the shares of the visitors to the different super markets can be estimated rather well ($r \geq .90$). The same authors discover an equivalent consistency between experiment and reality concerning the choice of residential location (see Louviere and Wilson 1978; Louviere, Wilson and Piccolo, 1979).

In one of our own studies about transport mode choice still in work,on the same evidence appears in principle: The intention to use the private automobile or the public transport mode depends on the travel times and the travel cost of the alternative modes in a similar way as the actual transport mode choice.

In a further,unpublished study on behavioural intentions of car drivers, the effects of the walk times from the bus station or the parking place respectively,and the effects of the frequency of transfers in case of using the bus to work have been analysed with respect to the car drivers' intention to use the bus. The results represent a dominant influence of the walk times, which has also been identified by the analysis of the actual mode choice behaviour in a sample being partly identical.

So far the empirical experiences demonstrate the following: The simulation method allows for estimating in advance

- the magnitude of the reactions to a proposed policy;
- the relative behavioural effects of different policy measures;
- the structure of the overall effect from different policy measures.

1.4 THE POLICY MEASURES OF THE SIMULATION STUDY

The questioning of the study under consideration may be formally expressed as follows:

$$I = f\,({}_{i}C_{1},\ {}_{j}C_{2},\ {}_{k}C_{3},\ {}_{l}C_{q})$$

with I = behavioural intention
C = presented characteristic of the policy measure
i,k, l = value of the characteristic

The presented characteristics C describe the quality of the sidewalk to and from the public transit station going beyond the dimensions of time or distance. The four charakteristics of quality assigned to the simulation experiment refer to the results of interviews from the area of the experiment and from different areas:

1. "automobile traffic"
   with the values: heavy, medium, no automobile traffic

2. "green" (i.e. flowers, trees, park area etc.)
   with the values: park area, trees in the street, no "green"

3. "sidewalk"
   with the values: narrow, broad, pedestrian street

4. "shopping opportunities"
   with the values: sufficiently available, not sufficiently available.

In the analysis,a particular emphasis has been put on the distinct effects of the characteristics under different circumstances (e.g. different trip lenghts, different social conditions).
Moreover,the analysis of the common effects of the characteristics proposed represent a central point of the research. In our research activities there has already been strong evidence that the transport mode choice behaviour can be better explained by a specific combination of the service characteristics than by their simple summation (see Martens 1983;

Martens, Verron 1983 a, 1983 b, 1983 c).

In this study it will now be tested, inasmuch this rule will also hold for the explanation of the behavioural intention.

2. EMPIRICAL INVESTIGATIONS

2.1 INTRODUCTION

The empirical analyses relate to the city district of Gostenhof close to the city centre of Nürnberg (500 000 inhabitants; Fed. Rep. of Germany). A housing renewal program and policies for improving the neighborhood conditions will complement each other: traffic restraint measures are part of these plans and besides diverting and rerouting the heavy automobile traffic of the main road they are designed to regain the public space of the streets especially for the sake of pedestrians, children,or in favour of the quality of life for the people living or working in that area. In consequence,the pedestrian walks to the public transit stations and their environment will be improved.

The postal survey among the employed people working or living in Gostenhof started in autumn 1979, prior to the implementation of the plans,and prior to the connexion of this district to a subway line substituting the existing light rail transit. The survey also included the foreign people representing a major share of the population in Gostenhof. Therefore the questionnaire has additionally been translated into the native languages of four nationalities being most frequent.

The local government promotes and finances a program in order to participate the people affected in the planning activities. It is obvious that the alternatives available for the design of the traffic restraint measures depend on the assumptions stated for the future travel pattern and especially for the future mode split between automobile and transit use. Specific analyses, however, about the mode choice behaviour with respect to the underlying factors of the quality of service have not been performed: The future development of the mode shares have been assumed more or less intuitively and the assumptions determine the available options.

Therefore our survey was directed to the overt behaviour of mode choice with reference to the quality of transport service.and as well to the behavioural intentions in order to measure and evaluate the effects of the sidewalk qualities to the public transit station.

The study under consideration is limited to the analysis of the behavioural intentions. In total 54 possible combinations have been designed with the values of the 4 attribute dimensions "automobile traffic", "green", "sidewalk" and "shopping opportunities". Six combinations have been assigned at random to the respondents so that there are six responses available for each person in the survey. The reactions have been mesured on a 5-point-scale. The car users indicate the days per week they will use the transit with respect to the alternative design proposed, and the public transit users answer inasmuch their decision to further use the public transit will be favoured or not favoured.

2.2 DESCRIPTION OF THE SAMPLE

About 70 % of the respondents using their cars to work are male persons. Only 10 % of the households have net-incomes of 1.250 $US and more, though

in 50 % of the households there live two persons being employed. Among the car users, 15 % also use the public transit and some further 80 % tell that they know about the public transit level of service. Approximately one third travels for more than 10 km to the workplace and one fifth up to 3,5 km. By car nearly 10 % take more than 30 min to travel and 25 % up to 10 min.
Among the public transit users, female persons are in the majority with a share of 60 %. The net income of households amounts to 1.250 $US or more for only 3 % of the transit users - the proportion of households with two employed persons is the same as with the car users. Half of the households have got a car and only 40 % of the transit have got a driver licence. 25 % travel more than 10 km to work and 20 % less than 3.5 km. The travel times exceed the car users' travel times by far. 50 % of the public transit users travel more than 30 min. Only 30 % do get to their destination without transferring and about 60 % have to transfer once. The average transfer wait time and the walk time between the station and the work place each exceed 5 min for 25 % of the transit users or for 30 % respectively.

The subjective ratings on the qualities of the existing walks between the station and the place of work provide a similar picture for the car and transit users. On a 7-point-scale the same dimensions have been presented to the respondents which are used for the simulation study. Only the proportion rating the existing "automobile traffic" to be rather heavy is with 65 % higher among the car users than among the transit users with 50 %. In both user groups 50 % valuate the existing "green" being poor, the existing "shopping opportunities" being insufficient and 30 % rate the "sidewalks" being narrow.

2.3 RESULTS OF THE SIMULATION STUDY

The analytical techniques applied for the empirical analysis of the behavioural intentions (analysis of variance and a binary segmentation procedure) do not account for the intrapersonal effects of the measurements repeated for each respondent. It may indeed be assumed that as a first approximation this kind of statistical analysis may well produce tenable and useful results. In some other studies the analysis of variance with the repeated measurements' design has been using (see Verron 1983).
In both user groups the effects of the dimensions designing the alternative combinations indicate the expected direction of the relationships: The less there is automobile traffic in the streets, the more favourably the intentions to use public transit are influenced. The positive values of the other dimensions produce similar effects: width of sidewalk, availability of trees, etc. ..., and of shopping opportunities. In general, the effects tested by the explanation of variance measure - eta^2- demonstrate greater magnitudes for transit users than for car users. Only the shopping opportunities play a minor role for the transit users.

Among the four attribute dimensions, the "automobile traffic" and the "green" present the strongest effects. Overall, indeed, the contributions of all of them explaining the intentions are fairly small.

In each of the user groups the explanation of variance equals 1-2 % for the single effects. Against this, the travel times and the travel lengths achieve an explanation of variance of 3-7 % and the social conditions like net income of households, size of household, and age, 2-6 %.

Therefore these travel characteristics and these personal variables are included into the binary segmentation process in order to search for relatively homogeneous subgroups being different in their average intention score and being expectedly heterogeneous in the structure of their effects.
A first general view of the single effects in the subgroups reveals different patterns. Among the five subgroups of the public transport users there are subgroups being relatively insensitive towards the simulated changes in the attribute values. One of these subgroups, on an average, provides a favourable jugdement on the intention to use public transit and the other subgroup a rather unfavourable one. The remaining 3 subgroups with their average intention scores lying between these subgroups are much more sensitive towards value changes in the attributes. They do not at all exhibit a "neutral" or "indifferent" behaviour, instead they highly balance one attribute value against the other.

Among the car users there prevails a different pattern. On the one side, three subgroups exist with mean intentions being unfavourable towards public transit and with relatively weak sensitivities on changes in the attributes. On the other side there are two subgroups with mean values on the intention scale and relatively strong sensitivities. But there is not any subgroup indicating fairly favourable intentions.

Next, with application of the binary segmentation procedure the joint effects of the simulated conditions are tested for each of the subgroups seperately. Summarising the results over all subgroups, again the attributes "automobile traffic" and "green" prove to be superior among the four dimensions being analyzed jointly. The shopping opportunities are predominantly relevant with the car users.

Aside from this general view, some of the dimensions, though different ones, have no effects at all in the respective subgroups and others have effects with different weights attached to them in the various subgroups. For one of the subgroups among the car users e.g., travelling up to 7,5 km and in the majority with two employed persons in a household of three persons, only the shopping opportunities prove to be of relevant influences upon the intentions. For a subgroup of the public transit users, comprising only "non-officials" with trip lengths up to 7.5 km, but with very high travel times (i.e. the excess time yields a major share), the attribute dimensions "automobile traffic", "green", etc. ... have lower weights than in the other subgroups.

Beside these differential weights according to the subgroups, the weights of the attribute values do vary with respect to the context, in which they have joint effects with the other attribute values. The pattern of the effects produced by the combined dimensions does not apply to an additive rule. In principle, the effects of the positive attribute values cumulate to such joint effects which comprise much more than the sum of their seperate effects. In addition, the pattern points out that the effects of negative attribute values, like heavy automobile traffic, can only be compensated for with difficulties by positive values of the other attribute dimensions. The negative attribute values partly dominate so strongly that they alone determine the overall effect on the intention. On the other hand the negative attribute values substitute the effects of the positive ones very easily.

Similar structures about the kind of balancing the attribute values have been discovered in other studies of our research. In opposite to the study under consideration there have been simulated conditions being of such major importance resulting from our analyses of overt behaviour, like differences of travel time or cost for the automobile and public transit mode

to work (see Verron, 1983), or like travel cost, headway times and in vehicle times for shopping trips (unpublished study). In those investigations the social conditions and the existing level of service play a minor role in comparison to the effects of the simulated attributes.
In the case study at hand there prevails just the opposite. This could not have been expected to happen in a different way. The qualities of the sidewalk to the public transit station have effects in every way, but standing on their own the effects are not of an outstanding magnitude compared to the effects of the remaining qualities of service. Only combined with additional changes in the relevant attributes of the public transit service major effects can be expected producing a traffic restraint in a more fundamental sense.

By the plausibility of the results in this analysis, and in relation to our experiences from other studies of our research, it may well be expected that behavioural intentions with respect to simulated conditions will be useful for planning activities. A careful design of the experiment, with the attributes of interest for designing the policy measures, the adequate techniques of statistical analysis, and the theoretical foundation well elaborated may assist in providing selection aspects for a wide spectrum of investment proposals, for which no real data are observable. In principle, this ultimately increases the efficiency and effectiveness of the planning results.
The traffic restraint policy is one example of concern, especially if under the issue of areawide traffic restraint one is going to search for relevant measures improving e.g. the public transit and the bicycle usage. In the same way the feasibility studies of new transport technologies e.g. may gain great advantages from such procedures in order to achieve a better informed selection among the alternative designs being available.

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