Ecological sustainability and personal behavior: relations demonstrated by the decision-making process of selecting a certain transportation mean

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Abstract
Facing the aim of ecological sustainability only little emphasis has been placed on the fact that the extent of environmental stresses is not only a consequence of certain factual or structural conditions but also essentially determined by varying human behavior patterns. Technologies and structures are not ecologically effective by themselves; their environmental relevance strongly depends on the persons’ way of acting within the prevailing systems. Recognizing the importance of that perspective, psychological and social theories about the generation of personal behavior as well as theoretical models of learning can offer useful indications concerning the intrapersonal and extrapersonal preconditions of environmentally oriented acting. With reference to the decision-making process of selecting a certain transportation mean, the influences of rational and emotional factors and obstacles to an ecologically sustainable personal act should be exemplarily demonstrated. At the same time very effective points of departure for behavioral change can be identified.

Ecologically-oriented selection of traffic modes
According to the ecological sustainability approach, that kind of transportation mean should be selected which enables the meeting of a defined mobility demand under a minimum of environmental stresses.

Doubtless walking and cycling are traffic modes that cause least environmental loads with reference to a certain transportation performance. The empirical fact, that more than 50 per cent of the ways covered in urban areas are finished within a distance of 3 kilometres makes those traffic modes mostly preferable. But in many cases, reality goes to the opposite direction. Very often, short distances are covered by using a car: 33 per cent to 40 per cent of the ways in towns covered by cars are not longer than 3 kilometres (Gruber et al., 1996).

Whereas walking and cycling are suitable alternative modes for short distances, public transportation means are the ecologically corresponding traffic mode in order to cover longer distances. Figure 1 demonstrates the decrease in ecological stress when alternative traffic modes are used instead of cars, with reference to the same transportation unit.

Neglecting its environmental benefits, the contribution of public transport is going to decrease more and more. So urgently the question arises, what could be done in order to bring people effectively to a change from car use to ecologically more compatible traffic modes?

Behavioral theories for understanding the decision-making process of selecting traffic modes
It took a long time to recognize scientific behavior and acting models as being relevant and useful for the field of traffic policy. Before that a mechanistic understanding was dominating the trials to explain why in a concrete situation people decide to use a certain transportation mean or refuse other ones. The opinion was prevailing that the behavior of traffic participants is exclusively determined by external conditions and consequently, there would not really be a scope for free decision (Held, 1982).

First, by the application of theoretical behavior models, the fact was taken into consideration that the decision on a certain transportation mean is also a matter of subjective perceptions and preconditions. Therefore only a synoptical view of objective and personal decision-making conditions enables us to understand the process of transportation mean selection. At the same time, a sufficient understanding of the personal decision-making process and the influences on it is necessary, in order be able to take traffic measures that turn out to be really accurate and efficient (Littig, 1995).

With the focus on analyzing the process of selecting transportation means, two theoretical approaches became more important. The one originally coming from the economic sphere is the “Rational choice approach”. Its modification into social terms – by Esser (1990) – is named the “Concept of subjective rationality”. The second model is the “Theory of planned behavior” created by Ajzen (1991).
From the point of view of the “Rational choice approach”, first applied to the field of traffic behavior analysis by Domencich and McFadden (1975), the personal process of selecting a certain transportation mean is assumed to be a rational decision among discrete alternatives. Which traffic mode finally will be chosen in order to cover a certain route is determined by the benefit differences of the transportation means available for a person in a concrete situation. The benefits perceived are a matter of specific attributes of the respective transportation means, such as time spent, comfort, costs, as well as a matter of personal conditions (age, sex, education, income, attitudes) (Franzen, 1997).

Due to this theory one transportation alternative will be selected, which brings about the transportation benefits required for a minimum of expense, in particular embracing the factors time spent, inconvenience and monetary costs. In evaluating these expense factors we have to consider, that the results of empirical studies analyzing the process of selecting transportation mean are based on subjective opinions of the traffic participants and not on objective data. (Brüderl and Preisendörfer, 1995)

Methodologically similar to the scientific approach described above, the selection of a certain traffic mode is explained by the “Theory of planned behavior” developed by Ajzen.

In the understanding of this theoretical approach, the decision to use a specific transportation mean is also based on personal expectations about its benefits, which result from:
- the attitude to the respective traffic mode;
- beliefs about the subjective abilities and preconditions for using it; and
- social norms, with reference to the transportation mean (Bamberg et al., 1995).

The attitude to a certain transportation mode results from specific subjective hypotheses on relevant attributes such as time spent, cost, convenience, safety and environmental compatibility.

Assumptions about the subjective ability to use one of the traffic means available are based on hypotheses, how easy or difficult it might be for a person to make use of a certain transportation mean; personal conditions (age, income, having a driving license or not), situative restrictions (disposal of time, transport of goods etc.) and even infrastructural supply in particular concerning the traffic modes play an important role.

The influence of social norms is based on beliefs whether there would be pressure or an incentive by friends, neighbours or other relevant persons to use a certain transportation mean or not. (Bamberg et al., 1995)

Theories like those described above can be very useful for traffic policy, because the results of analyzing the relevant factors of personal transportation decisions indicate which of the measures available could be more or less effective in order to support an environmentally-oriented organization of the transportation sector.

Empirical studies elaborated with reference to the theories mentioned before indicate that the primary influence on transportation mode decision comes from three quality dimensions which make the use of a transportation mean more or less preferable, namely:
- time spent;
- convenience; and
- to a lesser extent – monetary costs (Priewasser, 1997).

Primarily differences in time spent and convenience are the most essential reasons why cars are often preferred to public transportation means.

Actual time spent using the public transportation system is considerably higher than that of private motor vehicles. But as Figure 2 shows, the time disadvantage of public transportation means is not a matter of speed but exclusively caused by
side time needs, e.g. time spent walking to the bus stop or waiting for the bus.

So traffic policy should primarily improve quality factors which have an essential influence on those time components. Empirical studies elaborated on the basis of the behavioral theories mentioned above demonstrate, that in the perception of the road users the following quality elements of public traffic systems are very decisive in the process of choosing a transportation mode: the number of stops per unit area, the intervals of departures and the number of necessary line changes.

A comparison of towns in the Ruhrgebiet with the town of Zurich may demonstrate the effects of different stops' densities and frequency of departures on the attractiveness of public transport. As Figure 3 shows, in Zurich the number of stops per square kilometre is about 50 to 75 per cent higher than in the German towns considered and the intervals between departures only amount to six minutes whereas those in the towns of the Ruhrgebiet range from ten minutes to 20 minutes. (Petersen, 1995; Petersen and Schallaböck, 1995).

Both of the indicators combined, namely density of stops and the number of departures a day result in “the number of stops-departures” (per square kilometre), which is four to six times higher in Zurich than in the German reference towns.

In the same figure, the effects of those differences in public transport’s quality on its contribution to traffic volume become evident. In Zurich, 42 per cent of the ways covered a day are done by public transport, whereas in the Ruhrgebiet towns the public traffic only holds a share of 13 per cent.

Additionally, the necessity of changing lines causes time loss at the stops and is seen to be unpleasant in the opinion of the traffic participants. Therefore direct communications should preferably be installed. A study on people’s traffic behavior in Munich demonstrates the effect of direct communications. Only 26 per cent of those persons who can reach destinations directly by public transport use a car for these ways. Even when people have to change once, the share of the car users only increases up to 28 per cent. However, when multiple changing is required, the portion of the car users increases up to 57 per cent (two changes) up to 76 per cent (several changes) respectively (Brüderl and Preisendorfer, 1995).

### Objective versus subjective reasons for car use instead of public transportation means

In many cases, car use instead of transportation alternatives cannot be justified by objective functional requirements such as transportation of goods or deficiency of alternative transport supply. Empirical studies show us, that very often only subjective motivations are decisive for using a car (Figure 4) such as:

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**Figure 2**
Average time spent with car and public transport in Linz (upper Austria)

- **time spent with car**
  - 2 min
  - 14 min
  - 16 min

- **time spent with public transport**
  - 13 min
  - 12 min
  - 25 min

**Source:** Socialdata, 1992

**Figure 3**
Quality indicators of public transport

- **density of stops per sq. km**
  - 3.2-3.8
  - 5.6

- **intervals of departures**
  - 15-20 min
  - 6 min

- **number of stops/departures per qkm a day**
  - 3,000
  - 2,500
  - 2,000
  - 1,500
  - 1,000
  - 500

**Source:** Petersen/Schallaböck, 1995; Priewasser, 1998
less information about alternatives (time of departure, tariffs, routes);
• negative attitude towards alternative transportation means in general; or
• negative assumptions concerning specific attributes of the alternatives such as speed, comfort or costs.

Moreover, a considerable number of car users cannot give any reasons – objective or subjective – why they do not use an alternative traffic mode. In those cases, selection of a transportation mean is a kind of habitual act, without rational consideration of alternatives available.

In those cases where only subjective obstacles stand in the way of using public transportation means, considerable increases of this traffic mode can be achieved even without higher investments in traffic infrastructure, namely by taking so-called “soft policy” measures. Measures in this category are:
• giving informations about the public transportation system in detail (e.g. by installing so-called “Mobility Centers”);
• indicating the subjective advantages of public transport and elimination of prejudices against it;
• elaborating communication strategies, such as awareness campaigns to improve the acceptance and the sympathy value of public transportation means; and finally
• to care for a user-friendly mobility supply based on target group oriented demand analysis, direct marketing and free trial tickets for potential public transport users.

For Germany, it has been estimated that as a consequence only of soft policy measures, the portion of the environmentally friendly transportation modes (on foot, biking, public transport) could in total increase from 47 per cent at present to 76 per cent in the nearer future. Nearly 60 per cent of that increase could be covered by public transport (Brög, 1997).

### Potentials of changing traffic modes – comparison of European cities

Different accents in transport policies lead to different portions of the transportation means prevailing, as Table I demonstrates. So Zurich became a model town in promoting public transport, whereas Groningen and Amsterdam, as well as Salzburg and

<table>
<thead>
<tr>
<th>Town</th>
<th>Car</th>
<th>Public transport</th>
<th>Bike</th>
<th>On foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linz 1992</td>
<td>42</td>
<td>22</td>
<td>4</td>
<td>31</td>
</tr>
<tr>
<td>Salzburg 1992</td>
<td>44</td>
<td>13</td>
<td>19</td>
<td>24</td>
</tr>
<tr>
<td>Innsbruck 1993</td>
<td>43</td>
<td>15</td>
<td>13</td>
<td>29</td>
</tr>
<tr>
<td>Saarbrücken 1989</td>
<td>54</td>
<td>17</td>
<td>2</td>
<td>27</td>
</tr>
<tr>
<td>Ruhrgebiet* 1988</td>
<td>53</td>
<td>13</td>
<td>7</td>
<td>27</td>
</tr>
<tr>
<td>München 1989</td>
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<td>Hannover 1990</td>
<td>38</td>
<td>22</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>Zürich 1988</td>
<td>29</td>
<td>42</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>Amsterdam 1991-1993</td>
<td>34</td>
<td>16</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>Groningen 1991-1993</td>
<td>36</td>
<td>6</td>
<td>35</td>
<td>22</td>
</tr>
</tbody>
</table>

**Note:** *Bochum, Essen, Gelsenkirchen

**Source:** Priewasser (1998)
Innsbruck to a minor extent, can be regarded as exemplary municipalities in supporting cycling. Portions of the public transport sector, particularly those of cycling in these towns, give an indicator of possible amounts of changing traffic modes.

References


Socialdata (1992), Linz in Bewegung – Chancen für Verhaltensänderungen, Linz.