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Identifying target groups for environmentally sustainable transport: assessment of different segmentation approaches

Sonja Haustein¹ and Marcel Hunecke²

Recently, the use of attitude-based market segmentation to promote environmentally sustainable transport has significantly increased. The segmentation of the population into meaningful groups sharing similar attitudes and preferences provides valuable information about how green measures should be designed and promoted in order to attract different user groups. This review highlights advances in the understanding of mode choice from a psychological perspective, taking into account behavioural theories of car use and car-use reduction. In this contribution, attitudinal, socio-demographic, geographical and behavioural segmentations are compared regarding marketing criteria. Although none of the different approaches can claim absolute superiority, attitudinal approaches show advantages in providing starting-points for interventions to reduce car use.

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Introduction

Private car use causes severe local and global environmental problems, such as pollution, noise, and global warming. Along with technological improvements and infrastructure optimisation, an overall solution to these problems would require behavioural change of individual car users. The target-group specific planning and design of interventions is a measure that is often requested to increase the efficiency of environmental interventions [1–3]. By contrast, marketing campaigns that are spread across the whole population according to the ‘shotgun approach’ have only limited chances to change environmental attitudes and individual travel behaviour. In this paper different ways of reducing the complexity and

heterogeneity of the whole population by dividing it into relevant subgroups are described. A special focus is put on attitude-based market segmentations, which have significantly increased in the recent years. They are compared with behaviour-based, socio-demographic and geographical approaches regarding selected marketing criteria in order to provide support in the choice of the appropriate approach for different fields of applications. This review highlights advances in the understanding of mode choice from a psychological perspective, taking into account behavioural theories of car use and car-use reduction. It concentrates on peer-reviewed papers that have been published over the past two years.

Market segmentation in the transport sector

Several transport providers/associations and municipalities have used market segmentation as a basis for targeted interventions to increase the use of sustainable transport modes (e.g. [4,5]). Unfortunately, in most cases the effects of these target-group specific interventions are not systematically evaluated or results are not published. However, the recent EU project ‘SEGMENT’ [6], in which market segmentation techniques are used to adopt more energy efficient forms of transport in seven European cities, indicates the great potential of this approach.

In marketing research a priori and post hoc segmentation approaches can be differentiated [7]. In the case of an *a priori segmentation*, the constituent variables of the segments, as well as the segment profiles, are well-defined so that each respondent can be clearly assigned to one of the postulated segments. Individualised travel marketing [8], for example, uses an a priori segmentation to classify the population into groups that are either already using environmentally friendly modes of transport regularly or not, and may or may not be interested in further information, as the first step of the procedure [9]. In the second approach to market segmentation, which is termed *post hoc segmentation*, groups are specified on the basis of empirical results. Individuals are grouped according to their similarity in a set of variables, and in most cases, the grouping is the result of a cluster analysis. The resulting multidimensional profiles can be used as a starting point for target-group specific measures to reduce car use.

More and more complex segmentations have been developed in transport research. There are four basic classes of variables that have been used to segment the population:

- travel behaviour
- spatial variables

- socio-demographic variables
- attitudinal variables

A behaviour-based approach defines the population segments by their actual travel behaviour, for example trip frequency, mode choice, or trip purpose. In the German national travel survey [10], a combination of frequency of public transport, car, and bicycle use, car availability and accessibility is used to segment the population into seven user groups, for example 'captive public transport users'. In behavioural approaches, groups are often formed a priori according to well-defined rules and the purpose is basically to describe the development of different user groups over time. By contrast, Prillwitz and Barr [11^{*}] presented post hoc generated groups based on a cluster analysis of daily travel behaviour.¹ They distinguished between 'persistent car users', 'frequent car users', 'constrained public transport users', and 'consistent green travellers' and showed that the clusters were particularly related to age, income and political views. In the context of holiday travel, Böhler *et al.* [13] identified four groups based on the number of trips and kilometres travelled. The segments varied according to socio-demographics, personal values, travel mode choice, and environmental impact, with the 'long-haul travellers' being responsible for 80% of the emissions of the whole sample.

Geographical approaches group people by aspects of their residential location, differentiating, for example, between people living in urban, suburban and rural areas. Such approaches are, for example, used in national travel surveys to describe the mode choice of people in different spatial contexts. Other studies choose specific study areas representing different settlement structures to examine the influence of neighbourhood characteristics on travel behaviour [14,15]. In addition to different geographical categories, continuous representations of location are often applied, for example 'accessibility' [16] or 'walkability' [17]. Respective measures can be integrated in other segmentation approaches in the transport sector, for example in predominantly behavioural [10] or predominantly attitudinal approaches [18^{*}].

The most common sociodemographic categorizations are based on age groups or gender. Different *life cycles* or *life stages* can be differentiated by the combined consideration of household variables, age, and work status, either a priori [19,20^{*}] or post hoc [21]. Ryley [21] identified 10 life stage based segments (e.g. 'Students', 'High Earner with Children', 'Retired in a couple') by cluster analysis, and showed that they differed in their individual travel patterns. A first step towards the integrations of *lifestyles* in travel research was done by Salomon and Ben-Akiva [22].

¹ While they refer to their segments as 'mobility styles', we use this term exclusively for segmentations that also take into consideration psychographic variables, cf. [12].

By contrast to the lifestyle concept that will be presented in the following section, their segmentation was solely based on socio-economic variables. A similar lifestyle approach, applied exclusively to the older population, was conducted by Hildebrand [23] who identified six distinct clusters of older people, who were found to have significant differences in mobility behaviour and activity engagement patterns.

Research into social stratification in modern societies has shown that the complexity of social activities cannot be explained satisfactorily by sociodemographic variables alone. Attitudinal variables have thus finally been introduced in order to explain and understand individual mobility behaviour in more depth, and to segment the population into meaningful groups.

Attitude-based segmentations

Attitudes and values were first integrated into mobility research systematically in the *lifestyle* approach. An often used model based on life styles is the 'milieu' approach of the Sinus Institute. The so-called Sinus milieus have been analysed longitudinally since the 1980s in Germany, and applied to 18 countries worldwide. The resulting segmentation is mainly based on values and aesthetic preferences (<http://www.sinus-institut.de>). *Mobility styles* can be regarded as a further development of the life style approach. Here, mobility-related attitudes and preferences have been integrated, in addition to the more general attitudes and values considered in life styles [12,24,25]. The identification of different mobility styles started based on sociological analyses of qualitative interviews on transport attitudes and behaviour [24,26]. With increased knowledge about the different motives and preferences, mobility styles are now in most cases identified based on standardised questionnaires [12,25].

While life style and milieu-oriented approaches also include other person-related variables (e.g. socio-economic variables and behaviour), *mobility types* are in general based on attitudinal variables alone. In recent years the use of 'pure' attitude-based market segmentation to promote environmentally sustainable transport has significantly increased [11^{*},20^{*},27–29,30^{*},31,32]. It is advisable to base mobility types on a theoretical background and on those variables which have been found to be relevant predictors for explaining mobility behaviour in social and behavioural research. Among the most important dimensions of behaviour theory are the constructs of the Theory of Planned Behaviour (TPB) [33–39], the construct of personal norm derived from Schwartz's [40] Norm Activation Theory (NAT) [39,41–43], and attitudes covering the symbolic-affective evaluation of different transport modes [44–51], such as status, autonomy, excitement and privacy, often connected with car use.

The mobility types developed by Anable [27] and Hunecke *et al.* [20^{*}] are particularly characterised by a theoretical foundation. Both are mainly based on an expanded version of the TPB [33]. The TPB regards the constructs of attitude, subjective norm (SN), perceived behavioural control (PBC), and intention, as predictors of behaviour. Intention is seen as a summary of all the pros and cons a person takes into account when deliberately reasoning whether a behaviour should be performed or not. Intention itself is viewed as causally determined by attitude, SN, and PBC. Attitude towards a behaviour is the degree to which the performance of the behaviour is positively or negatively valued. SN is defined as the perceived social pressure to engage or not engage in a behaviour. PBC refers to people's perceptions of their ability to perform a behaviour. It is assumed to be a direct predictor of both intention and behaviour.

The common methodology of most attitude-based segmentations is to first identify the underlying attitude dimension through a factor analysis and then run a cluster analysis based on the obtained factors. Procedures differ in whether all extracted factors are used for the cluster analyses or only a subset. Hunecke *et al.* [20^{*}], for example, chose only those factors which turned out to be significant predictors of mobility behaviour and the resulting environmental impact in regression analysis where demographic and infrastructural variables were also included. As a result, five segments were obtained, which differed significantly from each other with regard to travel mode choice, distances travelled, and ecological impact.

Apart from the rather standardised procedure based on cluster analysis, some alternative methods have been applied for grouping individuals based on travel-related attitudes, for example profiling travellers by Q-methodology [52,53]. This primarily explorative technique is based on personal rankings of a set of heterogeneous items (=Q sort), see [54] for a detailed description of the method.

The mobility types described so far have been based solely on attitudes, norms, and values. This restriction, however, is not a necessity. Depending on the context socio-demographic or infrastructural variables can also be included in cluster analysis. When considering, for example, a population of older people, it makes sense to include variables such as age, income, accessibility and the size of their social network, which are important factors in older people's mobility behaviour in addition to attitudinal variables [18^{*},55].

In addition to the segmentations mainly influenced by TPB and NAT, another theoretical approach is based on the assumptions of the Transtheoretical Model of Behaviour Change (TTM) [56]. Here it is suggested that

people go through distinct stages before they voluntarily change their behaviour. This approach has been applied to both the reduction of car use [57^{*}] and promotion of cycling [58]. When applied to car use reduction, the stages of change can be described as follows: **pre-contemplation**: people at this stage do not intend to change their mode choice and may be unaware of the need to change; **contemplation**: a reduction of car-use is considered; **preparation**: a concrete strategy on how to reduce car-use exists; **action**: people at this stage have reduced their car-use within the past 6 months; **maintenance**: mobility behaviour has changed and the use of alternative modes has become a new habit. Bamberg *et al.* [59^{*}] integrated assumptions of the TPB, NAT, and TTM into a new self-regulation theory. Bamberg [57^{*}] showed based on a social-marketing campaign that stage-specific interventions triggered the transition to more action-oriented stages, significantly reduced participants' car use and increased their public transport use. Even though this is regarded as a promising approach, the few studies available so far do not allow for a systematic assessment of this approach.

Assessment of different segmentation approaches based on marketing criteria

The performance of the different segmentation approaches reviewed in this paper can be evaluated based on the criteria of marketing research, such as predictive power, actionability, measurability, stability, accessibility, and efficiency [60,61] as summarized in Table 1.

Hunecke *et al.* [20^{*}] compared an attitude-based approach (mobility types), a sociodemographic approach (life stages) and a micro-geographical approach considering **predictive power** related to car use, travelled distances, and related greenhouse-gas emissions. They showed that mobility types were superior in predicting car use, while the differences in travelled distance and emissions were not so pronounced. An advantage of mobility types in predicting mode choice could also be demonstrated by comparison to a general lifestyle approach [62]. Although lifestyles are clearly linked to consumption patterns and related GHG emissions [63], they seem to be less relevant to daily travel than to holiday travel, while in holiday travel decisions attitudes towards transport modes play only a minor role [11^{*},13]. Within the socio-demographic approaches, lifestyle clusters were found to perform better than life stages and income groups with regard to mode and destination choice [22].

Predictive power is only one of several criteria. Assessment with regard to the other criteria in Table 1 is, however, not evidence-based but relies on a synthesis of the experiences in mobility research and practice. Here, **actionability** can be regarded as another strength of mobility types. Whether people value the car as a status-symbol or for mainly functional reasons, whether

Table 1

Assessment of different segmentation approaches based on marketing criteria

Approach [examples]	Predictive power	Actionability	Measurability	Stability	Accessibility	Efficiency	Field of application
Behaviour based segmentations [10,11*]	Mainly descriptive function	Requires additional information about individuals	High measurability when behaviour is observed; some bias in self-report data	Stability depends on the stability of individual and infrastructural determinants	Good addressability regarding space- and time-related aspects of the recorded behaviour	Low effort but also limited benefit	Monitoring
Geographic segmentations [14,15]	Low with regard to environmental impact of travel; prediction of travel behaviour depends highly on the specific approach and the included variables	Provides information for spatial and infrastructural planning	High reliability if measured by experts or objective parameters; self-reporting often biased	High stability	Direct local addressability	Depends highly on the specific approach and the included variables (very efficient when based on a geographic information system)	Long-term planning of traffic infrastructure
Sociodemographic segmentations Life stages [20*,21] Lifestyles [22,23]	Best with regard to destination choice; good with regard to environmental impact of travel; low with regard to car use, cycling, walking, better for public transport use	Measures can be adjusted to needs resulting from socio-demographic profiles (e.g. life stages); but: sociodemographic variables cannot be changed	High measurability also in self-reported data	Very stable at population level; at individual level most characteristics change systematically during the life cycle (age, employment, ...)	Rough information about spatial distribution and used media	Lowest effort for comparably high benefit	Travel demand modelling; destination choice; residential choice
Segmentations including attitudes: Lifestyles [62,70]	Low predictive power, best in the sector of leisure mobility and use of services with high symbolic meaning	Symbolic-affective design and communication of products and services	Measurement of mental orientations is subject to measurement errors; no generally accepted operationalisation of life styles	On individual level more stable than attitudes; on population level changes can be observed based on longitudinal data	Allows for most differentiated communication via media; only rough information about spatial distribution	Depending on the operationalisation a various high effort (at least 50 items) with limited benefit	Symbolic communication of specific products and services
Mobility styles [12,25]	Sensitive for new forms of behaviour; high relevance for destination choice and travelled distances; also relevant for mode choice and environmental impact	Entire spectrum of soft-policy measures; Symbolic-affective design and communication of products and services	Measurement of mobility and life-style-orientations are subject to measurement errors; no generally accepted operationalisation of life styles	Segments are, on individual and population level, more stable than mobility types but less stable than life styles	High accessibility with regard to communication forms and media use; only rough information about spatial distribution	Highest effort (ca. 100 items) but does not guaranty highest benefit	Destination choice; holiday travel decisions; innovative kinds of behaviour

Mobility types [20*,27]	Best segmentation approach for mode choice; slight advantage for environmental impact; weak for destination choice and travelled distances	Direct starting points for information and communication strategies; attitudes can be changed; measures can be adjusted to attitude-profiles	Measurement of attitudes is always subject to measurement errors; higher when based on empirically tested items derived from behaviour theory	Attitudes are not stable at both individual and population level as changes in situative framework conditions and realized behaviour will always lead to adjustment of attitudes	Lowest accessibility as attitudes must be measured and cannot be derived from spatial or sociodemographic variables	Mean effort (ca. 25 items) with comparably high benefit	Mode choice; emissions resulting from daily travel patterns
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Note. The assessment regarding predictive power is based on empirical results [20*,22,62,65], whereas the evaluation with regard to the other criteria mainly relies on a synthesis of the authors' experiences in mobility research and practice.

they perceive using public transport as difficult, and the extent to which they feel personally obliged to use environmentally friendly modes, is valuable information which can be used in measures to reduce car-use. Depending on the attitude profile, interventions can be developed that focus on changing attitudes, on the activation of social or personal norms or on an increase in the scope of action. As for life styles and mobility styles, products and services can also be adjusted to the psychographic profiles of the respective population segments. Interventions based on attitude profiles are, for example, suggested in [20*,27]. However, reliable empirical studies that evaluate the environmental effect of such interventions are either missing or not published in scientific journals. The use of symbolic-affective marketing in the car-industry, however, can be regarded as an indicator of its success, even though details are not published [64]. Regarding actionability, socio-demographic, geographical and especially behavioural approaches offer fewer possibilities [20*,65] and may oversimplify the market structure [27].

However, the measurement of psychographic variables is exposed to a higher risk of error than the measurement of socio-demographic variables and mobility behaviour, so that life styles, mobility styles and mobility types must be regarded as less reliable with regard to **measurability**.

Stability and **accessibility** can be regarded as a weakness of mobility types. Hunecke and Haustein [66] clustered a subsample of their mobility types again after a year and found that only 51% could be assigned to the same clusters, although underlying attitude dimensions showed an acceptable retest-reliability. This result indicates, even though reliable empirical comparison data are not available, that the stability of the mobility types is inferior compared to the other psychographical approaches.

With regard to **efficiency**, sociodemographic approaches and mobility types are evaluated positively. By contrast, the measurement of mobility styles, and particularly life styles, requires a much greater effort without guaranteeing an increased benefit. Geographical approaches are highly efficient when they make use of a geographic information system. Behavioural approaches require comparatively less effort but are also restricted in their use, which is basically descriptive.

Conclusion

All in all, it can be concluded that none of the approaches can claim absolute superiority. Instead they show specific pros and cons, which suggests an application in different fields of the planning and design of mobility measures, as described in Table 1. The presented assessment is mainly a synthesis of the experiences in mobility research and practice. More research is needed that allows for a more

evidence-based evaluation of the different approaches, for example by examining the stability of the different segmentation approaches over time.

Attitude-based approaches provide important information for measures that aim to reduce greenhouse gas emissions. This results especially from their ability to predict mode choice in daily travel. With regard to the reduction of car use, attitudinal segmentations that are based on theories of car use and car-use reduction seem to be the most promising approach. Whether they are successful or not, depends not only on the segmentation itself but especially on the measures addressed to the different segments. Unfortunately, studies that implement and evaluate theory-based and target-group specific intervention to reduce car use are rare, with [57[•]] being a positive exception.

Besides daily mode choice it is in particular destination choice that determines transport-related greenhouse gas emissions. In predicting travelled distances [20[•]] and holiday mobility [67] attitudinal approaches perform much weaker and additional research effort is needed to increase the understanding of destination choices.

Both, with regard to mode and destination choice the different sets of variables should not be considered isolated. People in specific life situations and with specific transport related attitudes are not regionally balanced, which can partly be explained with residential self-selection [14,68,69]. Interactions between different sociodemographic, spatial and attitudinal variables and their effect on mode and destination choice should be further investigated.

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