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Measuring Political Commitment in Statistical Models for Evidence-based Agenda Setting in Non-motorized Traffic

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1 ABSTRACT

When investigating national and international transport policies of the last decade, an ever increasing emphasis on promoting non-motorized transport modes such as walking or cycling can be identified, aiming at reaching multiple political targets (eg. reducing pollution, increasing health or lowering land consumption). However, despite substantial financial efforts being put into infrastructural or awareness-raising activities, achieving the desired modal shift towards active mobility remains a challenge. This is frequently due to unclear cause and effect patterns between active mode shares and their determinants, which in turn leads to uncoordinated or highly fragmented initiatives that impede target-oriented planning.

An internationally adopted approach to overcome this problem is applying aggregated statistical models that explain modal choice involving multiple regression techniques and hypothetical covariates. Still, general critique against these models points out that important intangible soft factors such as attitudinal characteristics of the local population or mind-sets and political commitment of decision makers are not duly reflected. Also, for Austria there is currently no systematic holistic approach to explain spatial variance in active travel shares on the scale of municipalities.

Hence the main objective of our research is to design a comprehensive macroscopic model-based approach for the quantitative explanation of modal split shares in active travel modes in Austria. In our approach we attach great importance to the inclusion of soft factors in order to contribute novel findings on the dynamics behind active travel. The research outcomes will aid decision makers and planners in their question where and more specifically, how to effectively invest into active mobility by revealing key soft factors and intangible determinants of active travel mode shares alongside a broad range of more known, traditional factors. Based on this evidence-based decision support approach it is possible to simulate impacts of actions when aiming at locally promoting active travel modes.

Keywords: transport policy, operationalization, proxies of political willingness and behaviour, statistical modelling, walking-cycling determinants

2 INTRODUCTION

2.1 Active modes in Austrian transport planning – problems and practices

Multiple historical views on the evolution of modern transport systems in the past decades have already pointed out that the alarmingly high shares of motorized transport modes (currently ~ 46.8%) (BMVIT, 2016) are closely related to negative externalities which manifest themselves in high social and environmental costs (Merki, 2008; Knoflacher 2013). In order to suggest appropriate actions as a remedy for these shortcomings including urban sprawl phenomena (VCÖ, 2007), pollution and traffic accident rates (Perschon, 2012), it is considered crucial to increase the share of active mobility modes (walking, cycling) (Knoflacher, 2007; Meschik, 2008; Perschon, 2012). Active modes offer a set of desirable ecological (resource neutrality, zero-emission, downsize of land consumption), economical (reflecting an indirect net product of up to 882.5 Mio.€, equivalent to 18,328 full-time jobs) (BMVIT, 2009) and socially (positive impact on health) sustainable properties (Meschik, 2008).

With this in mind, current Austrian transport strategy papers at the federal and state level show a clear commitment for the fostering of non-motorized transport modes. This is particularly reflected by Austrias national masterplan for walking (BMLFUW, 2015a), the national cycling strategy (BMLFUW, 2015b) as well as potent funding structures and multiple state-level strategy papers (eg. Stadt Wien, 2014).

Despite the actions taken at national and regional levels, recent surveys show that reaching the desired shift towards active mode shares at the local level of municipalities remains a challenge (BMVIT, 2016). This problem is on the one hand reflected by the strongly varying number of planning projects (BMLFUW, 2011; Raffler, 2016) and on the other hand due to the still greatly differing and generally low modal shares of walking and especially cycling (BMVIT, 2013). On top of that, the decentralized character of the Austrian planning system impedes coordinated actions of the federal strategies and funding programs. As it has been depicted in the overview of the Austrian bicycle planning system by Raffler (2016a) (s. fig. 1), the legally binding instruments for infrastructure planning are tied to the local level of approximately 2100 municipalities. This leaves Austrian active-mobility planners with a rather heterogeneous planning landscape and the problem “that investments in cycling promotion are currently not always put into action where they may be most expedient, but there, where local political will is the highest” (Raffler et al., 2016b, p. 2) which is also true for walking.

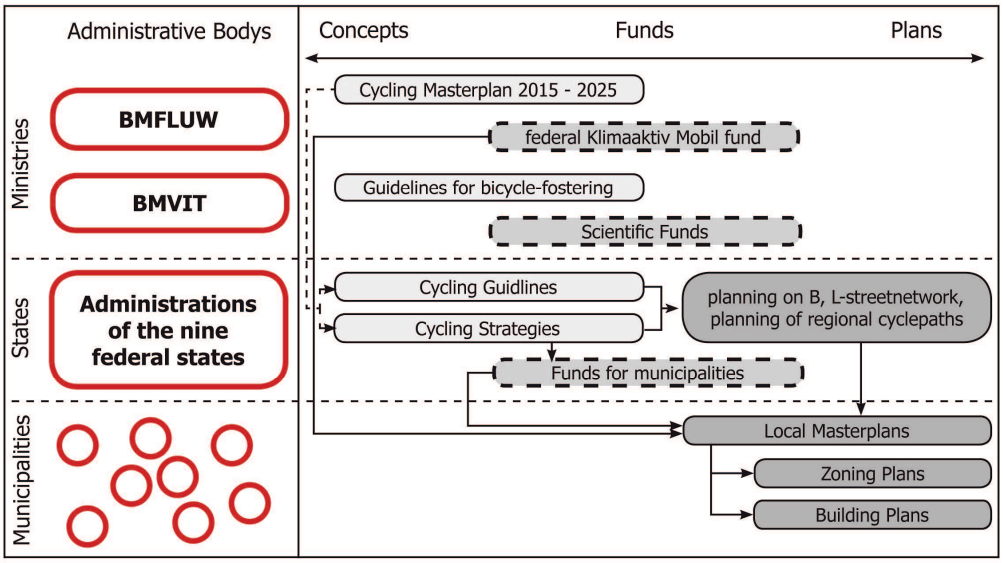

Fig. 1: Structure of Austrian bicycle planning (Source: Raffler, 2016a)

Summing up the current problems and practices, the lack of knowledge about cause and effect patterns between active modes and their drivers in the context of their respective users is currently limiting actions to achieve a substantial modal shift.

2.2 International approaches and methods

Investigating international research on active mobility planning reveals a broad spectrum of papers that aim at solving the above planning problems through the provision of decision support to planners and political stakeholders. Mainly lead by the approach of evidence-based planning (Faludi et al., 2006) whose influence shows itself especially in western-european planning culture, much research is focused on understanding factors that have an influence on active mobility. This is particularly true for research in the cycling domain whereas papers on pedestrian traffic tend to have a health science perspective (eg. Leslie et al., 2005; Cerin et al., 2009; Verhoeven et al., 2016). Hence they do not explicitly propose results that are designed for decision support; nevertheless they have an indirect implication for planning activities.

The main rationale behind explaining influencing factors is to reveal the relevant mechanisms planners may address in order to positively influence the development of active modal shares (eg. changes in infrastructures, accessibility, network topology, social structures, etc.) (Parkin et al., 2008). Another key advantage of a solid evidence base on the influencing factors of active mobility is that funding activities can be focused where they will provide the biggest return values in terms of modal spilt increase, hence tackling the problem of uncoordinated initiatives (Raffler et al., 2016b).

From a methodological point of view, research approaches are generally based in the field of quantitative statistical analysis. The assessment of influences can generally be facilitated by performing simple, monocausal correlational analyses (Leslie et al., 2005) or through the setup of more sophisticated models using regression techniques. They either estimate walking or cycling modal shares from census or survey data at the administrative level of municipalities or origin-destination flows (eg. aggregated approaches) or reflect the probability of choice to participate in active mobility at the individual level (eg. disaggregated approaches) (Parkin et al., 2007; Aoun et al., 2015). Prominent examples for models that calculate active modal shares from multiple variables representing the local conditions and situations exist for the Netherlands and Belgium (Rietveld et al., 2004; Vandenbulcke et al., 2010), Great Britain (Parkin et al., 2008) as well as the USA/Canada (Pucher/Buehler, 2006) and Australia (Cerin et al., 2009). In addition, Heinen et al. (2013) conducted an analysis on the choice to cycle at the individual level. The models can then be used by planners and decision makers to assess the impact of certain planning actions by consolidating the raw model equation. The barrier of dealing with raw mathematical constructs in planning support is even lowered by the recent work of Lovelace et al. (2017): The proposed Propensity to Cycle Tool opens the possibility to provide easier access to decision support for planning affiliated stakeholders via web-mapping applications. While there is a great deal of research investigating British, Dutch, Belgian or American situations, there are currently no such comprehensive models for Austria.

General critique on active mode share modelling approaches focuses on the representation of ‘soft’ influencing factors (in contrast to ‘hard’ factors, such as topography, infrastructure or accessibility). As Heinen et al. (2010) point out with regard to poorly reflected psychological factors (eg. personal attitudes towards active modes) we suggest to extend this critique to the insufficient reflection of political will or commitment, factors that are frequently cited as being crucial for the successful promotion of non-motorized modes. This assumption is strongly based on oral evidence sourced from local planning stakeholders – and therefore considered a relevant point of critique. Despite the efforts of preceding models to model the effects of “policy” (Rietveld, 2004; Pucher/Buehler, 2006) by measuring the impact through proxy-variables such as gasoline prices per litre, cycling fatality rate (Pucher/Buehler, 2006), parking costs, network speed or voter-proportion of certain political parties (Rietveld, 2004), the quality political will has internationally not yet been assessed properly in the context of quantitative aggregated mode-choice models.

2.3 Aim of this research

In face of the organisational problems in Austria (heterogeneous political commitment, lack of knowledge about cause and effect patterns, uncoordinated action) related to active mobility and the shortcomings of recent international approaches in terms of intangible factors, this paper aims to present an solution approach for using political commitment and other soft factors as predictor variables in the context of a comprehensive macroscopic modelling framework for active travel modes at the level of Austrian municipalities. We thus test the hypothesis stating that the local presence of political commitment does help promoting walking and cycling shares with respect to the specific local cultural context. Doing so, special methodological attention is devoted to the operationalisation and measurement of soft factor impacts on non-motorized modal shares. We also implicitly include past political decisions which already manifested themselves in the planning by including related variables in the models such as accessibility levels or infrastructural characteristics. In this context, our understanding of commitment and policy-related factors is therefore purely non-physical and oriented towards mind-sets rather than tangible attributes.

3 MATERIALS AND METHODS

3.1 Data

In order to be able to assess influences on walking and cycling modes, we acquired data from the traffic survey of the state of Upper Austria which was conducted in October 2012 (Government of Upper Austria, 2014). Although this decision narrows the focus of our research through the exclusion of the other eight federal states from the analysis, Upper Austria is one of the few states that feature nearly every element of the heterogeneous Austrian spatial structure (eg. alpine regions as well as rural forests, hills, urban and semi-urban zones). Furthermore it shall be noted that Upper Austria’s traffic survey is currently unique among Austrian surveys regarding its spatial granularity and detail.

Modal shares for a total N of 444 municipalities are based on mobility surveys of person-specific trips (specified by mode and trip purpose): numbers of trips were projected and statistically weighted in order to correct for sample bias. Active mode shares were calculated as the respective proportions of walking and cycling trips, in the total number of reported trips per municipality. In order to secure a sound 95% confidence interval of the modal shares, we excluded municipalities where the number of persons was less than 200. (s. Table 1, filtered). Also, we used the unweighted number of reported trips to weight cases (municipalities) when calibrating the regression models so to give relatively more weight to more robust values in the outcome variable. Those measures do not harm the models' representativeness but rather remove modal share values based on a weak empirical foundation. Related issues pertaining to the confidence levels of the non-motorized modal shares also impeded a further differentiation of the models in terms of trip-purposes. Though initially planned this would have asked for substantially larger sample sizes of the mobility survey and was therefore skipped. The descriptive statistics presented in table 1 show that Upper Austrian walking shares at the municipality level are considerably larger than cycling shares.

mode	model-type	N [municipalities]	mean [%]	min [%]	max [%]	SD [%]
walking	unfiltered	444	11,46	0,71	32,48	4,88
	filtered	338	12,21	3,32	32,48	4,83
cycling	unfiltered	444	3,55	0	21,4	2,70
	filtered	338	3,88	0,25	17,47	2,60

Table 1: Descriptives of the Upper-Austrian active modes' shares by municipality (Travel Survey 2012).

Cycling shares by municipality range between 0% and 21% and exhibit a substantial left skew resulting from a far from normal distribution.[1] Removing municipalities with less than 200 surveyed persons reduces N by 106 while slightly increasing the mean values for both modes. Also, some of the extreme values on the outer limits of the distribution have been excluded due to the filtering. Alongside these traffic data various additional data sources have been tapped including the thriving Austrian OpenData Initiative (data.gv.at) which was used to describe local spatial, infrastructural and socioeconomic properties. Further datasets range from spatial data (street graphs) from the national Graph-Integration-Platform (GIP) and OpenStreetMap (OSM), digital elevation models and population density rasters to more census related information. In terms of demographic and socioeconomic data as well as for data on various other items datasets published by Statistics Austria were used. Data on weather and climate was sourced from ZAMG (Zentralanstalt für Meteorologie und Geodynamik). Some data was directly obtained from representatives of the Upper Austrian state administration. Information on social milieus was procured from INTEGRAL Markt- und Meinungsforschung.

3.2 Methods

Our holistic research approach was guided by structuring the model building procedure in four major steps (s. Fig. 2). Firstly we built three main groups of factors that are known to have an influence non-motorized traffic from literature: spatial and environmental, infrastructural, demographic/socioeconomic factors and political commitment. In a second step, we gathered hypotheses on the expected impact direction and strength of these factors. The third working step was dedicated to operationalizing (geospatial and mathematical modelling, econometric techniques) of the determinants on the aforementioned data sources. The last work step constituted the statistical inference process and the formulation of multivariate regression models to predict non-motorized modal shares on the municipality scale as the outcome variable. At the time of writing this paper a dedicated survey by the research team among Upper Austrian municipalities has just been completed focussing on the self-evaluation of their political commitment towards active travel and the related local culture (mind-sets, attitudes, etc.). However, as the raw sample data needs yet to be post-processed it will be added to the model database at a later stage.

[1] The mean modal shares among Upper Austrian municipalities should not be mixed up with the overall Upper Austrian shares which amount to 14.6% for walking and 5.1% for cycling, respectively.

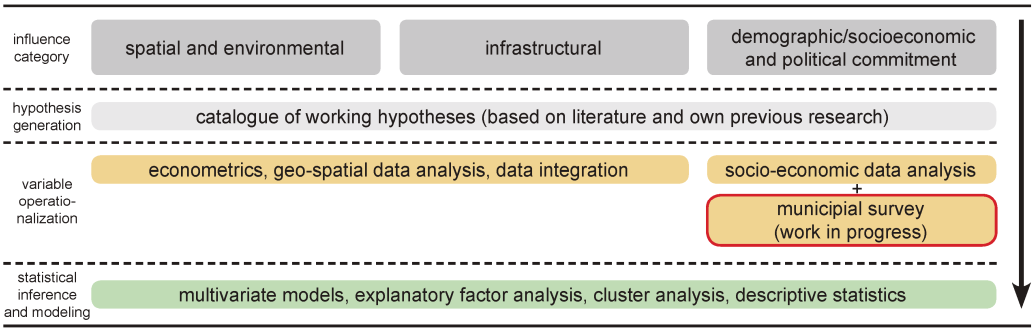

Fig. 2 Overview of workflow (Source: own, 2017).

3.2.1 Operationalization of influencing factors

The following section gives a brief overview by determinant category over the 700+ variables that were gathered and computed in the course of this research. The main tools that were applied in the variable-forming process include Geographic Information Systems (GIS) (in this case ArcGIS QGIS and PostGIS) as well as the statistical software package SPSS for the data management and processing testing and inference and model formulation.

Spatial and environmental determinants:

This group of factors deals with influences that are largely determined by spatial configuration such as settlement structure, but also various ‘static’ environmental characteristics that cannot directly be influence by planners (relief, climate). Settlement structure covariates include several types of accessibility specified for walking, cycling and car-driving modes. The calculation concept follows the approach of density-based intra-zonal and external distance estimation by Kordi et al. (2012): Local/regional walking, cycling and driving distances to different categories of trip destinations (e.g. health services, social infrastructure, shopping) were computed via network analysis in combination with weights extracted from population density grids (250m resolution). In order to realistically characterize the modal accessibilities of a municipality in single values, they were again weighted according to a literature-driven list of demand-factors reflecting their relative importance (frequency of visits per time interval) and specific weights related to the sizes of the respective target groups. Another group of variables to characterize local conditions for active travel was provided by calculating arithmetic ratios between car-based and walking/cycling-accessibilities. Related approaches were applied for the operationalization of environmental variables. Examples are the covariates on environmental determinants such as climate or topography (eg. number of snow cover days, frost, etc.) which were fine-tuned using population density grids. They therefore reflect the actual affectedness of the local population by the respective determinant.

Infrastructural determinants:

Determinants reflecting infrastructural conditions play a crucial role in this research, as they can be directly addressed by planning actions and local/regional development plans. We calculated measures describing the local topology of the road network (such as intersection density or connected node ratio) following the approach of Tresidder (2005) which describes the permeability of the municipal road network as these can influence the enjoyment and comfort of local active trips. Other variables in this determinant category include information on the density of cycle racks, the share of traffic-calmed streets or the density of traffic accident hotspots. On a methodical note due to unstable and incomplete information on cycle paths and cycle lanes along highways information from GIP and OSM was combined in order to calculate arithmetic ratios between the shortest path in the local network and the length of the most appealing and safe (most bikeable) path as a proxy for cycling detour disutility

Demographic and socioeconomic factors and political commitment:

Demographic and socioeconomic factors have frequently been a major point of discussion in the context of research on non-motorized traffic (Goodman, 2012; Heinen et al, 2010). Therefore we extracted several variables from census-based surveys which include aggregate measures on demographic structures, household structure (eg. mean household size), age groups, education, car ownership or purchase power per person/household. A more sophisticated view on local mind sets was provided by variables on social milieus

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(local shares of Sinus-milieu groups) that cluster population according to lifestyles and attitudes (milieus include conservatives, hedonists, or performers, etc.). In the specific context of this research, we aimed at shedding light on the operationalization of the local active travel mode culture and the local political commitment to support active modes. One approach consisted of collecting information on the municipality's membership in federal or state-level initiatives such as at the Upper Austrian cycling promotion programme (fahrradberatung.at, bicycle coaching initiative for municipalities), Klimabündnis Austria (an organisation promoting climate protection) or the number of projects realized in the Klima-aktiv programme (climate protection initiative of the Austrian BMLFUW). This information was used to calculate workable variables such as number of years since first assignment or simple 0/1 dummy variables. We also tested a variable reflecting a subjective evaluation of the state administration on the municipal level of pro-cycling activity. A second approach was based on including election results on municipal and state level elections. In this context it shall be noted that past political commitment may have implicitly manifested itself in kind of actually realized infrastructure projects or awareness-raising projects in favour of active travel modes whereas the above variables describe the current local 'climate' for active travel modes and potential for its promotion in the near future.

3.2.2 Project-specific survey of the municipalities' self-evaluation regarding cycling (add on)

The municipality survey that was designed and conducted by the research team aims at determining the local importance of cycling based on a self-evaluation by municipality representatives. It thus presents a picture of the pre-conditions and current efforts related to the actions to promote cycling and walking. The survey questionnaire was jointly agreed upon with the coordinator for cycling in Upper Austria and programmed as an online survey. To increase the response rate the web link for participating in the survey was sent by a known sender (Government of Upper Austria) to all 444 municipalities shortly afterwards the Summit for Cycling event in Linz, Upper Austria. The very high response rate of 54 percent (242 cases) proves that this approach has been successful.

The survey is also regarded a means of cross- check and comparing subjective perception with objective data (i.e. modal split or the variables on political commitment presented in this paper). A tabulation of the model data across a computed index based on the survey data will reveal if there is any accordance. The respective results presented in section 4 refer to the 242 participating municipalities.

3.2.3 Regression Model

In the context of this paper, both the results and conclusion sections of this paper refer to the model on cycling shares on the Upper Austrian municipality level.[2] This simplification is also done in order to provide a compact overview of our work. We derived a multivariate model aiming at identifying the relative importance of the determinants on the spatial variation of bicycle use at the scale of Upper Austrian municipalities. In a generic form the model can be written as:

$$y_i = b_0 + b_1 x_{1i} + b_2 x_{2i} + \cdots + b_n x_{ni} + \varepsilon_i$$

(Field, 2009.)

Where y_i is the outcome variable (share of walking/cycling trips in all trips in municipality i), b_0 is the regression intercept, b1 to bn denote the regression coefficients, x1i to xni is the matrix of the municipalities' characteristics in the independent variables or covariates and εi denotes the error term in municipality i. The final set of independent variables was derived iteratively from a pool of 700+ candidate variables by adopting a hierarchical scheme of model selection and a set of complementary tests and procedures (descriptives, factor analysis, cluster analysis, etc.). Note that any of these candidate variables fall in one of the three basic determinant categories described in 3.2.1. As sample size is relatively small (338 municipalities after applying the filter as described above) the possible number of predictor variables is somewhat limited. However, with 23 predictor variables the upper value following Green (1991) in minimum sample size is 234, which is well exceeded. As a guiding principle we were aiming at combining several individual variables to form combined indicators (such as merging several accessibility variables into

[2] Basically our research approach comprises two regression models (one for each major active mode). However, as the current model on cycling shares is most developed at the time of writing this paper and due to length restriction we focus on the cycling model

a single value) wherever feasible in order to reduce the number of covariates while increasing their explanatory power.

Starting off by testing the inclusion of a basic set determinants (largely based on previous research) which were force-entered into the regression model we continued to include thematic sets of additional variables in stepwise modes (both backward and forward) in order to check for incremental improvements by adding new predictors to the equation. Each step was checked in terms of theoretical plausibility and accompanied by applying statistical tests (e.g. checking for multicollinearity or suppressor effects) so not to leave crucial modelling decisions to purely statistical criteria or let them be unduly influenced by random sampling variation. For each model variant we tested for autocorrelation (independent errors) and heteroscedasticity.

4 RESULTS

Statistical results from the model explaining cycling shares among Upper Austrian municipalities are shown below in table 2. It shall be noted that while the focus of this paper is on determinants reflecting political commitment it is nonetheless crucial to include a comprehensive set of variables covering other thematic fields in order to control for the respective effects and explaining the corresponding variance proportions in the regression outcome variable. Omitting these controlling covariates one would run the risk of falsely attributing non-related parts of variance in y to political commitment while they are in fact due to other factors. In total the current model including 23 predictors accounts for 73.1% of the cycling share among the municipalities (R^2=0.731).

For the purpose of this paper the interpretation of coefficients will focus on the determinants reflecting political commitment to promote cycling on the local level and attitudinal factors. Regarding the former, we tested additional variables for inclusion before committing to the final variant of the model: the number of Klima-aktiv supported projects in the walking/cycling domain positively correlates with y (number of projects: +0.144, no. of projects by municipal area: +0.267, both correlations are significant at a level of 0.001). The subjective evaluation of the state administration on the municipal level of pro-cycling activity (on a scale between 0 and 3; 3 is best) proved to be positively correlated with y (+0.226, significant at a level of 0.001).

Variable	b	ß	t-statistic	Sig.	correlation with y
constant	0.145	-	226.077	0.000	-
ENV_no_frost_days	0.001	0,279	155.739	0.000	-0.310**
ENV_no_snow_cover_days	-0.001	-0,642	-353.809	0.000	-0.317**
ENV_hilliness_settlement_area	-0.010	-0,439	-387.230	0.000	-0.495**
ENV_share_agri_areas	-0.049	-0.403	-228.622	0.000	-0.499**
ENV_ratio_accessibility_pot_cycle_car	0.001	0.384	255.282	0.000	0.612**
ENV_ratio_accessibility_prim_schools_walk_car	0.001	0.206	188,593	0.000	0.494**
ENV_bikeability_routes_schools	0.007	0.043	43.164	0.000	0.410**
INF_share_pleasent_green_roadside	-1.467	0.330	222.058	0.000	-0.338**
INF_density_accident_hotspot	-0.004	-0.152	-149.548	0.000	0.322**
INF_dummy_highway_access	-6.030E-07	-0.053	-57.263	0.000	0.106**
INF_minimum_distance_highway	0.000	-0.190	-169.075	0.000	-0.189**
INF_bike_racks_per_1000_pop	-0.018	0.078	102.668	0.000	0.208**
INF_settlement_proportion	-1.022E-06	-0.122	-78.352	0.000	0.496**
INF_minimum_distance_major_cycle_routes	-0.039	-0.071	-84.454	0.000	-0.323**
INF_share_roads_GT_60kmh	-1.467	-0.079	-90.677	0.000	-0.030**
POP_share_out-commuters	0.000	-0.221	-181.178	0.000	-0.450**
POP_share_milieu_established	0.003	0.120	105.556	0.000	-0.378**
POP_share_milieu_performer	-0.006	-0.362	-168.032	0.000	0.321**
POP_mean_duration_work_commute	0.001	0.090	90.829	0.000	-0.183**
POP_dummy_klimabuendnis	0.002	0.030	37.810	0.000	0.154**
POP_years_participation_fahradberatung	0.001	0.082	98.310	0.000	0.329**
POP_share_workplaces_agri	-0.019	-0.112	-58.277	0.000	-0.531**
POP_purchase_power_index_person	-0.001	-0.152	-98.349	0.000	0.146**
R	0.855				
R^2	0.731				
R^2_{adj}	0.711				

Table 2: Cycling model coefficients, standardized coefficients, t-statistic, significance and correlation with outcome variable (** p < .001, * p < .005).

However, when controlling for the many other determinants affecting cycling modal shares those variables turned out not to be significant in the regression model and have consequently been excluded. The covariates on political commitment remaining in the model are 'POP_dummy_klimabuendnis' (1 if the municipality is

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a member of Klimabündis Austria, 0 otherwise) and 'POP_years_participation_fahradberatung' the number of years since the municipality first enrolled to the fahrradberatung.at programme are significant in the model context and the related coefficients generally suggest that political commitment in favour of cycling has a positive effect on the modal spilt share of cycling trips. More specifically, for every year since the first enrolment to fahradberatung.at the municipality gains an 0.11% increase in cycling share, i.e. after approx. 9 years of taking part in the initiative the cycling share will increase by 1%. Given that the average municipal cycling share is at some 3.5% proves that the programme does have an impact. In a similar fashion the enrolment to Klimabündnis will increase the cycling share by 0.22% constituting a one-time effect. It needs to be stressed here that these figures are incremental meaning that they reflect the net effect of the respective predictor while all other variables are kept constant. In this sense supporting planning actions affecting any of the other thematic areas will add up to an increase in cycling modal share.

In terms of attitudinal variables 'POP_share_milieu_established' (local population share of social milieu established) and 'POP_share_milieu_performer' (local population share of social milieu performers) have the most significant effects on cycling shares. On average approximately 10% of the Austrian population belong to the social milieu established. It represents the performance-oriented and success-oriented elite in middle age groups. With other effects being controlled for in the model, a 1% increase of established milieu among the total local population will increase the municipality's cycling share by approx. 0.3%. Performers being the younger part of the elite can be broadly characterized as being globally oriented, highly efficient, success-oriented with comprehensive skills in IT and business (making up approx. 9% of the Austrian population). Model results indicate that a 1% increase in performer population share will reduce the cycling share by -0.6%. Note that the zero-order correlations with y show reverse signs for both milieus. This is due to the inclusion of other factors which explain large parts of the variance in cycling. Hence the milieu population shares explain unique parts of the variance. Our interpretation is that both milieus share specific patterns of other mobility relevant factors such as choice of residential location or purchase power. Once these variables are controlled for and the other factors are kept constant, the coefficients for the milieu variables express the respective net effects while other things are being equal. While performers have a tendency towards high performance recreational sports they do not have environmentally conscious or cost-conscious mind-sets when it comes to everyday mobility (Dangschat et al, 2012). We even expect rebound effects on active travel shares to be related with performers' recreational behaviour (e.g. using the car to go to cycle routes). In Upper Austria, established milieu shares are over-represented in settlement structures typically associated with low cycling shares (suburban regions, regions with some agricultural land use, etc.). Also they exhibit above average household sizes generally associated with below average cycling shares as well as above average income levels and purchase power. Once we control for some of these effects, the model results show that attracting established population will help increase the local cycling share.

Interpreting the standardized coefficients allows a direct comparison of the determinants' impact magnitude. Table 2 reveals that the effects of political commitment on cycling shares are smaller than those of determinants that are traditionally scope of models, but considerable and within a range that fits our initial theoretical considerations. The beta values for the two social milieu shares show relatively higher, generally suggesting medium-sized effects on the local cycling share.

In a spatial dimension, figure 3 shows a classification of the municipalities based on a model residual analysis exercise. As a first element of an evidence-based decision support system the blue-marked areas indicate municipalities that are currently underutilizing their local potential for cycling, i.e. their respective modal shares are below what could be expected if they made decent use of the local conditions in the three thematic areas relating to the determinant categories described in section 3.2.1 (negative residuals). By contrast the areas marked in orange and red indicate municipalities leading by good example, i.e. their cycling share is higher than could be expected given their local preconditions (positive residuals). Spatial interpretation suggests that no fundamental amount of spatial heterogeneity can be concluded from the map, rather both categories are scattered all over Upper Austria. The same is true for the basic types of settlement structure (rural, semi-urban and urban). However, there are apparent spill-over effects as can be seen from the relative proximity of municipalities in both main categories (these effects might be considered in future updates of the model by including spatial autoregressive terms). From a strategical planning perspective the red/orange areas can be seen as best practice examples and results can be used as follows: if the planning agenda aims at reducing the existing disparities in cycling shares among the Upper Austrian municipalities it should focus on investing into areas marked in blue, starting at the locations marked deep blue. In case the agenda calls for maximizing the investments' marginal modal shift effect towards cycling the actions' spatial focus should be put on locations marked in red and orange.

Results from the added-on municipality survey can be summarized as follows: responses generally confirm the increasing importance of cycling (also e-biking). 27% of the municipal representatives consider cycling to be 'very important' for the local population and 61% state that it is 'rather important'.

However, cycling is mainly seen as a recreational activity. Many municipalities (44%) lack a dedicated administrative staff or other personnel resources specifically responsible for cycling or walking agendas. Among other things this results in bicycle infrastructure expenditure for 2017 being earmarked in only 26% of the municipal budgets, or the availability of bike racks at railway stations or large bus stops being confirmed by only 55% of the respondents. However, the (further) extension of the cycling network and engaging in awareness-raising measures are well supported by the local authorities.

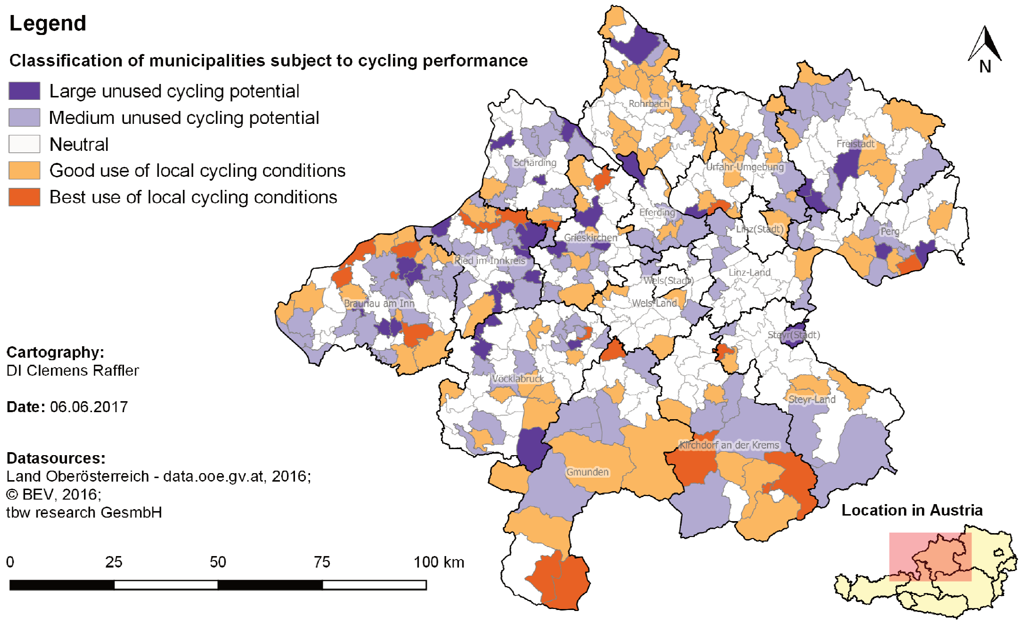

Fig. 3: evidence-based decision support: classification of Upper-Austrian municipalities based on model residuals analysis (Source: own, 2017).

The specific benefits of the survey lie in the mapping of the mood and the documentation of the importance of active mobility among local decision makers. The survey confirms our above model-based findings that a positive attitude among municipality representatives towards cycling as well as enrolling to the Fahrradberatung.at programme are important prerequisites for the sustainable improvement of regional cycling conditions, particularly pertaining to everyday mobility. Overall, the future relevance of local transport mobility is classified as 'rather large' (57%) on a four-stage scale. The analysis of non-participating communities (non-response analysis) is still in progress. A cross-check with other data sources will indicate whether these communities have not participated due to a lack of interest in cycling or for other reasons.

5 CONCLUSIONS

On a general note the added value of our research lies in providing a first systematic approach to model active mode shares on a municipal level in Austria laying the foundations for evidence-based decision making in the walking and cycling domain. Our current model framework is capable of simulating the modals-shift effects of various policy-relevant and planning-relevant domains at local and regional levels.

Our research proves that political commitment in favour of active travel modes in general and cycling in particular can be operationalized. Moreover, it could be demonstrated that political commitment has a positive effect on the relative importance of active traffic modes and that these effects can be quantified. That being said, in the absence of any periodical data it is not without doubt to draw a clear line between cause and effect or ultimately determine the direction of causality: the decision of enrolling to one of the pro-cycling or pro-environment initiatives under investigation might be due to an already existing critical mass of local decision-makers in favour of doing so. In this case a ‘friendly’ climate for active travel modes already exists in the municipality culminating in the enrolment decision. In contrast, taking part in the just mentioned programmes might be the triggering a change of mind-sets among local decision-makers even when local prospects seem difficult at first glance. Most likely the truth lies somewhere in between, it first takes a group of local stakeholders to generate sufficient interest to invest into active travel modes. The initial momentum can then be substantially sustained by joining a state-wide or federal programme. Ultimately when pursuing an increase in active travel mode shares the question of direction of causality is not of prime concern, particularly when facing rather low average cycling shares such as in Upper Austria.

We are aware that our current research resembles a work-in-progress state rather than a fully completed approach as some inputs are yet to be integrated (e.g. survey data on the municipalities’ self-evaluation or investigating spatial spill-over effects). Still as we go forward we regard the current results highly relevant for planning in that many of the determinants examined in our research can be influenced by planning actions and policy-making in a direct or indirect way within different respective planning horizons.

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