Shifting the Urban Modal Mix Towards Cycling: Development of a Typology of Policy Measures

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Abstract

Across the world, an increasing number of cities and municipal administrations is currently developing the mobility-related product- and services portfolio they offer to consumers and businesses towards more sustainable modes such as walking and cycling. While several cities represent role models in this regard, others only tentatively experiment with a broad variety of measures that might or might not be effective in supporting sustainable and/or suppressing less sustainable mobility behaviours. Given a gap in the literature at the interface of marketing, public administration, and urban mobility, this study develops a typology of policy measures to promote cycling as a mode of transport. To do so, we draw on secondary data in the form of city mobility plans and related documentation, resulting in a typology outlining 45 different measures alongside the criteria of benefits and costs. The typology and generalized evaluation of measures provide a framework further empirical work can build on.

Keywords: Urban mobility, sustainability transformation, modal shift

Track: Public Sector and Non-Profit Marketing

1. Introduction

With 57% of the worldwide population now living in urban areas (Statistisches Bundesamt Deutschland, 2023a), cities can contribute significantly to reducing emissions of climate-damaging gases (Kousky & Schneider, 2003). While greenhouse gas emissions in the energy industry, in waste management and in the construction, industry have fallen by more than 50%, emissions in the transport sector only fell by 10.9% between 1990 and 2023 (Umweltbundesamt, 2024). One way to make transportation more climate-friendly is to rely on environmentally friendly alternatives, and this is where the bicycle comes into play.

In the midst of the climate crisis, the bicycle offers an almost neutral alternative to motorized traffic when it comes to transportation-related carbon emissions and air pollution (Brand, Dons, et al., 2021; Brand, Götschi, et al., 2021; Woodcock et al., 2009; Xia et al., 2015). Shifting the modal mix in urban spaces towards cycling offers various benefits, including reductions of greenhouse gas emissions and noise, as well as health-related effects (Mrkajic et al., 2015; Nieuwenhuijsen & Khreis, 2016; David Rojas-Rueda et al., 2011). Given that mobility demands to a significant extent relate to short- and medium distances (in Germany, for example, more than 25% of distances traveled are less than 5 km (Statistisches Bundesamt Deutschland, 2022)), the bicycle can compete with the car when it comes to travel speed, making it particularly suited for urban travel (Jensen et al., 2010).

In an attempt to capitalize on the opportunities, the bicycle offers, a growing number of cities and municipalities worldwide is currently developing the mobility-related product- and services portfolio they offer to consumers and businesses towards cycling. Representing role models in this regard, cities including Copenhagen, Amsterdam and Utrecht, have through comprehensive change programmes succeeded in making the transition towards active mobility and cycling (Hull & O'Holleran, 2014; Larsen, 2017). In Copenhagen, for example, bicycle-related traffic accounts for 35 % of the modal split in 2021, rising from 21% in just 2 years, building a strong reputation and brand image associated with cycling (Technical and Environmental Administration of the City of Copenhagen, 2022). Despite such positive examples, many other cities seem less successful or

even struggle with regards to their transition towards more sustainable mobility. Despite the construction of new cycle paths, the Australian city of Sydney has not yet been able to increase its modal share of cycling, which accounts for 1 percent (Deloitte, 2020; Rissel et al., 2015). Such cities seem to tentatively experiment with selected measures that might or might not be effective in supporting sustainable and/or suppressing less sustainable mobility behaviours.

While a range of studies in the areas of mobility management and sustainability management has identified an attractive mobility offering in the area of cycling as an excellent opportunity for urban environments (Rojas-Rueda et al., 2012; Trpković et al., 2023), little insight exists regarding the broader array of policy instruments that are generally available to city mobility management and municipal administrations. In particular, no research to date has, to the best of our knowledge, developed a typology of such instruments.

On this background, this study attempts to contribute to the literature in two ways. First, based on a review of mobility plans and similar strategy and policy documents of large cities in Germany, we synthesize instruments and practices utilized by cities attempting to increase their modal share related to cycling. Second, based on a total of 99 different measures identified of which 45 were assessed regarding costs and benefits, we develop a typology of such instruments or measures, depicting the broader portfolio alongside the broader dimension's costs.

2. Literature Review

Studies investigating cycling in urban contexts have primarily been conducted in the disciplines of mobility and transportation management, policy making and sustainable mobility, in particular. Here, a range of measures and their impact on bicycle traffic were explored, with the majority of studies drawing on case study approaches. Marqués et al. (2015), for example, have focused on cycling infrastructure to increase the modal share of cycling in Sevilla, highlighting the role of interconnection of routes as a major success factor (Marqués et al., 2015). Félix et al. (2020) have observed that an expansion of the infrastructure increased cycling activity in Lisbon (Félix et al., 2020). For the city of Cagliari, Piras et al. (2022) suggest that the probability of using cycling infrastructure increases for those living near the cycle infrastructure (Piras et al., 2022). Furthermore, their study underlines the importance of policies and long-term strategies. The installation of new biking infrastructure and the expansion of the space reserved for cyclists is constantly in

competition with other participants in road traffic. This results in a conflict for the limited space available in a city. A case study by Lanzendorf et al. (2023) in the city of Frankfurt am Main investigated a policy of the city government regarding parking space management (Lanzendorf et al., 2023). In order to expand the cycle paths, car roads were reduced, the number of parking spaces was reduced and an inner-city area was excluded from car access. The case of Frankfurt am Main displays how inhabitants support the policies if the positive effect on the population is well understandable. Pucher et al. (2010) gathered programs and policies regarding the increase of bicycling in 14 case studies and their findings underline the important role of public policies. Their findings display a combination of infrastructure improvements, bicycle programs, car restrictions and support in the land use management which will result in an increase of bicycle usage (Pucher et al., 2010). With Berlin, Freiburg and Münster, their study included three German cities and their measures. These insights into traffic policies in European cities reveal strategies and success factors for transforming mobility patterns. Notably, a holistic and comprehensive synthesis of the broad array of instruments that are generally available to policy making and public administrations is lacking.

3. Method

To provide as complete a picture as possible on measures considered relevant to increase cycling activity, our analysis contained a sample of 27 of the 50 biggest cities of Germany (Statistisches Bundesamt Deutschland, 2023b). In a first step, measures these cities have considered and taken to increase cycling activity were identified through a manual search across relevant websites and mobility-related planning documents and communications. This resulted in a catalogue of 989 individual cycling-related measures, which were subsequently condensed into 170 distinct measures. These 170 measures were the basis for further a further classification. To classify the measures, our approach draws on indicators cities use to evaluate their measures. Therefore, we analyzed existing action plans collected from the city´s websites in the areas of climate protection, mobility and cycling infrastructure. These plans formulate measures to achieve the goals of climate protection, mobility and cycling infrastructure. In total, 128 documents were identified during the research, covering a time span ranging from 2009 to 2024. Out of the 27 cities included in our study, 12 used a rating system assessing their cycling measures, and publicly communicate their

evaluations through one or more actions plans (e.g., a climate action plan, a mobility actions plan, or both, in some cases). The assessed total of 17 documents in sum presented 118 indicators which were used to evaluate the measures. After consolidation, 35 different indicators were identified. While priority appeared as the most frequently utilized measure (mentioned in 16 out of the 17 documents), we focused our analysis on cost- and benefit-related measures to obtain a more fine-grained perspective. Both, *costs* and *benefits* related to cycling measures were used in nine of the documents. Matching of both cost- and benefit-evaluation scores to the portfolio of measures led to 45 measures which obtained a cost- *and* a benefit score form at least one city (where evaluation scores were available from more than one city or document, an average was calculated). Since evaluations were assessed using various scale levels (from a 3-point Likert scale up to a 7-point scale), all evaluations were harmonized, resulting in a scale from 0 to 1 (with 0 resembling the lowest possible score and 1 the highest possible score for both benefits and costs).

Subsequently, a cluster analysis was performed, resulting in two possible solutions (with 2 or 5 clusters). To obtain a more versatile perspective, the five clusters solution was chosen.

4. Results

Table 1 depicts the resulting cluster solution alongside the number of cycling measures within each cluster, and a categorization in terms of benefits and costs at the cluster level.

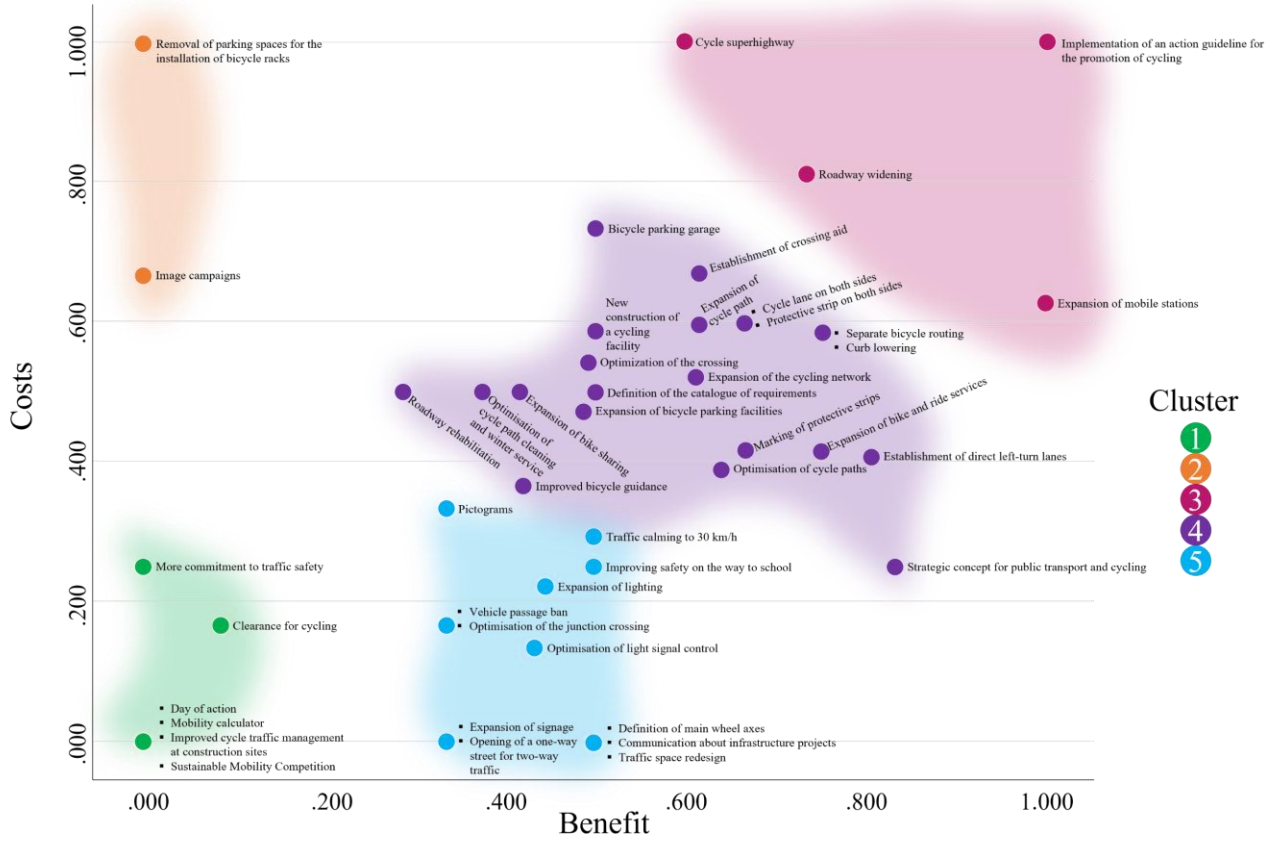
Table 1*:* Cluster Analysis Results

Cluster	Benefits	Costs
I (6)	low	low
II (2)	low	high
III (4)	high	high
VI (21)	medium	medium
V (12)	medium	low

Cluster 1 consists of 6 measures. These include instruments such as a “day of action” informing about and promoting the bicycle, improved guidance at constructions sites and more commitment from the administration to traffic safety. This cluster consists of measures that were given a low benefit score (Ø = 0.014) and a low costs score (Ø = 0.069) on a scale from 0 to 1. An overview of all measures by cluster is shown in figure 2. An The second cluster is described by

low benefits with Ø = 0.000 and costs of Ø = 0.833 holds 2 measures. The measures included are the removal of parking spaces for the installation of bicycle racks and the usage of an image campaign for improving the reputation of the bicycle. The third cluster consists of a benefit level of Ø = 0.833 and costs of 0.859 which resembles both the highest score for benefits and for costs over all clusters. Measures like the construction of cycling highways, the expansion of mobile stations and the implementation of an action guideline for the promotion of cycling were sorted to this cluster. Cluster 4, including measures such as curb lowering for easier traveling on paths, bicycle parking garages and the establishment of direct left-turn lanes, represents the biggest cluster with 21 measures, and was on average evaluated at a benefit level of Ø = 0.588 and a cost level of Ø = 0.512. Measures in Cluster 5 show a benefit score of Ø = 0.420, and a cost score of Ø = 0.130. Examples for cluster 5, which consists of 12 measures, are expansion of street lighting, optimisation of junction crossings and Traffic calming to 30 km/h. Figure 1 depicts all 45 measures with an indication of their cluster, based on the criteria of benefits and costs.

Figure 2: City measures by clusters



Looking at the 12 cities, it can be noted that considerable variance exists with regards to the policy measures they implement and their cluster association. For example, Braunschweig uses 2 measures associated to cluster 1, 0 measures of cluster 2, 1 measure from cluster 3, 2 measures of cluster 4 and 4 measures of cluster 5. For Erfurt, only 5 measures were displayed in the clusters, 1 for cluster 3 and 2 for cluster 4 and 5. Frankfurt, Freiburg, Karlsruhe, Cologne, Munich, Nuremberg, Osnabrück and Rostock target cluster 4 for their most measures. Münster focuses on measures of cluster 2 and cluster 3 with 2 measures each. The only 3 measures from Karlsruhe are in cluster 4. Only 3 cities use measures from cluster 2, namely Nuremberg, Oberhausen and Osnabrück.

5. Discussion and conclusion

The aim of this paper was to develop a typology of measures used by large cities to promote cycling activity. Based on an analysis of city plans in the area of sustainability mobility, our results provide cities with an indication of the actions they can implement to improve the existing infrastructure for bicycles. In order to select measures, the cities are offered two dimensions for costs and benefits. Depending on the benefit level and costs, the cities can make a selection. This study identified that most cities focused on cities that have a medium benefit level and medium costs. A limitation of our study is that out of the total of 170 different measures identified only 45 of them could be integrated into the cluster analysis, given that evaluation scores were not available for the remaining measures. To obtain an evaluation for these remaining 125 measures, we plan to conduct expert interviews with cycling officials, city planners and city administrators.

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