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CARROTS WITHOUT STICKS: CYCLING POLICY OF MEDIUM-SIZED POLISH CITIES

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Abstract
Development of cycling infrastructure is becoming a global trend in urban policies. High congestion, mitigating smog and CO2 reduction have led to the re-birth of cycling as a significant mode of urban mobility. The article aims to present the response of medium-sized Polish cities (ranging from 100.000 to 200.000 residents) to these challenges, which are among the most important problems to solve within the next decades. The study analyses the cycling policy of Polish cities, showing the dynamic increase in kilometres of cycle paths constructed (often built alongside street renovation projects), as well as the boom in bike-sharing programmes. Shortcomings such as the lack of consistency in realisation and varied implementation in different cities and culturally ingrained preference for cars, related to historical experiences of post-communist cities, are also outlined. The Polish approach is the cautious policy of carrots without sticks, in which solutions facilitating bicycle travel are not followed up by deterrents against using cars. As a result, there are no political conflicts and opposition regarding this issue, but the numbers of cyclists (although increasing) is still lower than in the world's leading bicycle cities.

Keywords
cycling policy, cycling infrastructure, active mobility, bike-sharing, post-socialist city, sustainable mobility

Introduction

As suggested by Mikael Colville-Andersen (2018), an urban designer from Copenhagen, a good design of cycling infrastructure contributes to popularising cycling as a way of moving around the city. Well-developed infrastructure is essential for increasing the number of cyclists, ensuring proper behaviour on the roads and popularising the use of bicycles for daily commuting. In order to improve both air quality and reduce traffic congestion, encouraging people to treat cycling as an everyday means of transport is key (Fishman, 2016a). Multiple researches in many disciplines prove that cycling is a low-cost mode of transport for both individuals and public authorities, and it has positive influences on health, safety, personal fitness and the natural environment (Ryley, 2001; Mueller et al., 2018; de Hartog et al., 2010; Rojas-Rueda et al., 2011; Handy et al., 2014); it can also promote the development of more people-friendly urban public spaces (Montgomery, 2013; Gehl, 2010) and become an interesting supplementary attraction for cities' tourism (Roman & Roman, 2014).

Polish cities are still undergoing multiple transformations related to their post-communist past and the necessity to overcome it and modernise the urban tissue. As prior to the late 1980s, cars were relatively inaccessible and perceived as luxury items. Public transport in socialist cities was well developed (Sýkora & Bouzarovski, 2012; Malý, et al., 2020; Hirt, 2013; Wiest, 2012; Stanilov, 2007). Cycling infrastructure was not considered as an important element of cities' landscape and was not commonly built, unlike in Denmark or the Netherlands, the leading countries in terms of cycling (Wardlaw, 2014; Harms et al., 2016). Being neglected throughout the post-1989 years, the development of good cycling infrastructure has become another challenge for Polish cities to overcome. The issue had become more and more pressing as the number of cars in Polish streets grew rapidly, such as in other post-communist countries (Barnfield & Plyushteva, 2016; Krisjane et al., 2012). Therefore during the modernisation process – apart from renovating and building new roads, renewing public transport, revitalising neglected neighbourhoods and refurbishing public buildings – bicycle paths also have started to play a significant role in spatial changes. Another element of the ongoing transformation of Polish cities is the transition to sustainable transport and to cyclable cities, as the current bike-share in urban mobility in Poland averages only about 3% of travellers. Encouraging more cycling amongst a population is a chance to reduce congestion, noise and smog – some of the most acute urban problems and particularly bothersome in Polish cities – and, at the same time, to make urban mobility more environmentally friendly (Buehler et al., 2017; Denis et al., 2021; Muñoz et al., 2016; Satterwaite, 1997; Skórska & Kiepas-Kokot, 2011; Liszka, 2013). This is related to a global trend of making towns more cycling-friendly, in which a number of cities have successfully undergone a difficult process of developing a network of bicycle paths despite strongly car-oriented urban design and infrastructure (Buehler & Pucher 2011; Caufield, 2014; Pucher et al., 2011; de Boer & Caprotti, 2017; Marqués et al., 2015).

The objective of this study is to examine the cycling policies in selected Polish cities, aspiring to develop cycling infrastructure and increase the participation of cycling in city mobility. This research seeks to understand how the mayors and administration managers plan and implement the construction of bicycle paths, including the types and forms are being built. Another aspect considered in this study is whether the cycling infrastructure is built as a part of bigger construction or renovation works, as separate projects dedicated

specifically to this issue or merely as a designation of existing sidewalks to cycling paths. A related issue is how the cyclists are treated in the areas of high-density housing. Another point of the analysis is the intermodality of bicycles and their coordination with other means of public transport. Finally, the systems of bike-sharing, their business model, number of stations, bikes and users are examined.

Five medium-sized Polish cities of 100,000 to 200,000 inhabitants – Olsztyn, Opole, Rzeszów, Toruń and Zielona Góra – were chosen for the case study. They are located in different parts of the country, but all of them are regional capitals, are university cities, are important economical centres and share a common spatial structure characterised by compact, densely built historical centres and suburban areas with a more dispersed building density. Consequently, the selected cities have a similar structure of urban mobility. The idea behind this selection was not to pick the cycling champions, but to investigate how cities similar in size, area and economic potential develop their cycling policies. In terms of their area and distances, the selected cities are potentially very convenient for cycling for all purposes.

Review of the to-date knowledge

The main factors that influence urban mobility are increasingly complex and dynamically changing, thus research on this topic should consider the social, cultural and economic context of a local community, individual mobility patterns and the complexity of transport choices. No less important are the relations between transport policy and land-use, as well as those between urban policy makers and residents who use the infrastructure. The best practice examples offer a useful direction for policy-making, but cannot be easily copied without concerning the local specifics (Miciukiewicz & Vigar, 2012). Urban mobility cultures are determined primarily by building density, diversity and spatial design, amongst other factors. Socio-economic factors, such as incomes, unemployment rate or age, determine the means of transport people can afford. Another element is the infrastructure, which makes specific types of transport comfortable and accessible. Users of different modes have also their own perceptions and can perceive the public transport as poor and thus avoid using it, or consider bicycle to be a means of recreation rather than a way of daily commuting (Klinger et al., 2013).

As is the case of walking-friendly cities, cycling infrastructure has to be attractive in its form and quality (Southworth, 2005). It can attract more cyclists, particularly when it has been designed with focus on connectivity, continuity, wide space, segregation from traffic and provision of safe parking areas (Hunt & Abraham, 2007; Hull & O'Holleran, 2014). Lack of safety, vandalism and insufficient facilities discourage people from cycling, while the convenience of efficient and flexible movement is one of the most important factors that make people choose this mode of transport (Fernández-Heredia et al., 2014). Achieving this is usually the most difficult challenge for cycling policies and requires a long-term vision, but it has potential long-term benefits such as better health of residents and lower infrastructure expenses for cities (Handy et al., 2014).

Pucher et al. (2010) stress the crucial role of public policies in improving the conditions for urban cycling and increasing the number of cyclists. The essence of any cycling policy is the planning and implementation of different infrastructural elements into the cities' landscape which make cycling more convenient and safe. These elements include

off-street bicycle paths, on-road bicycle lanes, contraflow, shared bus-bicycle lanes, signed routes, boulevards, cycle tracks on the roads, bike boxes and dedicated traffic lights at intersections. Spaces for cyclists can be coloured or otherwise marked to increase their visibility. This can be supplemented with traffic calming and home zones in residential areas, or temporarily car-free zones in main streets. No less important are places to leave bikes – racks, parking spaces and stations, as well as showers at workplaces. A soft element of cycling policy is the promotion of activities ranging from training to action and events. Bicycle use should also be integrated with public transport by allowing persons to transport their bikes on buses and trains, or by providing bike-and-ride facilities (Martens, 2007). Bike-sharing has also become a part of cycling policy and an element of public transport. On the one hand it gives an opportunity to promote cycling, and on the other it provides quick and positive political gains (DeMaio, 2009; Fishman, 2016b; Kwiatkowski, 2018). The countries with the greatest share of bicycle trips, e.g. Denmark, the Netherlands or Germany, have developed their cycling policies with a view not only to improve the number of cyclists and their safety, but also to make using cars more difficult and inconvenient. Those policies have been implemented since 1975 and supported by central and regional governments. Apart from building infrastructure, this process included changes in law (regarding right of way), as well as educational and promotion campaigns among all age groups (Pucher, 1997; Rietveld & Daniel, 2004; Pucher & Buehler, 2008; Harms et al., 2016).

Buehler and Pucher (2011) say there are seven crucial elements to run successful cycling policies: (1) it is necessary to implement the controversial policies in stages; (2) such policies should adapt to changing conditions in a flexible way; (3) they must include a multi-modal approach with incentives and disincentives; (4) they should be integrated with land-use planning; (5) they should involve citizens; (6) they must be supported by higher levels of government; (7) they should focus on long-term goals and not strive for quick successes. Fast development of a coherent network can be an important factor helping not only to popularise cycling but also to introduce it as yet another means of urban transport (Marqués et al., 2015). A cycling policy can be carried out not only through top-down but also bottom-up processes of governance as the civil society groups and activists often engage in this process. Collaboration of government and non-government actors can produce marked effects, e.g. in promotion of cycling (Balkmar, 2020). A cycling policy needs to find a political window of opportunity, in which even the most controversial concepts can be accepted by the local community. Advocacy can be helpful in the process, but it also can hinder the process, therefore building long-term support is crucial. Involvement of political champions and leaders without communicating with the stakeholders may be insufficient (Weber, 2017).

Wilson and Mitra (2020) determine four strategies of implementing the policies of developing the cycling infrastructure: (1) "piggybacking" on public work projects, in which bicycle paths are constructed as a part of bigger rebuilding and resurfacing of roads; (2) using external grants and funding, which helps to reduce the costs of an investment for a city and is also a powerful means to persuade the political opposition; (3) pre-emptively re-routing cycling infrastructure, aimed at building new cycling infrastructure on the roads where it is not controversial and will not meet a strong opposition; (4) finding a political champion in the municipal council who will be able to persuade the governors to put the infrastructure project into effect.

Piatkowski et al. (2019) analysed the "carrots and sticks" strategies employed in developing cycling infrastructure and assessed their effectiveness. There are three types of intervention. The first is to enable active modes that encourage cycling ("carrots"), e.g. building bike lanes and cycle tracks. The second is to deter driving to make it less comfortable ("sticks"), e.g. through traffic calming and parking pricing. The third is the combined approach, in which development of new cycling infrastructure goes together with deterrents to driving, with an aim to make active transportation attractive and cars unattractive. A significant element of a cycling policy involves leveraging the opportunity when resources for this particular aim are available. No less important is a shift in priorities to developing more cycling paths than roads for cars. The deterring activities usually are controversial and make picking battles necessary, as conflicts are common. Similarly, improvement of quality of the routes is a way to gain support for cycling as a transport mode. This is necessary, because the political process leading to the development of cycling infrastructure can be very difficult, painful and have the potential for causing conflicts as residents accustomed to travelling by car often refuse to accept the expansion of cycling infrastructure at the cost of car parks or traffic lanes. In case of controversial solutions, favourable media coverage is essential for the social acceptance of changes (Siemiatycki et al., 2016). Apart from political opposition, barriers to development of cycling infrastructure stem from lack of resources, institutional problems such as organisational culture, expertise and tools available, and attitudes of stakeholders, including the public, business and media (Aldred et el., 2019).

Harms et al. (2016) presume the outcomes of cycling policy are hard to measure as the factors such as the percentage of trips by bicycle can be considered as results of short-term policies, while car ownership or improved road safety can provide a longer perspective. Factors like health, local economy or general liveability depend on many other issues besides cycling. They also determine the policy input, the "orgware" understood as conditions and framework in which a policy is created, and the policy output which includes hardware (infrastructure) and software (education, communication and information). The most effective policy measures are the ones that simultaneously improve the cycling infrastructure and decrease the attractiveness of cars. What is crucial in terms of "orgware" is a high degree of policy adaptability, as the possibilities to monitor it (also with experimental methods), as well as citizen participation and presence of strong leaders.

Research methods

To investigate the cycling policies, the selected cities' documents were analysed with desk research method. The first step of the research process was to find the information on the general conditions of cycling in Polish cities, so the information on weather, spatial layout and topography was collected from internet sources and maps. Statistical data about cities' populations, areas, number of students and number of bikes and cars in Polish households was gathered from the Bank of Local Data by Statistics Poland and its other reports. This source also records the information on the kilometres of cycling paths built in Polish cities, which was used to follow the dynamic of their development. The data on the psychological aspects, showing Polish people's opinions and attitude to cycling was gathered from the Centre for Public Opinion Research (CBOS), which conducts surveys on most relevant social issues.

The second stage of research was the qualitative analysis of the components of cycling policy in the cities selected for case studies. Their development strategies were analysed to examine the importance of cycling infrastructure in the city development (5 documents). The third stage involved the analysis of cities' cycling policies. If such documents had been issued, their content was analysed with respect to the diagnosis, the main objectives and challenges such policies faced (2 documents). If a city had not implemented such a document, other resolutions containing mobility issues were examined (5 documents). Supplementary material came from the cities' official websites, from the on-line Bulletin of Public Information (BIP) (which contains information on expansion of cycling infrastructure, bicycle maps and route planning) and from the departments in the city offices responsible for cycling-related issues. These sources were used to gain the information on standards for constructing the cycling infrastructure, racks and parking lots, as well as on cycling officers and participation of local communities. To gather information on the various types of cycling paths and their surface materials, reports and registers provided directly by city clerks were used (5 documents). The documents of city councils (session protocols) and local press offered an insider's view on the debates on urban cycling, and on the level of acceptance or disputes regarding this issue. Part of the information came directly from the city clerks, mostly in cases when the relevant data was not available in published documents and web sources. The fourth stage focused on the integration of cycling with public transport and on bike-sharing, with the analysis based on the regulations of public transport (5 documents), and the web pages of bike-sharing providers in each city (5 web pages). The time period of research and data collection were the years 2020 and 2021.

Results

Conditions for cycling in Polish cities

Polish cities can be classified as auto-oriented and transit cities, due to the high number of car trips and use public transport. They still are before the transformation into cycling cities, in which they will become more cycling friendly (Klinger et al., 2013). The number of cyclists in cities is determined by several factors: built and natural environments, socio-economic dimension, psychological dimension and effectiveness of travel (Heinen, van Wee & Maat, 2010). These five elements form the foundation for designing cycling infrastructure and the policies for its development. Considering them will help one understand the conditions of developing the cycling infrastructure in Poland and dynamics of this process.

The way cities were developed during the communist era (Enyedi, 1992) created a convenient space for cycling infrastructure, as the pre-WWII model of constructing dense quarters of buildings was abandoned. New settlements from prefabricated elements were constructed in some distance from the city centre in the form of detached buildings. Therefore the characteristics of the built environment of most Polish cities today are threefold: (1) relatively small old towns with very dense building patterns and a network of very narrow streets; (2) residential quarters from the 19th and early 20th century that still have rows of tenement houses, but with wider streets and avenues; (3) post-1945 districts

of blocks of flats constructed mostly from prefabricated elements. This makes the built environment convenient for localising the bicycle paths.

In terms of distances and changes in elevation, Polish cities are bicycle friendly: the radius from the city centre to the furthest outskirts in the five cities examined as case studies ranges from 5.5km to 12–15km. In cities with large territories created by amalgamation with surrounding municipalities, the radius within which the urban space is densely inhabited usually does not exceed 10km. The existing studies prove that the optimal distance to cycle in the cities is in the range of 2–8km, and bicycle share decreases for distances above 5km and even more if they exceed 10km (Ryley, 2001; van Wee et al., 2006). Considering the natural environment in Poland, the landscape is quite cyclist-friendly, as most of the country (including the cities) is flat, with some hilly areas (cf. Table 1). What is more problematic is the weather and seasons, as the winters are traditionally cold and snowy, and autumns are windy and rainy, although milder in recent years. In late autumn and winter months the daylight time is also much shorter, which may be seen as an obstacle to cycling (Gatersleben & Appleton, 2007). Therefore the cycling conditions are strongly correlated with weather and seasons, as snowfalls, slippery roads and low temperature, often below 0 °C, discourage potential cyclists from riding. Cycling rates in other countries with hard winter fall significantly at that time, such as in Sweden. However, for some cyclists this is not necessarily a discouraging factor, although people mostly cycle in spring and summer (Guo et al., 2007; Dill & Carr, 2003; Bergström & Magnussen, 2003; Böcker, Dijst & Prillwitz, 2013).

Table 1. Environmental conditions of Polish cities (2019)

	Olsztyn	Opole	Rzeszów	Toruń	Zielona Góra
Inhabitants	171,979	128,035	196,208	201,447	141,222
Area (km2)	88	149	126	116	277
Students	19,605	19,202	36,819	22,224	9,490
Building environment	Centre: dense building pattern; outskirts: blocks of flats with broad avenues leading to them				
Rainfall (lowest and highest monthly average)	28 mm (Feb) 81 mm (Jun)	30 mm (Feb) 83 mm (Jul)	28 mm (Feb) 89 mm (Jul)	22mm (Feb) 77 mm (Jul)	30 mm (Feb) 70 mm (Jul)
Temperature (°C) (lowest and highest monthly average)	-5.4 (Jan) 18.9 (Jul)	-1.9 (Jan) 17.8 (Jul)	-5.9 (Jan) 18.6 (Jul)	-3.0 (Jan) 17.9 (Jul)	-1.9 (Jan) 18.6 (Jul)
Topography	Slightly hilly	Flat	Flat, hilly in some spots	Flat, hilly in some spots	Distinctly hilly
Centre-borders radius (km)	6.5	9 (12.6 northward)	5.5 (11 southward)	5.5	10 (northward) 15 (southward)

Source: Bank of local data, 2021, Statistics Poland, bdl.stat.gov.pl/BDL/start; pl.climate-data.org; maps.google.com

With regard to socio-economic conditions, it has to be noted that the material situation of Polish citizens improves constantly, which results in the high number of cars owned.

According to Statistics Poland (GUS, 2020) in 2019 there were 634.7 cars per 1000 inhabitants; however, this number is questioned as many old or non-existing cars are not de-registered. It is estimated that the real number is around 486 cars per 1000 inhabitants (Auto Świat, 2020). Altogether, 67.8% of households own a car, yet the bigger the city, the lower the number is (57.4% in the largest cities) (cf. Table 2). This shows that a car has become the most important means of transport for Poles, also due to degradation of public transport, especially in smaller villages. This results in high incidence of car-commuting to cities, and regular commuters from the city-adjacent areas are responsible for high congestion.

Bicycle ownership is less frequent (57.3%) in families without children than in those with children. The larger the family, the more likely they are to have a bicycle – 78.6% of households with three and more children own a bike. In terms of employment, 68.0% of employed people, 72.1% of self-employed and 47.3% of pensioners and retirees own a bicycle. Cycling is a popular means of transport in rural areas, as 86.4% of households have at least one bicycle. Considering education, bicycles are most popular among people with vocational education (65.2% households), followed by tertiary (63.0%) and with secondary or lower education 52.7% (GUS, 2020).

Table 2. Bicycles and cars in Polish households

Year	2000	2005	2010	2015	2019
Bike (% of households)	60.1	62.4	64.3	62.2	61.4
Car (% of households)	47.2	47.3	59.5	62.8	67.8
City population (thousands)	under 20	20–99	100–199	200–499	500 and more
Bike (% of households)	66.9	60.0	44.5	44.0	45.0
Car (% of households)	68.8	65.2	61.5	58.9	57.4

Source: GUS, 2020.

From the psychological point of view, the problem is that the bicycle is traditionally not considered as a means of transport and, as public transport was for a long time unreliable, the affection for cars is very strong. The culture of cycling has not taken roots in popular consciousness yet; commuting in this way in particular is still not a common thing (Aldred, 2010). A survey done for 2015 proved that only 10.9% of Poles take up cycling and only 7.6% do it frequently, which, compared to states like Denmark or the Netherlands, is a very low figure. The majority of bicycle commuters are people who do not have any other alternative, usually in rural areas (Biernat et al., 2018).

According to Public Opinion Research Center (CBOS) which regularly conducts a variety of public opinion polls on carefully chosen sample groups, for 2018 a car was selected as the most popular means of transport (74%), but bicycle was chosen as the second

most popular mode (32%), ahead of public transport (28%) (more than one mode could be chosen) (CBOS, 2018). In a 2017 survey considering accidents and road safety, 68% of respondents declared that they cycled at least occasionally, which is an increase compared to 2007 (59%). A vast majority (80%) of Polish cyclists felt safe on the roads (21% safe and 59% rather safe), which is also an improvement, as in 2002 this figure was 69% and 74% in 2007. The research showed also that Poles felt equally safe walking as cycling on the streets (CBOS, 2017). Poles perceive cycling as a pro-health activity; in a 2016 survey 27% respondents mentioned cycling (together with walks) as their favourite leisure activity, 11% declared to do it daily and 34% at least once a week (CBOS 2016).

Table 3. Development of cycling paths in Polish cities

City	Poland	Olsztyn	Opole	Rzeszów	Toruń	Zielona Góra
Overall length in km						
2011	5,728.8	31.0	28.1	65.9	61.0	38.4
2013	7,726.0	42.0	37.4	95.5	78.7	47.5
2015	10,797.2	72.5	66.8	120.0	97.0	62.2
2017	12,138.2	76.0	75.2	151.0	110.0	65.9
2019	15,538.7	101.0	93.5	162.4	123.0	68.0
2021	18,509.9	102.0	108.8	168.1	147.0	84.3
Increase 2011–21 (%)	223.1	229.0	287.2	167.5	140.9	119.5
Km per 100km^2						
2011	1.85	35.1	29.1	56.6	52.7	65.8
2013	2.47	47.5	38.7	82.1	68.0	12.8
2015	3.45	82.1	69.2	103.1	83.8	22.3
2017	3.88	86.0	50.5	125.4	95.0	23.7
2019	4.97	114.3	62.8	128.2	106.3	24.4
2021	5.92	115.4	73.0	130.3	127.0	30.3

Source: Bank of local data, 2021, Statistics Poland, bdl.stat.gov.pl/BDL/start.

With a very high number of cars in Polish cities, the effectiveness of bicycles in terms of travel time is comparable to cars and public transport, as the distances are not very long. Even despite the inconveniences of absent or incomplete infrastructure, the effectiveness

of travel and getting from point A to point B can be rated as high. What can discourage from using bicycle in daily commuting though are the relatively low ticket prices in public transport (about $0.90/single ride) and of petrol ($1.50/l).

Polish legal regulations on cycling can be seen in two dimensions: firstly, the status of cyclists on the roads and participation in the traffic, secondly, the technical standards for constructing and maintenance of cycling paths. Cyclists should ride on a cycling path; when this is not possible they are allowed to use roads on which they are treated like other vehicles. Thus cyclists do not have any privileged status in traffic regulations. It is similar in residential areas, where a cyclist is treated as an ordinary driver who should not go faster than 20km/h. The cars are not allowed to park on the cycling paths and they are obliged to stop at the cyclists' crossings. Cyclists are allowed to use footpaths, on the condition that they are looking after a child, there is no cycling path, the footpath is at least 2m wide and the road along allows to ride faster than 50km/h (Ustawa, 1997).

The development of cycle paths has been very dynamic over the last decade. The number of kilometres has tripled. The length of cycling networks is improving, both measured in kilometres and in kilometres per 100km² (cf. Table 3). In the cases of Opole and Zielona Góra, the falling numbers per 100km² can be explained by the expansion of the cities' borders due to the incorporation of large rural territories of the neighbouring municipalities. Polish cities in general have good preconditions for cycling but, as mentioned, the cycling infrastructure remains underdeveloped for different reasons. The research done in various places worldwide proves that a well-developed infrastructure encourages more cycling (Dill & Carr, 2003; Panter et al., 2016; Félix et al., 2020).

Outcomes of cycling policies

Polish cities vary in their approaches to cycling policy. The analysis of strategic documents of 39 Polish cities with over 100.000 inhabitants shows that cycling has become an issue included in general development strategies for 37 of these cities. However, only 20 cities have implemented a specific document dealing with cycling infrastructure. Among 18 regional capitals, 9 cities implemented a document containing a cycling policy, and three more cities enacted a document with a general plan for developing cycling paths (Kwiatkowski, & Szymańska, 2020). Among 66 county cities, 36 (including 11 of 18 regional capitals) have set up a special team or designated a clerk responsible for the coordination of different activities in this area. The main activities regarding cycling policy involve the development of bicycle paths, which should improve the comfort and safety of cycling. Another very popular trend is bike-sharing, which is developing rapidly in many places, both the largest metropolises and smaller towns (Gadziński & Goras, 2019).

Polish cities have a rather conservative approach to cycling policy, which can be described as a "careful one". There is a political consensus on developing cycling paths, but none of the examined cities combined development of cycling infrastructure with making car-use more expensive and/or difficult, or with prioritising bikes over cars. Cycling is seen as supplementary to cars and public transport (and not priority over them); therefore cycling projects do not generate conflicts or incite great disputes and debates. All the analysed cities acknowledge it in their development strategies, which indicate though that the main challenges in terms of cycling policy include improving connectivity and con-

structing a coherent network of paths (Olsztyn, 2013; Opole, 2019; Rzeszów, 2016; Toruń, 2018; Zielona Góra, 2012).

Among the examined cities, Olsztyn and Toruń introduced separate strategical documents for developing their cycling infrastructure. They contain both the audit of existing infrastructure and ideas for the new projects (Gabory et al., 2019; Grochowski, & Schneider 2017; Toruń, 2007; 2020b). The defined objective is that 10% of city travels should be made by bicycle; although in itself it is not a very outstanding figure, but compared to the current 3% of travels, it would be a notable change. Other cities include issues related to cycling infrastructure into other documents, e.g. concerning the development of public transport (Opole, 2015; 2020a; Rzeszów, 2021; Zielona Góra, 2014; 2017). Three of the examined cities introduced their own standards for constructing the cycling infrastructure, all based on Dutch CROW-standards (2007) (Opole, 2012; Olsztyn, 2016; Toruń, 2005). All employed a bicycle officer in their city offices. However, not permanently in some cases, such as in Olsztyn where the holder of this post resigned after eight years of work, complaining of not being treated seriously enough and being marginalised in the city office (cf. Table 4).

None of the examined cities gave priorities to cyclists in planning their investments, nor did they privilege them in the existing solutions. Cycle paths are usually built in two forms: together with other infrastructure (e.g. during the renovation or building of roads, bridges, pavements, tram lines, or parks and recreational facilities) or through dedicated projects to build cycling infrastructure. In many cases the cities cooperate with the neighbouring counties and municipalities and develop longer routes. They also develop routes through picturesque parts of the countryside to create longer trips, sometimes repurposing structures like old railway tracks. Many projects are carried out using tools of public participation, e.g. in Olsztyn the construction of the "*Łynostrada" cyclovia* was selected in participatory budgeting, and Toruń organised a public consultation where the residents could pick the locations of bicycle racks. The solutions are also consulted with local cycling associations, who also organise "critical mass rides" through the streets of the cities to promote cycling (Blickstein, & Hanson, 2001).

The next examined element were types and forms of cycling paths. The most popular type of path is a twin-path with the pedestrian pavement, in which the block-paved walking part runs adjacent to the asphalt bicycle part. Also shared-paths with pedestrians are frequent, especially in green areas and less frequented parts of the city. Contra-flow schemes are becoming more and more popular, especially in high-density city centres and home zones are implemented in residential areas, particularly in districts of blocks of flats. Cycle lanes are a rare solution, and there are hardly any cycle tracks and buffered bike lanes.

Table 4. Cycling policies in Polish cities

	Olsztyn	**Opole**	**Rzeszów**	**Toruń**	**Zielona Góra**
Cycling policy document	2009	NO	NO	2007	NO
City strategies	YES				
Bike share in urban mobility (%)	No data	No data	3%	3.36%	No data
Bike share goal (%)	Not defined	Not defined	10%	10%	Not defined
Standards for cycling paths	2009	2012	NO	2005	NO
Dedicated unit of city office	Cycling officer (2009–17)	Team for cycling infrastructure (since 2011) Cycling officer (2012–19)	none	Team for Bicycle Communication (2005) Cycling officer (since 2021)	Cycling officer 2010–12
Priority for bicycles in planning investments	NO				
Priority for bicycles in existing solutions	NO				
Building cycling paths alongside other investments	YES				
Cycling paths as separate projects	YES				
Opposition	NO				
Participation	Public consultation with international partner cities Cycling projects in participatory budget	Consultation with neighbourhood councils	Consultation with cycling associations	Consultation of cycling infrastructure development project	Consultation with cycling associations
Advocates of cycling policy	Cycling associations				

Source: Own research.

The surface of most of the paths is made of asphalt as this is the most suitable for cyclists. The second most popular material are paver blocks, laid in a form of a flat surface. Older paths made from this material have small gaps; this makes the surface less comfortable for cyclists, so paths are not no longer built this way. A problem of Polish cycling routes is their insufficient marking. Usually the signs are painted on paths, and bicycle crossings with the streets are tinted red to be more visible. Vertical traffic signs for cyclists (either those regulating the traffic or providing general information) are very rare (cf. Table 5).

Table 5. Types and surface of cycle paths

	Olsztyn	**Opole**	**Rzeszów**	**Toruń**	**Zielona Góra**
Type					
Cycle paths	64%	29%	No data	79%	No data
Cycle lanes	2%	-	No data	2%	No data
Multi-use paths, shared with pedestrians	31%	62%	No data	15%	No data
Contra-flow cycle scheme	YES				
Surface					
Asphalt	43%	42%	Dominant	77%	64%
Paver blocks	17%	48%	30%	18%	33%
Mixed asphalt/ paver blocks	25%	1%	-	-	-
Other	14%	7%	-	5%	2%
Signs	Pavement markings				

Source: Own research based on reports provided by the city offices.

What is still missing, and develops less dynamically, are bike parks. In the examined cities some projects have been carried out, but not on a larger scale. Bicycle racks are installed, and some cities developed their design, corresponding to the logo of the city (Olsztyn, Rzeszów), or differentiated between the ornamental racks in the city centre and ordinary ones in other neighbourhoods (Toruń). The complex process of bicycle-public transport integration has no priority, as bicycle parks are installed at renovated train stations, but not necessarily at bus stops. Bikes are allowed on trams and buses in all the examined cities although in Opole and Zielona Góra it has been limited to outside the peak hours. Other cities allow one to carry the bikes on public transport and do not require any additional fee or ticket (in Toruń it has changed since COVID-19 pandemic). Bikes are to

be placed in the dedicated space and in a way that does not disturb other travellers (cf. Table 6) (Olsztyn, 2014; Opole, 2020b; Rzeszów, 2015; Toruń, 2017; Zielona Góra, 2018).

Intersections are not rebuilt in a bicycle-friendly manner – neither in terms of prioritising bicycles nor right of way nor green waves at traffic lights. There are some bike-boxes designed, but not on a broader scale as bike lanes are not a commonly used solution (Ciesielski, 2014).

Table 6. Additional infrastructure and integration of cycling with public transport

	Olsztyn	**Opole**	**Rzeszów**	**Toruń**	**Zielona Góra**
Parking	Smaller facilities, at various public places	Two big facilities	Two big facilities	Several smaller facilities	One big park at the central bus stop
Racks	Special leaf design	No special design	Clover design introduced in cooperation with business and NGO	Ornamental and standard U-shape, over 5000	No special design
Bikes allowed on public transport	YES	YES (Outside peak hours in buses marked with bike sign)	YES	YES	YES (Outside peak hours)
Bike ticket/fee	NO			$1,85	NO
Green waves at intersections	NO				
Priority for cyclists at intersections	NO				YES (2 intersections)
Bike boxes	YES	NO	NO	YES	YES

Source: Own research.

In Poland bike-sharing systems are an integral and important part of cycling policy, which develop very dynamically. In their analysis Shaheen, Guzman and Zhang (2010) noted that in 2010 there was one bike-sharing system in Poland, with 100 bikes and 13 stations. Since then such projects mushroomed and in 2019 there were 96 systems, both in the largest Polish cities, and in smaller towns, offering over 26,000 bikes (Mobilne Miasto, 2020; Kwiatkowski, 2018). Furthermore, bike-sharing in Poland started already with the third and fourth generation of bicycles, with distinguishable designs, docking stations, IT solutions (e.g. GPS-tracking), and mobile applications for check-ins and check-outs.

The bike-sharing business model in the Polish cities is a combination of "providers for profit" and "local governments and public authority". The projects are carried out in public-private partnership mode, in which the commercial provider establishes the system of docking stations and supplies bicycles, their servicing and repairs, as well as the management of hiring bikes to the people. Local government input is public subsidies, which

are the most important financial component (up to 70% of provider's costs). The scale of subsidies depends on the size and scope of the system (DeMaio, 2009; Shaheen et al., 2010). This has already brought some implementation problems, e.g. in Toruń bike-share services were unavailable for a year when the city failed to settle the tender and sign a contract with an operating company. Because of COVID-19 pandemics Olsztyn and Rzeszów decided to abandon their bike-sharing system, citing high costs and sanitary problems as the reason. Opole did the same because of declining popularity. This decision evoked criticism and protests of residents (Jaszczanin, 2020).

Table 7. Bike sharing systems in Polish cities

	Olsztyn	**Opole**	**Rzeszów**	**Toruń**	**Zielona Góra**
Operation	2018–19	2012–2021	Since 2010	Since 2014	Since 2018
	Mar-Nov	Mar-Nov	Mar-Nov	Feb-Dec	Mar-Nov
Bikes	210	280	20 (e-bikes)	400	400
Stations	20+virtual stations (return without docking)	18	No docking-system	45	40
Registered users (thousands)	25	5	No data	17	35
Hires (thousands per year)	200	23.5	22.8	145	137
Mode	PPP				
Operator	Orange Roovee	2012–18 Nextbike 2019–21 Geovelo	2010–17 Romet Rental 2018- Blinkee.city	2014–17 Romet Rental 2019- BikeU	Nextbike
City subsidies per year (thou. $)	141.4	205.2	34.4	457.4	363.6
Free usage	30 min	20 min	none	30 min	20 min
Fee	1.3¢/min	1.3¢/min	26.4¢/30min	26.4¢/20–60min 79¢/60–120min $1.32/120–180min $1.85/every next hour	0.53¢/21–60 min $1.05/every next hour
Participation in placing stations	YES	YES	-	YES	YES

Source: zielonogorskirowermiejski.pl; torvelo.pl; opole.geovelo.pl; blinkee.city/pl; roovee.eu.

Bike-sharing systems usually operate from March to November, with a break for winter. Although they are a relatively new service (the oldest system was established in 2010), they have gained popularity, which manifests in the numbers of registered users and hired bikes. The docking stations were placed with the participation of residents, who could point the spots in which they were most needed. Rzeszów developed a system without docking stations. The usage is partially free of charge, usually for the time of first 20–30 minutes; afterwards a cyclist has to pay for each additional minute, or longer intervals. Usually there is an additional starting fee and a special tariff for tourists (cf. Table 7).

Discussion

Polish cities dynamically develop cycling policies, implement modern solutions and follow the standards and best practices of constructing the cycling infrastructure (Skórska & Kiepas-Kokot, 2011; Liszka, 2013; Ciesielski, 2014). City planners introduce cycling as an important part of low-emission, ecological and healthy means of commuting, but also as a tourist attraction, particularly when cities are located in picturesque landscapes. For this purpose, Polish cities cooperate with neighbouring municipalities and counties. The regional authorities also prepare development plans in a broader, regional perspective (Sulmicki & Pawłowski, 2019). Cities develop their cycling policies by themselves, but in compliance with general EU guidelines and Polish legal acts that set standards for constructing cycling infrastructure (Ciesielski, 2014; Ministerstwo Infrastruktury, 2019).

All the examined cities have put a lot of effort into developing cycling paths, and it is at present the main focus of their cycling policy. This contributes to increase in bicycle travels in the cities, but these numbers are still far lower than in the leading cycling cities in Europe. For example, in Toruń a cyclist counting confirmed a substantial growth of the number of bicycle users in the period of 2005–2016 – of about 76%, and up to 164% in the spots where a new cycle path was constructed. Interestingly, the participation of women varied from 20.5% to 47.2% on weekdays in different parts of the city and averaged at 36% for the whole city; only 7.2% of cyclists wore helmets (Grochowski & Schneider, 2017). In Rzeszów a similar counting made by the local association "Rowery.Rzeszow.pl" showed an overall increase of 28% – 31% during the morning peak and 24% during the noon peak.

Most of the cycling projects are implemented in an enabling way, providing carrots, but without sticks to deter the use of cars (Piatkowski et al., 2019). The investments often seize the window of opportunity as well – usually the projects are supported with EU structural and investment funds, which makes an additional impulse to launch them. Cycling policies do not generate a potential for conflict, as they are not directed against cars, attempting instead to create a supplementary solution and an alternative more than a replacement (Siemiatycki et al. 2016). In terms of Wilson and Mitra's (2020) typology of ways of developing the cycling infrastructure, Polish cities extensively use the model of piggybacking on public work projects, in which bicycle paths are built during renovations of streets and roads. In two of the investigated cities the local councillors took the role of political champions, making cycling one of their main agendas and working actively in its favour.

Cities take care to integrate transport with land-use planning as the new transport projects involve cycling paths and facilities, but on the other hand spatial planning fails to stop urban sprawl and unsustainable city planning (Buehler & Pucher, 2011). The in-

volvement of citizens gradually increases as well, as the cycling projects are consulted with residents and receive support e.g. from participatory budgeting. In every city there are active advocate organisations who promote cycling and take part in debates on cycling facilities (Balkmar, 2020). Cycling projects have general public support, and no opposition against any of them was registered in the examined cities; instead, advocate organisations and activists rather pressure the authorities to do more, or criticise some projects for not being cyclist-friendly enough (Toruń, 2020a; Weber, 2017).

What is still lacking is the support of the central government (e.g. national programs for cycling development) and, more importantly, a comprehensive approach to cycling and its prioritisation over other means of transport, which would help establish truly connective networks of cycling paths. None of the examined cities has yet created a complete and coherent network, and there are still gaps where paths suddenly end, forcing cyclists to use the pavements or the streets. In some cases paths are poorly maintained, insufficiently lit or not cleared of snow during and after winter; they can be overgrown by the surrounding vegetation. There are also cases of badly planned solutions. Often the projects actually completed are much less ambitious than the standards implemented by the cities, as if the paths were destined for recreation rather than for transport. Cyclists are allowed to take their bikes into buses and trams, but it is rarely practiced – in medium-sized cities the distances are short, so residents are not used to this (Marqués et al., 2015; Iwińska et al., 2018). The soft components of cycling policy are underdeveloped, as the cities rarely undertake any activities encouraging the residents to cycle. Mostly these are the one-time events organised in cooperation with NGOs, e.g. bicycle rides around the city or trips to picturesque places. No long-term and ongoing educational activities were reported in the examined cities. Another shortcoming of cycling policies is lack of result measurement – usually the only indicators are the implemented projects and the kilometres of constructed cycle paths, although e.g. Toruń outsourced the audit of the existing infrastructure, its shape and counting of cyclists (Harms et al. 2016).

Conclusion

A successful cycling policy needs continuity, and usually has to be set for a long-term perspective as building up the "cycling citizenship" is a rather complex process (Aldred, 2010). Cities that have succeeded in this field – e.g. Copenhagen, Freiburg, Vienna, or Dutch towns – needed several decades to achieve both sustainable transport and high cycling rates. Apart from building the cycling infrastructure, other means had to be introduced as well, in the most radical cases including discouraging car-use through limiting parking space, or introducing high parking fees. Also the land-use planning had to change in order to re-design cities from motorised to active transportation mode (Buehler & Pucher, 2011; Buehler et al. 2017). Polish city authorities avoid the conflicts by not introducing restrictive car-deterring policies. Although they have long-term cycling policies, bicycles are not prioritised over cars. The policies are implemented inconsequently. For example, there are no complex solutions for introducing the contraflow schemes wherever possible rather than on selected streets only, and changing the organisation of traffic at intersections barely makes the city council agenda. Similarly, the potential of universities (students are likely to use bicycles) is not fully utilised.

Despite very favourable conditions for cycling and rapidity of transformations, medium-sized Polish cities still have a long way to go in becoming cycling-friendly. Their policies focus mainly on constructing cycling paths, installing racks and developing bike-sharing systems. More advanced means of developing cycling infrastructure are barely used and seem to be relegated to the (hypothetical) second stage, when the path networks are completed. Yet promoting cycling and developing cycling culture is no less important than the material component. The cycling infrastructure of Polish cities is improving constantly, and more people choose bicycles. Nevertheless, the cycling culture and routine commuting by bicycle are a thing of the future.

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