A methodology for planning short-term urban bike lane networks; the example of downtown Gijon

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Abstract

Recently there has been increasing interest in the construction of bike lanes in cities due to their enormous positive effects; however, in some places society is resistant to these infrastructures and it is difficult to break a dynamic defined as the vicious circle of cycling mobility. In view of this, there is the option of proposing temporary bike lanes to evaluate the social response and, if successful, to make them permanent. This option is called temporary or tactical urbanism and has been widely used in the field of bicycle infrastructure during the COVID 19 pandemic. The problem is that there is no quick and low-cost method to determine a comprehensive and well-connected scheme of bike lanes in the whole of a city; therefore, sometimes design mistakes are made and as a consequence temporary infrastructures, far from becoming permanent, disappear. This research proposes an agile and economical methodology to establish which streets, within those that define the urban grid as a whole, can accommodate a temporary bike lane without altering the motorized traffic grid. The method is based on the use of QGIS and on a quick and easy data collection. The method was applied to downtown Gijon (Spain).

Keywords: Infrastructure planning; Transport planning; Urban regeneration; Local government; Pavements & roads; GIS; traffic; COVID-19; temporary networks; tactical urbanism

1 Introduction

The advantages of using the bicycle as a means of transportation in the city are well known, from environmental sustainability to positive repercussions on the health of its citizenry (Frank *et al.*, 2006; Gotschi, 2011; Howden-Chapman *et al.*, 2015; Mueller *et al.*, 2018; Hammond, Iddenden and Wildblood, 2022). Moreover, the increase on active mobility has been associated with increased shopping and dining activities, which has in turn been found to increase retail sales at the locations where they occur (Bent and Singa, 2009; Clifton *et al.*, 2016). Additionally, Vision Zero programs which seek to eliminate all traffic related deaths encourage to provide enhanced facilities not only for pedestrians but also for bicyclists (Cushing *et al.*, 2016; Dumbaugh and Marshall, 2018).

However, in some countries, society is reluctant to accept the construction of new cycling infrastructure, and municipal authorities are therefore unenthusiastic to introduce it (Tsafarakis *et al.*, 2019; Plasencia-Lozano, 2021). This is the case, for example, of Spain, whose cities have shown strong reticence to the bicycle as an urban vehicle compared to the good implementation it has had for decades in other northern European countries (European Union, 2013, 2014). Important cities such as Malaga, Granada or Tarragona have proven reticent to change (Monzón de Cáceres *et al.*, no date); furthermore in Madrid the commitment to cycling is considerably less than in other major European capitals (Medina, Álvarez and Clemente, 2020) and its cycle lanes are built on the periphery or in parks, and have a leisure-oriented character (Juárez Barber, 2021; Bernabeu-Larena *et al.*, 2023).

At the same time, the irruption of COVID-19 caused severe changes in mobility in cities (Awad-Núñez *et al.*, 2021; Benita, 2021; Borkowski, Jażdżewska-Gutta and Szmelter-Jarosz, 2021; Ehsani *et al.*, 2021). New transportation habits show a downward trend in the use of public transportation and an increase in mobility in private vehicles, especially bicycles or electric scooters, which has led to the construction of new bike lanes around the world. During the pandemic, the most diverse cities made modifications in the use of public spaces (more or less successfully) to implant temporary bike lane networks (Soengas, 2020; Nikitas *et al.*, 2021; Jasiński, 2022; Rérat, Haldimann and Widmer, 2022), within a general demand for open spaces to guarantee social distance (Shoari *et al.*, 2020; Slater, Christiana and Gustat, 2020; Venter *et al.*, 2020). Sometimes such actions were limited to vertical signals and horizontal signs painted right on the street or sidewalk (Abad, 2020; Kraus and Koch, 2021), with no previous planning to the best of our knowledge (Figure 1). This lack of prior planning and their temporary nature led to the temporary network created in cities such as Berlin to be called pop-up bike lanes (Becker *et al.*, 2022).

Figure 1. Bike lanes set up in various cities during the pandemic: Oviedo (Abad, 2020), Vigo (Vila, 2020), Barcelona (Blanchar, 2020) and Berlin (Redacción).

These bike lanes can fit into what is known as temporary urbanism or tactical urbanism. Briefly, tactical urbanism is in fact a range of planning and design methods to address a problem of a lack of infrastructure with low-cost, often small-size, sometimes even temporary or non-spatial means (Balicka *et al.*, 2021; Panjaitan, Pojani and Darchen, 2022). The term was coined in 1984 by Certeau (1984), and has been widely used since the publications of Lydon and Garcia, where urban transformations are referred to as tactics rather than strategies (2015); the seminal book by Bishop and Williams *The temporary city* (2012) can also be highlighted. Temporary urban interventions have also been related to innovation and creativity (Stevens, 2018), characteristics associated with dynamic and vibrant cities (Florida, 2005; Matoga, 2019), and with the process-oriented planning (Havemann and Schild, 2007).

Tactical or temporary urbanism has been regularly applied for transportation infrastructure schemes, being New York City's closure of Times Square to vehicle traffic the best known project. During the transformation the city studied the project's effects on overall vehicle mobility and take into consideration a survey of residents; as a consequence, the temporary project became permanent (Dumbaugh and Marshall, 2018). New York has transformed its planning and design practices, and tries temporary projects; where successful, these temporary projects become permanent, and where unsuccessful, they are eliminated or modified (New York City Department of Transportation, 2010, 2016). In Milan bike lanes were implemented in existing streets reducing the area destined to motorized traffic, first within a project called "Open squares/Piazze Aperte" realized in collaboration with Bloomberg Associates, NACTO and Global Designing Cities Initiatives which allowed "for a rapid and reversible solution testing, before investing time and resources in a definitive structural arrangement, anticipating the impacts with immediate benefits and supporting the decision-making process towards a permanent solution"; after a citizen listening process, residents proposed 65 new spaces to eliminate traffic and include pedestrian and bike lane areas (Comune di Milano, 2020; Moro, 2022).

The number of projects multiplied due to the emergence of COVID-19, as mentioned above. In Bogota, temporary bike lanes were implemented on the roadbeds, as a measure to confront the pandemic (Olmos, Borchers and Guerreiro, 2021). These bike lanes were designed on streets where they were planned to be built in the future, according to the mobility plan, and were also implemented on streets that allowed interconnection between scattered bike lanes or connections to neighborhoods with more workers. The effects of their implementation were evaluated after the pandemic, and based on this a posteriori study, it was determined which segments were removed and which remained permanent. The measure has meant that the city now has 74 km of new permanent bike lanes, and their construction has been faster than usual. In the case of Berlin, the lanes built during the pandemic were located on streets that were already part of a project to build temporary bike lanes in the future, and which had been identified by various civil society actors (Kraus and Koch, 2021). In Paris, a temporary network of bicycles lanes which added more than 50 km to the existing one was defined by following the routes of some of the busiest underground public transit lines, including metro and commuter lines (Bird Cities, 2020).

As we can see, the planning methods of this tactical, or temporary, urbanism are usually developed in the trial-and-error environment, something explicitly pointed out by Lehtovuori and Ruoppila: "historically, temporary uses have been often unplanned, i.e. they have taken shape outside (or preceding) the official planning process" (2012), which also insist that have been increasingly incorporated into official planning processes as phases of development, to the point that they are becoming central and strategic components of urban planning, development and management. As Dumbaugh and Marshall note (2018), rather than investing in a large-scale capital project that is uncertain of success, cities have increasingly undertaken small-scale, iterative projects aimed at transforming public rights-of-way to better accommodate human activity. For that, local governments design temporary installations and low-cost materials to evaluate the public response to a project prior to committing to a permanent transformation of the right-of-way. As an example of the reduced amount of these projects, the cost of the traditional bike lanes in Seville, 250,000 €/km, and the cost of the temporary bike lanes in Berlin, 9,500 €/km, can be compared (Kraus and Koch, 2021).

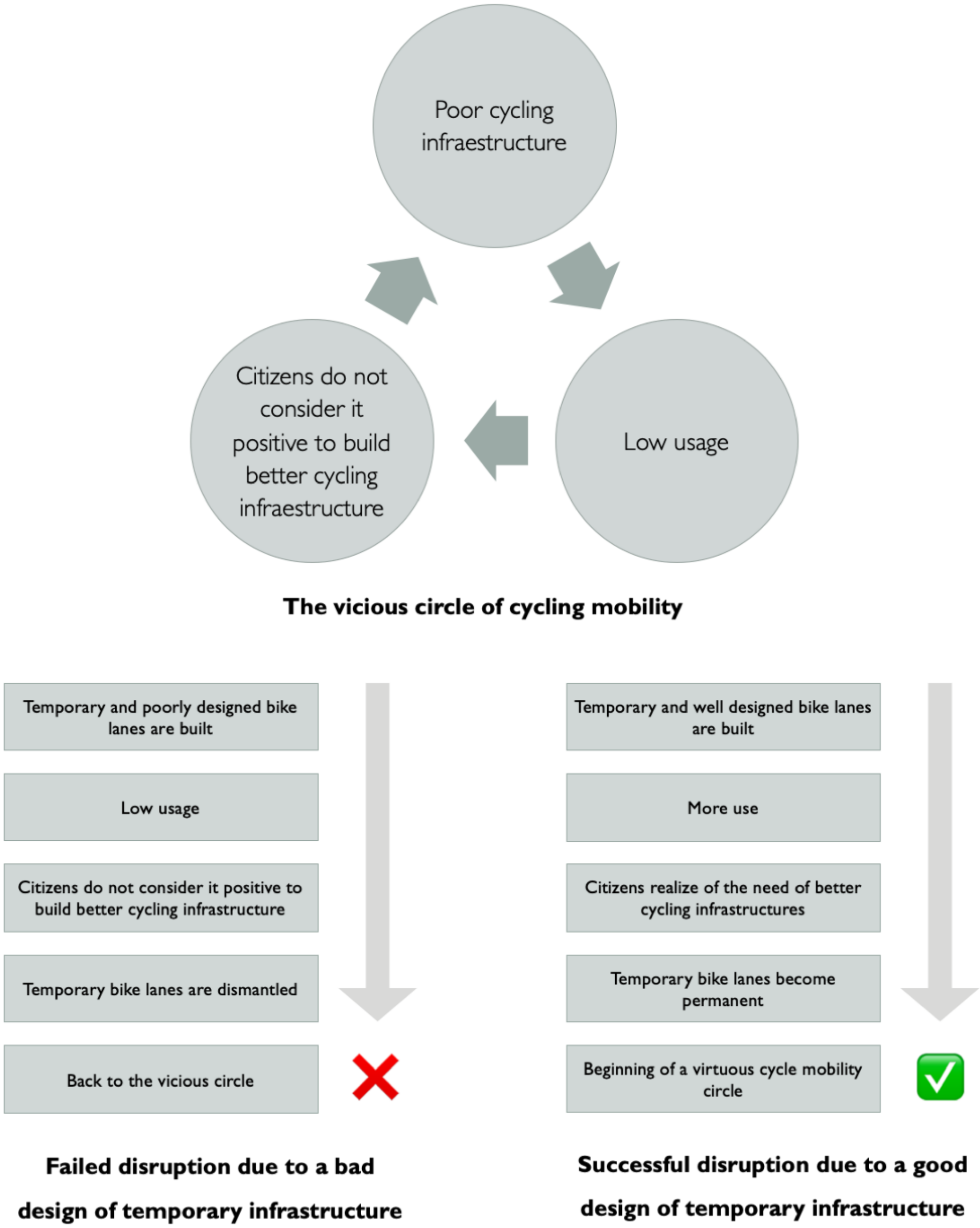

Figure 2. The vicious circle of cycling mobility, and the possible disruption due to the implementation of a new temporary bike lane (own production)

The problem with this lack of planning is that mistakes can be made quite often, such as building disconnected networks as happened in Thessaloniki (Kinis, Palantzas and Nalmpantis, 2022) or in Madrid (Medina, Álvarez and Clemente, 2020), or invading pedestrian spaces in Oviedo (J.C.A., 2020). It is true that one of the characteristics of tactical urbanism is its character of testing a hypothesis at scale and in real time, but it is also true that the opportunity to introduce a temporary bike lane should be used to break the vicious circle of cycling mobility in those societies most resistant to a paradigm shift in their cities (Figure 2). Some researchers openly talk about the window of opportunity created by COVID-19 (Nalmpantis, Vatavali and Kehagia, 2021; Becker *et al.*, 2022).

At the same time, the main problem is that detailed planning of a bike lane network, within a larger mobility strategy, is a complex task which involves many hours of work. Public space in city centers is usually minimal and therefore, the introduction of a new transportation grid (the bike lane) involves reduction or elimination of existing uses, normally those associated with motorized traffic (CROW, 2011; Kinis, Palantzas and Nalmpantis, 2022); for that, a new bike lane project is often preceded by consultation, negotiation, concept design and planning stages before the realization can even start (de Smet, 2013). Recent methods have been developed for laying out a network efficiently (Winters *et al.*, 2011; Koh and Wong, 2013). Among them are those derived from the BLOS method (Bicycle Level of Service) developed by the Transportation Research Board, which evaluates the conditions urban streets have for incorporating a space for bicycles (Terh and Cao, 2018; Pritchard, Frøyen and Snizek, 2019; Kazemzadeh *et al.*, 2020; Buehler, Teoman and Shelton, 2021; Talavera-Garcia and Pérez-Campaña, 2021).

These methods require a previous phase of traffic data collection that takes place over a series of days, usually accompanied by a campaign of citizen surveys; with these data, traffic simulation models can be developed with specialized software. However, in the context of a pandemic such as COVID-19 it is not possible to have true and real traffic data because mobility habits change; on the other hand, in the context of a municipal administration that wishes to carry out a real test -associated to the tactical urbanism practices we have described- it does not make sense to carry out this study because precisely in this case the objective of the construction of a temporary bicycle lane is to evaluate how the citizenry responds to the replacement of parking lots and duplicated traffic lanes by a new cycling infrastructure.

Along this line, we think it is of interest to develop a rapid planning methodology defining a temporary bike lane network that can be used both for a mobility disruption due to a pandemic, and for a city council that wants to test in real time and scale how society responds to a complete cycling infrastructure that implies a change of mobility paradigm in the city, following the practice of tactical or temporary urbanism. And we believe it is necessary to develop a rapid method due to the absence of other robust methods to design complete cycling networks that go beyond intervening in isolated streets or asking citizens or reproducing the routes of public transport already established (as we have seen before), and that allow us to quickly determine an evaluation of the geometric condition of the streets, in order to evaluate if a bike lane can be inserted without affecting existing traffic. Those city councils that wish to introduce a temporary network by inserting vertical and horizontal signing may find this method useful for analyzing whether a valid network can be laid out quickly without affecting traffic schemes:

consultants who are designing a mobility plan may find it to be a valid method for determining a priori what set of streets are suitable for introducing a bike lane in them.

The developed methodology uses GIS tools based on public information and other data collected in the field. The method was applied to downtown Gijón, an average-sized city in northern Spain, where the bike lane network is underdeveloped, although there are plans to enlarge it (Ayuntamiento de Gijón, 2021) (Figure 3).

Figure 3. Location of Gijon and the study area

2 Method

The method developed is based on data acquisition and later use of a GIS tool for their processing and analysis (Figure 4). First, design guides and reference publications related to planning and designing bike lanes were selected. The reference publications were: the *CROW Design Manual* (2011), the *Cycle Infrastructure Design* by the Department for Transports (2020); *Focus on cycling*, Copenhagen (2013); *Cycle concepts*, Denmark (Andersen *et al.*, 2012); the *Sustrans Design Manual* (2015); the recommendations included in the *Plan Andaluz de Bicicleta [Andalusian Bicycle Plan] 2014-2020* (2014); and the *Recomendaciones para el proyecto y diseño de viario urbano* [Recommendations for Urban Roadway Projects and Layout] of the Spanish Ministry of Development (2000). Recommended values were sought for the following parameters: maximum slope of the street; street width necessary for an adjacent bike lane on the same level; speed limit in the street; type of paving; suitability or not of bicycles and pedestrians sharing the street. The values found were compared with real data from the streets in the study area, enabling us to determine what sections of street met theoretical criteria. With these data, it was then possible to determine what current spaces could be replaced with future bike lanes without modifying the existing traffic layout, the minimum premise that the resulting bike lane network must meet.

Then work began with the GIS using open QGIS software. The street plan and the properties of each section of street were entered. Finally, the resulting layout was analyzed, and conclusions arrived at.

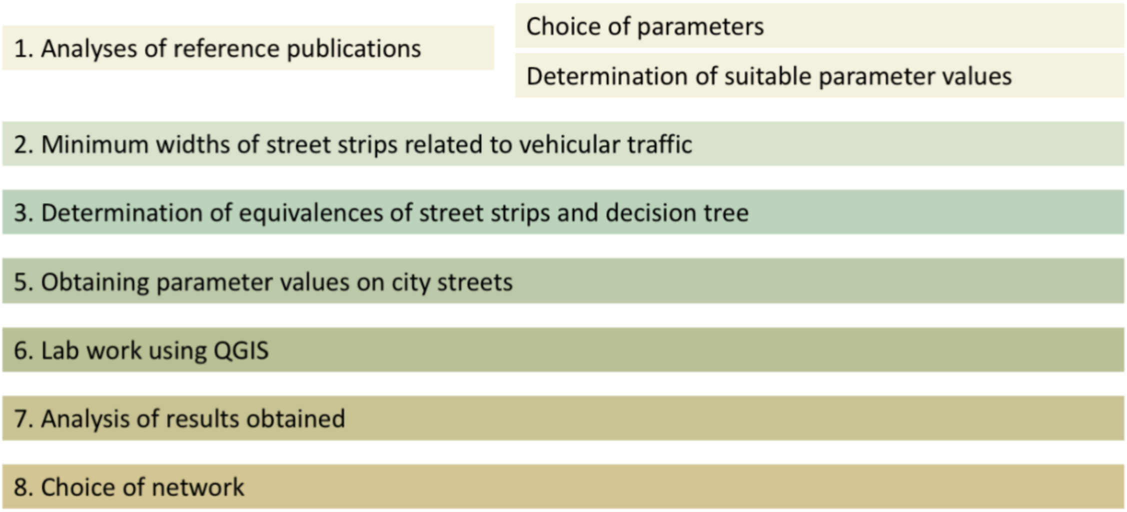

Figure 4. Method

3 Results

3.1 Data from technical guides

First, the study results were compared with the manuals (Table 1). Slope of the streets in most of the manuals is limited to 5. In our case, the maximum admissible was that 5% and up to 2% was considered suitable. Intermediate values were assigned progressive scores.

PARAMETER		CROW	Cycle Infrastructure Design	Focus on cycling	Cycling concepts	Sustrans	Plan Andaluz de Bicicleta	Recomendaciones para el proyecto y diseño de viario urbano
Street slope		5% recommended maximum	5%, recommended maximum	-	5% recommended maximum	6% recommended maximum	5% recommended maximum	7% recommended maximum
Width of a bike lane attached to a lane with traffic at the same level	Bidirectional bike lane	Not recommended	-	-	-	Not recommended	Min 2,5 m	Not recommended
	One-way bike lane	Min 1,5 m; appropriate 2,0 m; max 2,5 m	Min 1,5 m; appropriate 2 m	Min 1,6 m; appropriate 2,2 m	Min 1,5 m	Min 1,5 m; appropriate 2 m	Min 1,5 m; appropriate 1,8 m	Min 1,8 m; appropriate 2 m
Traffic speed on the street in a bicycle lane at the same level		Prohibited in street > 70 km/h. Not recommended in streets > 50 km/h	Prohibited in street > 50 mph. Not recommended in streets > 30 mph.	-	Prohibited in street > 55 km/h. Not recommended in streets > 35 km/h	Prohibited in street > 40 mph	Prohibited in street > 50 km/h	-

		Caution in streets > 20 mph					
Pavement type	Asphalt ok; concrete correct; paving slabs wrong	Asphalt ok; paving slabs wrong	Asphalt ok; paving slabs wrong	Asphalt ok; paving slabs wrong	Asphalt mandatory in ramps	Asphalt ok; paving slabs wrong	Asphalt ok; paving slabs wrong
Pedestrian streets. Shared space with the pedestrian	Only if there are less than 100 pedestrians per hour and per meter	Up to 300 pedestrians per hour, on a 3 m street	-	Discourage mixed use in general	-	-	-

Table 1. Parameters values in the consulted manuals

Information was found for two possibilities for including a bike lane adjacent to a lane of traffic on the same level. The option of placing a two-way bike lane next to a lane in one direction was eliminated because the publications analyzed did not advise it or even consider it. The option of a one-way bike lane adjacent to a lane in each direction must be at least 1.5 m wide, making the whole width of pavement to be occupied 3.0 m. Another important parameter for traffic safety is the speed limit allowable where a bike lane shares the roadway with motor vehicle lanes without a clear physical separation. In general, the manuals do not recommend this configuration in streets with vehicles traveling at over 50 km/h, and that speed was decided on as the maximum permissible speed. A bike lane could be inserted in streets with higher speeds, but then they would have to make the speed limit 50 km/h.

With respect to the type of pavement, the manuals clearly misadvise paving slabs, and prefer a smooth surface such as asphalt mixtures or even concrete.

Finally, the possibility of including bicycles in pedestrian streets was evaluated. The manuals consulted do not recommend it when there is heavy pedestrian traffic. In Gijon there are no limits on pedestrians, and therefore it was decided not to include pedestrian streets in the grid.

3.2 Minimum widths of strips in streets. Decision tree

Once the appropriate values for the parameters had been quantified, the minimum widths of the different strips of street space occupied by vehicles were determined. The minimums established by the Ministry of Development's *Recommendations* were taken as the reference document for Spain. Using this document, we could decide which street or parking spaces could be replaced by one-way bike lanes (Table 2).

Space	**Width (m)**
One-way bike lane. One 1.5-m-wide bike lane each way	3 m
In-line parking	2 m
30° diagonal parking (more restrictive than 45° or 60° angle)	3.6 m
Pavement	3 m

Table 2. Widths of the different road spaces analysed

At the same time, a decision tree for expected values was drawn (Figure 5). Replacement of a paved lane by two one-way bike lanes was found to be the least severe modification, as long as the street has more than one lane in one of the directions of traffic: this can be done in Class A streets. With it, the existing traffic system remains unchanged as does available parking space. One modification that does change the status quo of the street somewhat is eliminating parking spaces: this option is possible in Class B streets. This leaves a street with two lines of parking that can be replaced by two one-way bike lanes. A row of diagonal parking can also be replaced by two bike lanes. Streets where a bike lane cannot be inserted immediately are in Class C.

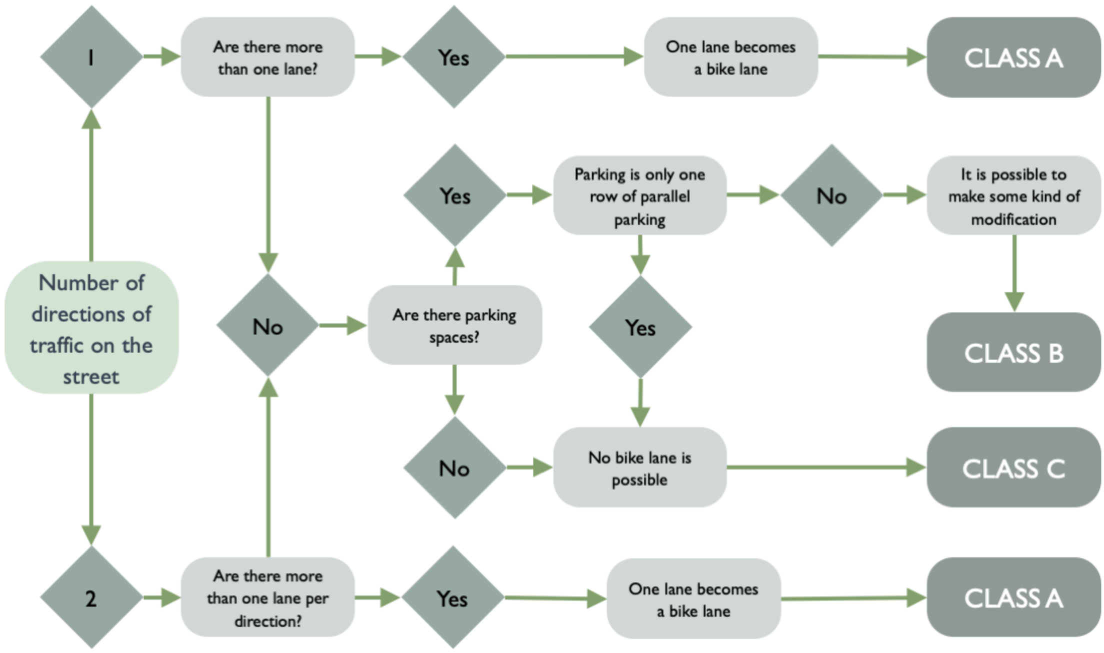

Figure 5. Decision tree (own production)

3.3 Deciding on streets using QGIS

A series of layers that include the various parameters are generated in the QGIS as a result of the above steps.

First, the streets with slopes are found (Figure 6). A large part of the street layout has a slope of less than 2%, with some sections between 2% and 5%. There are slopes over 5% on the Cimadevilla peninsula and occasionally in some sections in the center.

Figure 6. Street slopes

Streets with paving unsuitable for bicycles were also found (Figure 7). It may be observed that all the streets on the Cimadevilla peninsula as well as some streets in the center and west have paving slabs.

Figure 7. Pavements

The speed limit found in all of them was found to be 50 km/h. Therefore, they all meet this parameter. Finally, streets were categorized as Class A, B or C (Figures 8, 9). Most of the streets in the western part are Class C, whereas in the middle and east they are Class B. Class A streets are reduced to a few sections.

Figure 8. Examples of the A, B and C categories of streets. Top: two lanes per traffic direction (class A). Middle: one traffic lane, with two parallel parking lanes (class B). Bottom: one traffic lane without parking lanes (class C)

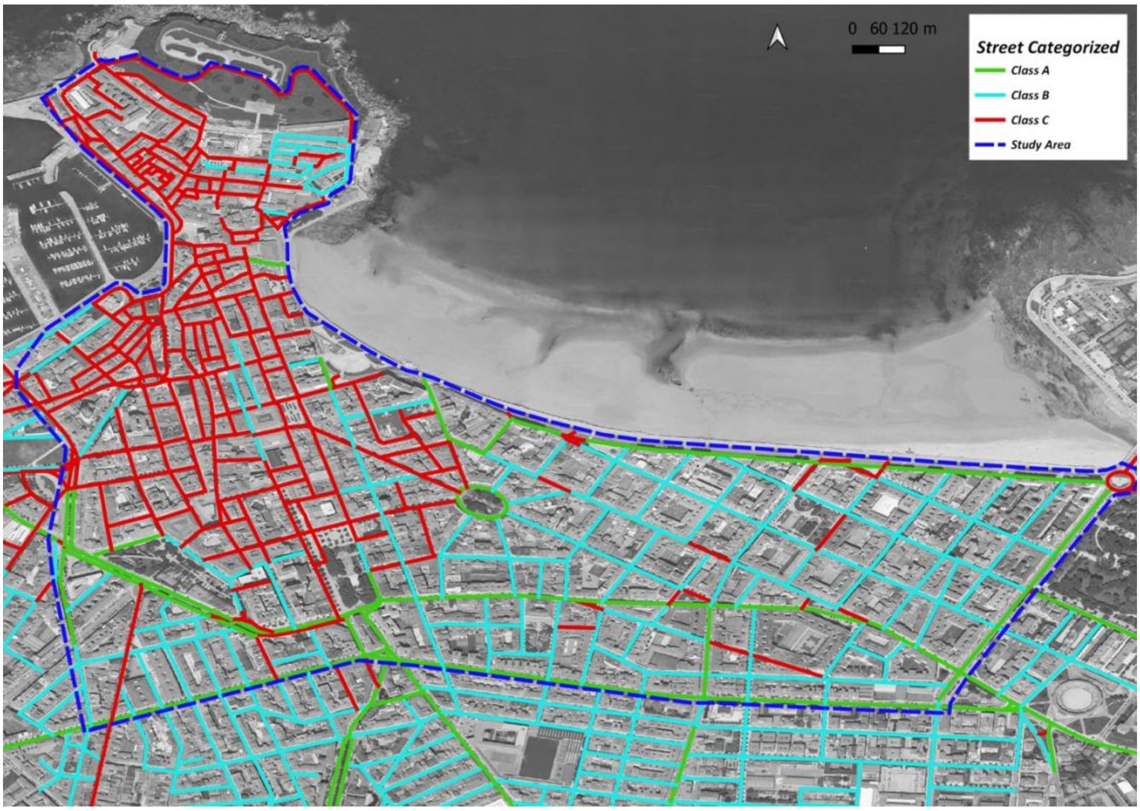

Figure 9. Streets categorized as Class A, B or C

The streets that a priori met all the criteria for incorporating a bike lane were found based on these results: Less than 5% slope, asphalt mixture paving, speed limit 50 km/h and Class A or B. Those that could meet space and speed limit criteria but not at least one of the two following criteria were also found: maximum slope or unsuitable paving. The streets suitable for bike lanes are represented as (Type 1); streets that can have a bike lane, but will be uncomfortable for cyclists because of their topography or unsuitable paving (Type 2); and streets that cannot have a bike lane without modifying the city traffic grid (Type 3) (Figure 10).

Figure 10. Streets where a bike lane could be inserted (Types 1 and 2)

4 Discussion and conclusions

In this section we will discuss the results obtained from the application of the method in the city of Gijón, recapitulating the decisions taken; in addition, we will establish the advantages and disadvantages of the methodology, determine the possible future research that may arise as a result of it, and draw some general conclusions.

This research arises after observing the absence of a systematic and rapid method to design a network of temporary bike lanes in the city, which can be used both within the trial and error practices associated with tactical urbanism and in a situation of urgent need arising from the outbreak of a pandemic similar to COVID-19. A rapid method has been developed to introduce a complete network of bicycle lanes in an urban environment without altering the existing motorized traffic pattern and guaranteeing geometric and pavement characteristics suitable for bicycles, as advocated by different specialized publications on bicycle lane design. This method has been applied to the city of Gijón, as an example.

The design parameters used to consider a bicycle lane as adequate were as follows:

- The slope of each street, which is considered to be inadmissible if over 5%.
- The width of the street and the number of lanes, which are only admissible if there is more than one lane in each direction or parking on both sides of the street.
- The speed limit of motor vehicle traffic on each street, which may not be over 50 km/h, when comfort of users of the bike lane decreases.
- The type of pavement, which may not be paving slabs.

When the streets had been categorized according to these parameters, the bike lane already present in the city of Gijon was observed to go through streets classified as Class A according to the method used, that is, the best for their implantation according to this method. This shows, in part, the reliability of the data found.

Furthermore, the bike lane network present in the city of Gijon was characterized and the values of various parameters of the streets they go through were found. Thus, it was shown that the existence of a bike lane is linked in general to streets without paving stones, with a motor vehicle speed limit of 50 km/h and with slopes of less than 2%.

The grid found after applying the method in the city of Gijon showed that most of the streets analyzed did not meet some parameter required, so the current bike lane in the city adapts rather well to the sections of its streets. Even so, a possible path joining the East and West sides of the city was observed that could complete the bike lane and extend it in the layout of the isthmus of Cimadevilla, with a detailed study, which however, was outside of the scope of this one.

If type 3 streets were to be introduced into a future bike lane scheme, it would be necessary to alter the motorized traffic scheme, which would require more stringent modifications (signal placement, traffic lights, etc.). This would make the bike lane more of a permanent rather than a tactical or temporary infrastructure. Another possibility could be to establish shared spaces for motorized traffic and bicycles, for which it would be reasonable to establish a maximum speed limit of 20 km/h on these streets. However, this possible decision could go against the will to define the safest possible bike lane in order to promote Suso among all citizens and break the above-mentioned vicious circle of cycling mobility (Figure 2).

Figure 11. Proposal for future bike and cycle lanes, in the future Mobility Urban Plan

A comparison between the results of this research and the bicycle lane network proposed in the future Mobility Plan promoted by the City Council (Ayuntamiento de Gijón, 2022), whose administrative processing is still underway, can be made; the horizon year for implementing the measures of the plan is 2030. As can be seen in Figure 11,the inclusion of cycle lanes (following the denomination of the plan itself are shared spaces by bicycles and cars,) shown in green, and also the inclusion of segregated bike lanes, shown in orange, are proposed. This official scheme is not very ambitious, since segregated bike lanes are not included in the area under study although it would be possible to include them, and the current cycle lanes could be upgraded to bike lanes. We therefore believe that our methodology could be used to evaluate the possibility of incorporating a segregated bike lane temporarily in this area, and if the response of users is satisfactory, make it permanent. Also, the small number of streets included in this proposal is surprising. It is true that in the western half of the area studied it is difficult to incorporate new segregated bike lanes, but in the eastern half it is easier and yet the future mobility plan does not contemplate it. In this line we are also struck by the absence of more bike lanes in the north-south direction compared to the greater number of east-west axes. Finally, the comparison confirms that the study area is a difficult zone to implement a bicycle lane.

Regarding the advantages and disadvantages of the method, we believe that the main characteristic is that it can be applied in any urban environment; it also can be used in other types of research, such as generating pedestrian spaces or temporary grids achieving a larger public pedestrian space; for this purpose, it would be sufficient to determine which geometric parameters or pavement characteristics are to be used as design requirements. Moreover, this method, as a tactical approach one, provides adaptive and cost-effective solutions for transforming the cities by inserting a whole new bicycle lane network, which can be tested without a great deal of resources or funding. Another advantage of it being less time consuming, makes it an appropriate choice for an intervention that can be done in the meanwhile before the municipality comes up with a solution. Based on success and reception of the project, the installations can be made to be permanent.

It is possible that these modifications will affect motorized traffic, reducing the Level of Service of the same in the affected streets; however, at present in the cities there is a tendency to increase the surface destined to pedestrians and cyclists to the detriment of vehicles (Dumbaugh, Tumlin and Marshall, 2014; Dumbaugh and Marshall, 2018), moreover, the literature on induced demand indicates that any travel time benefits from capacity expansion will be consumed by additional travel (Hansen and Huang, 1997; Cervero and Hansen, 2002; Duranton and Turner, 2011), and therefore reducing the number of available lanes will reduce induced traffic. Also, parking availability not only encourages vehicle travel but also increases induced traffic (Shiftan and Burd-Eden, 2001; Arnott and Inci, 2006; Speck, 2018), so a reduction in parking spaces on some streets would help reduce traffic.

This research opens up several lines of study. Firstly, a future 2.0 version of the method could take into account some additional parameters, such as the number of garages on each street, which if they are very many, would make it hard to design a separate bike lane; the percentage of heavy vehicle traffic down each street, which could affect the comfort of cyclists if it were very high; or the radius of turns, very important for cyclists.

Another future study coming out of this one would be application of the same method to other cities of a size similar to Gijon to compare the parameters found in each of them, and this way each of the cities could be characterized and similarities found between them. Another subject for future research would be to include which two-way streets could house a bike lane by reducing the number of directions to just one. However, this would require altering the traffic layout, which means greater and perhaps not temporary changes.

Likewise, comparisons could be made between the temporary bicycle lanes built in various cities and the hypothetical network that could have been designed if the methodology described here had been used. Moreover, the option of a bike lane in pedestrian streets could be evaluated. The method would be similar, considering parameters such as width of the street, existence or not of urban furniture and trees or the intensity of pedestrian traffic.

One last future research line in relation to this topic is that, as far as we know, there is still no synthesis research that analyzes in depth the temporary bike lanes that have emerged in recent years in cities around the world from the point of view of the method used to select the streets that make up their respective bike lane networks. We have identified and described some examples such as Bogotá, Berlin or Paris, but it would be interesting for a future research to make a compendium of such decisions.

Finally, we can point out that the study has demonstrated the power of GIS methods for proposing improvements in urban environments by making "macro" studies that facilitate the first steps in the planning process by analyzing the current situation. And we consider it interesting to note that the specialized publications on bike lane design consulted and compared to determine the ranges of the parameters generally agreed on values recommended and not recommended, although they are from different years and have been published in different countries.

Finally, we should remember that the bicycle as a means of urban transportation in environments where it is hardly present (as is the case in many southern European cities) is an indisputable added value in the fight against climate change and energy savings on a national scale. At the present time, where many countries are rethinking their energy model, perhaps implanting a temporary bike lane network could be a first step in evaluating the response of the population and if positive, plan more ambitious permanent networks.

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