

Urban Research & Practice

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rurp20

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To cite this article: Aniss M Mezoued , Quentin Letesson & Vincent Kaufmann (2021): Making the slow metropolis by designing walkability: a methodology for the evaluation of public space design and prioritizing pedestrian mobility, Urban Research & Practice

To link to this article: https://doi.org/10.1080/17535069.2021.1875038

Published online: 28 Jan 2021.

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URBAN RESEARCH & PRACTICE
https://doi.org/10.1080/17535069.2021.1875038

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Making the slow metropolis by designing walkability: a methodology for the evaluation of public space design and prioritizing pedestrian mobility

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ABSTRACT

Focusing on the mobility aspects of big cities and metropolises, the paper starts with the assessment that the Slow City is linked, in terms of mobility, to slowing down traffic. This paper proposes the following working hypothesis: if the Slow City concept is relevant for making our bigger cities sustainable, it needs, in terms of mobility, to be adapted to the slowest mode of transportation: walking. To that extent, our research develops atool to evaluate the design of public spaces with regard to their affordance to walking (walkability) and to their prioritization of pedestrian mobility.

KEYWORDS

Slow City; slow metropolis; walkability; public space; mobility; Brussels

Introduction

The 20th century is marked by the development of fast and segregated modes of transportation that shaped cities and its public spaces. It created unsustainable territories and ways of life (Salat 2011; Rosa and Trejo-Mathys 2013). Nowadays, after several decades of valorizing speed, a variety of strong critiques against 'the myth of the "natural" benefits of speed' is now emerging (Tranter and Tolley 2020; Pelgrims 2020; Desjardins 2015; Godillon, Lesteven, and Mallet 2015). The Slow City concept appears as one of theses critics as well as an alternative solution. It is said to contribute to sustainable development (Turkseven Dogrusoy 2011; Cho 2011) and to foster the social rediscovery of the culture of place (Knox 2005; Turkseven Dogrusoy 2011). However, it is in most cases developed only within small cities or in small localized areas of larger cities, rarely at larger scale.

In this article, we aim to question the conditions of slow urbanism within larger cities by focusing on mobility aspects and by adopting a non-segregated logic of modes of transportation. Considering a city as the iterative interplay between the activation of the actors' mobility potential and the affordance of urban spaces to their projects (Kaufmann 2011; Jensen 2013, 2014), we propose to consider the Slow City from the perspective of the materiality of its public spaces and their capacity to activate potentials of soft or active mobility. In this view, we will test the following hypothesis: if spaces in the Slow City – or for larger cities, in the Slow Metropolis – are to afford slowness, the

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overall planning of public spaces has to be based on a pedestrian frame of reference. In other words, a Slow Metropolis is first and foremost a walkable metropolis. In this hypothesis, inspired by the works of Marc Wiel (1999) and Jacques Lévy (2008), our focus is not strictly on walking but on the pedestrian 'metric' associated with it, i.e., the mode of distance management and the spatial practices centred on pedestrian users.[1] In such a perspective, all modes of transportation, mechanized or not, public or private, individual or collective, are conceptualized – and their associated spaces designed – with the pedestrian metric, and not their own, in mind. In other words, walkability becomes the capacity of the city to accommodate and facilitate walking in the majority of its public spaces, including those reserved for other modes of transport. Such a configuration turns the pedestrian into a first-class user of public spaces by putting him or her at the centre of mobility measures while contributing to the development of sustainable cities at a human scale (Carpenter 2013; Mongin 2013; Gehl 2010; Jacobs 1961).

With these remarks in mind, this article aims at exploring the walkability of public space as a lever for thinking the Slow City on a larger scale. It will focus on presenting the analytical framework concerning the evaluation of the public space affordance for walking, developed as part of an academic research carried out at the Ecole Polytechnique Fédérale de Lausanne (EPFL) and the University of Louvain (UCLouvain). In this research, local actors, in particular Brussels Mobility, were involved in making data available and discussing the potential implementation of the results in the framework of the pedestrian policy of the Brussels Capital Region.

From city forms to mobility metrics

Walkability of urban public spaces

Since the seminal works of Kevin Lynch (1960) and Jane Jacobs (1961), an enduring interest in the interplay between city forms and urban practices has created a large body of research. In the last 20 years, these studies have used a wide range of empirical approaches focusing on the relationship between the characteristics of the built environment and individual and collective mobility practises (Rodríguez and Joo 2004). Such studies have aimed at identifying the key attributes of a space that define its affordance to particular mobility practises. These attributes have been identified by focusing on different urban typologies and types of neighbourhoods, where they addressed land uses, built forms, street networks and their topological properties, density, landscape, street furniture, the design of public space, etc. (Cervero and Radisch 1996; Cervero and Kockelman 1997; Rodríguez and Joo 2004; Hillier 1996; Bafna 2003; Pafka et al. 2020; Newman and Kenworthy 2006; Foltête and Piombini 2007; Genre-Grandpierre and Foltête 2003; Frank et al. 2010; Parsons Brinckerhoff Quade and Douglas I, Systématics C and Associates C 1993; Pafka and Dovey 2017). Generally, these studies combine results from various types of surveys (demographic data, gate counts, GPS tracking, semi-structured interviews, life narratives, etc.) with simulations and multicriteria analyses. Almost all conclude that the walkability of an urban environment is linked to a complex combination of factors and that none of these factors seems to have a strict causal relationship with walkability or to systematically outweigh the others in

terms of its influence on walkability (see Frank et al. 2010: 924; Rodríguez and Joo 2004: 166; Newman and Kenworthy 2006: 42; Flitti and Piombini 2003:6–7; Foltête and Piombini 2007, 232). Although these studies often concur that 'pedestrian behaviours depend on the complex interaction of elements that require a continuous reevaluation according to multiple criteria' (Piombini and Foltête, 2007: 88), they argue that this apparent flexibility is nonetheless constrained by numerous factors (Flitti and Piombini 2003, 6–7) (See Table 1).

Without going into excessive detail, we can summarize a general theme of these studies: they highlight that the structure, connectivity, permeability and topology of the street network are often considered key factors in generating pedestrian movements (Forsyth et al. 2008; Frank et al. 2010; Flitti and Piombini 2003: 6; Genre-Grandpierre and Foltête 2003: 2, 12 and 20; Foltête and Piombini 2007; Hillier 1996; Bafna 2003). Other factors include the importance of high residential, commercial and employment densities or, more generally, the density of built surfaces (Forsyth et al. 2008; Frank et al. 2010; Genre-Grandpierre and Foltête 2003, 18); the attracting role of mixed-use areas (Forsyth et al. 2008; Frank et al. 2010); the presence of infrastructures and amenities (Forsyth et al. 2008; Foltête and Piombini 2007, 226); sidewalk continuity between origin and destination (Rodríguez and Joo 2004: 165; contra, see Foltête and Piombini 2007, 231–232); a 'fragmentation of forms which indicates a high spatial variability of types of land uses' (Genre-Grandpierre and Foltête 2003, 18); and the visual impact of specific urban forms, such as open spaces like plazas and squares (Foltête and Piombini 2007: 226 and 231). Other factors are also hinted at in these studies but their impact on walkability is less straightforward and more complex to evaluate. Among the latter; such factors include the width of sidewalks (Frank et al. 2010: 925; Rodríguez and Joo 2004: 153; Foltête and Piombini 2007, 231–232); local topography (Rodríguez and Joo 2004: 153 and 165); the presence of pedestrian and bike

Table 1. Elements of the urban morphology with an impact on pedestrian movements according to the literature and the elements available in our data used in the present analysis (/indicates a factor not included in the geodatabase; * signals factors considered but not included in the geodatabase; = means that the factor is part of the geodatabase).

	Factors clearly impacting pedestrian movement	Enhancers/impediments
1	Structure, connectivity and permeability of street network	/
2	High residential, commercial and employment densities	/
3	Mixed-use areas	/
4	Presence of infrastructures and amenities	Benches, pedestrian crossings, traffic lights, public transportation stops.
5	Visual impact of some urban forms	/
6	Spatial variability of land uses (cf.3)	/
7	Sidewalk continuity from origin to destination (cf.4)	/
	Factors whose importance is less supported in the literature	
8	Local topography	Slope gradient
9	Number of traffic lanes	*
10	Presence of pedestrian and bike paths	=
11	Existence of green spaces and vegetation	Trees
12	Sidewalk width	*
13	Number of parking spaces	*

paths (Rodríguez and Joo 2004, 153); the existence of green spaces and vegetation (Genre-Grandpierre and Foltête 2003: 19; Piombini and Foltête 2007: 102); the number of traffic lanes (Foltête and Piombini 2007: 229 and 231; Piombini and Foltête 2007: 102); and the number of parking spaces (Foltête and Piombini 2007, 229). Several studies also underline the variability of results depending on the motives of movements; utilitarian movements, for example, are differently impacted by the aforementioned factors than are leisure trips (Genre-Grandpierre and Foltête 2003: 15; Piombini and Foltête 2007: 100). It is worth recalling that a large number of these factors were already evoked with foresight by Jacobs (1961) or even Lynch (1960), who also insisted on the necessity of considering them in combination. Nevertheless, quantitative methods to evaluate their integrated impact more systematically were only developed in later decades (see Handy 1996 for the state of the art at the end of the 20th century; see also Cervero and Kockelman 1997).

The slow city and walkability

More than 20 years ago, in 1999, the Slow City concept emerged in Italy with the creation of a network of small towns, *Cittàslow*. The common goals of these towns revolved around the development of soft and slow mobility, the reorganization of working times, the promotion of quality of life at the local scale, and the economic and cultural valorization of local areas (Knox 2005; Pink 2008; Pink and Lewis 2014).

Applied to mobility, the Slow City concept considers the previously described findings and proposes to overturn a conception that would erect speed as the source of urban vitality (Pelgrims 2020). Hence, the Slow City concept aims to create a new paradigm that would constitute an alternative to the domination of mechanized traffic in urban spaces (Pelgrims 2020; Turkseven Dogrusoy 2011; Genre-Grandpierre 2007). The application of the Slow City concept nevertheless faces a few hindrances. First, it is often proposed in the name of environmental and heritage values but clearly raises questions about several economic, social and urban issues (Bopp, Der Ananian, and Campbell 2014; Godillon, Lesteven, and Mallet 2015). Because slowness is often thought of in terms of attitudes and ways of life, its materialization in public spaces is found to be lacking. When it nonetheless finds its way into urban design, the Slow City concept often leads to the creation of zones of limited car traffic in the historic parts of town centres. Slow then literally means moving slowly by walking. Such infrastructures are often susceptible to fostering new touristic dynamics that, in turn, could contribute to the production of new forms of gentrification, which is precisely what the Slow City concept aims to avoid, as argued by Knox (2005:7–8): 'paradoxically, Slow City designation becomes a form of brand recognition within the heritage industry [...] the charming attractions of Slow Cities could all too easily be overwhelmed by tourism'.

Furthermore, it is worth noting that the Slow City concept also presents specific problems in terms of scale and mobility design. The Cittàslow network only includes small towns (fewer than 50,000 inhabitants) that have embraced the ideal of an overall reduction of speed in their ways of life. When such a concept is – often loosely – applied to larger cities, it often leads to particular infrastructures and legal dispositions being concentrated in the city centres. There, the concept takes the form of slowing down car traffic by introducing speed limits (as in residential areas of Belgium with speed limits

of 20 km/h), of the introduction of pedestrianization schemes in urban centres, or of the creation of shared spaces in terms of mobility, in areas often targeting high-income groups within processes of urban renewal under a neo-liberal market logic (Audikana 2019). The Slow City concept can also take the form of a pedestrianization scheme associated with the development of public spaces in the vicinity of train stations and public transportation hubs. This tendency is very typical of Transit-Oriented Development (TOD), born in North America but emulated in Europe and elsewhere in the last decade (Pal 2018; Thomas et al. 2018). Then, the concept can also involve slow mobility networks at the metropolitan scale but where modes of transportation are treated in a functionalist and segregating logic (Bopp, Der Ananian, and Campbell 2014). This is, for example, the case of the Two Networks Strategy, which distinguishes between, on one hand, functional fast lanes linked to mechanized modes of transport and economic efficiency and, on the other hand, slow lanes related to leisure and also comprising green and blue networks (Tjallingii 2012). Although this type of approach acknowledges the multiplicity of mobility practises, it fails to consider the sharing of the city's public spaces as a whole and to address the coexistence of speed and slowness within the same space (Paiva, Cachinho, and Barata-Salgueiro 2017; Osman & Mulíček, 2017; Godillon, Lesteven, and Mallet 2015; Parkins, 2004; Urry, 2009).

Finally, slowness is also reflected in the recent concept of the '15 minutes city', developed by Carlos Moreno of the Sorbonne University, which aims to reorganize the city around walkable spaces in 15 minutes radiuses, in which a significant offer of services and a better quality of life would be deployed (Whittle 2020). In recent years, the concept has been implemented in the public policies of some large cities such as Paris, Milan and Brussels. The latter is translating it at the regional level with the concept of 'noyaux d'identité locale' but also in policies adopted at the level of the municipality (Corijn and Vanderstraeten, 2018). This concept, which appeared particularly relevant with the lockdown provoked by the COVID-19 pandemic, is interesting in terms of the deployment of walkable spaces, but it is no less problematic in terms of social inequalities in access to housing and services (Weng et al. 2019), which remains one of the major issues in the deployment of the slow and walkable city.

Methodology for the walkability analysis

Testing our hypothesis requires a tool that would allow us to categorize how public spaces can afford practices of pedestrian mobility. This tool would be akin to the Pedestrian Environment Factor (PEF), which was designed to measure the 'pedestrian friendliness' of urban environments (Parsons Brinckerhoff Quade and Douglas I, Systématics C and Associates C 1993), or to the Pedestrian Environment Index (Peiravian, Derrible, and Ijaz 2014). The differences between the PEF and the PEI are on the attributes used and their ranking. The PEF, for example, is based on four attributes of the built environment of Portland, Oregon, each ranked on a scale of 1 to 3. These attributes are ease of street crossing, sidewalk continuity, street connectivity, and topography (Parsons Brinckerhoff Quade and Douglas I, Systématics C and Associates C 1993).

The PEF's and PEI's principal shortcomings are that like many indicators of this type, it confines itself to a logic of modal segregation, primarily investigating sidewalks

or other pedestrian spaces. Interactions with other modes of transportation are evaluated on the basis of the width of intersections, the presence of traffic lights, the amounts of car and pedestrian traffic, etc. In other words, each metric is only considered in relation to the space that is dedicated to it in the total width of the street. Space for car traffic, for example, is measured in relation to the car metric, and thus the car remains the first-class user of public space. To our knowledge, there is no indicator that includes all modes of transportation while evaluating them in relation to a pedestrian metric as the main frame of reference.

We therefore aim to address the sharing of public space while integrating the spatial configurations and infrastructures specific to each mode of transportation (Mezoued and Letesson 2018). We focused on the materiality of street networks to evaluate the walkability of spaces dedicated to each mode of transportation and to synthetize this information for the public space in its entirety (Büscher, Urry, and Witchger 2010). These analyses were conducted at the scale of the Brussels-Capital Region (hereafter BCR), following different steps:

1. *Ranking mobility infrastructures on the basis of their affordance for walking*

To approach the sharing of public space as systematically as possible, we devised a table comprising all modes of transportation that occupy public space with specific infrastructures, while ranking these infrastructures on the basis of the more or less confrontational nature of their relation to the pedestrian metric. For each mode (pedestrian, bike, tram, bus, and car), the table is divided into four columns that correspond to urban infrastructures ranging from the least to the most accommodating to pedestrian movements (Figure 1). However, it should be noted that some of the configurations don't exist in the case of Brussels on which this work is based. It is notably the case of the Bus and Tramway level 1. Also, Tramway level 4 exists in only one configuration, on a section of a few dozen meters. They are therefore included in the table but without illustration.

The various materializations of each mode of transportation were mostly ranked on the basis of the criteria of permeability and safety while considering their *adherence*[2] (Mezoued 2016). Related factors such as speed limits and priority rules were also considered. It is also worth noting that here, permeability is treated somewhat particularly. In the aforementioned studies, permeability clearly refers to the relation between the street network and built space. It is one of the four generators of diversity discussed by Jacobs (1961, 150–151), the 'need for small blocks', which she interprets by underlining that such an urban morphology allows for multiple potential itineraries – in other words, high permeability – and, consequently, can trigger a better distribution of users within the street network, i.e. one that maximizes encounters and co-presence (Jacobs 1961, 178–186).

In this paper, permeability is considered the potential of a street segment, characterized by the infrastructures of the modes of transportation that are represented on it, to be crossed by pedestrians in a transversal movement. By adopting this definition of permeability, we do not intend to minimize the longitudinal movements, but we chose to highlight the strong potential of walking to percolate through urban space. As argued by Jacobs: " [...] the main virtue of pedestrian streets is not



Figure 1. Ranking of affordance to walking of the spaces dedicated to each mode of transportation. The four columns correspond to urban infrastructures ranging from the least to the most accommodating to pedestrian movements.

that they completely lack cars, but rather that they are not overwhelmed and dominated by floods of cars, and that they are easy to cross' (Jacobs 1961: 348; our italics; see also Genre-Grandpierre 2007, 34–35). Thus, we voluntary chose permeability instead of 'crossability' to highlight the width of the streets, which comprises an area extending beyond the lanes dedicated to a specific mode of transport to

encompass the entire breadth of the public spaces. This table is therefore used as a tool for a preliminary approach to the tensions, within a street network, between 'general space' ('land used for general public circulation by people on foot') and 'special space' ('land not commonly used as public thoroughfare by people on foot') (Jacobs 1961, 262–263). In other words, we will specifically measure to what extent street segments dedicated to particular types of movements and corresponding to different metrics hinder the percolation of pedestrian circulations within the urban space in Brussels.

2. *Collecting GIS data sets*

The next logical step was to implement the modal table in an environment that would allow the visualization of its spatial materialization at the regional scale while making it possible to integrate the other factors potentially impacting the pedestrian metric. The Geographic Information System (GIS) ArcGIS and its component ArcMap were selected as the main work platform. We first collected raw geospatial data (feature class) available from various public institutions.[3] These data mostly comprised the axis (polyline) or outline (polygon) of different categories of public roads and streets, of public transport lines, and of the demarcation of administrative boundaries, waterways and bodies of water. Other elements (points) were also selected; they represent enhancers and impediments to the pedestrian metric, used at a later stage of our analyses.

3. *Classifying data according to the mobility infrastructure ranking*

Once the geospatial data sets were collected, a key step of our approach revolved around the modification of the feature classes to generate shapefiles corresponding to the four levels of each mode included in the analyses. This represented a lengthy process requiring geoprocessing operations and vector drawing to complete and/or modify some of the results of these operations. Furthermore, several procedural steps were followed to evaluate or improve the data quality through field observations, satellite imagery, and Google Street View. This process led to the creation of shapefiles representing most of the levels of each mode of transportation.[4]

4. *Transferring data attributes to the same spatial visualization: street axis*

The next step was to transfer these shapefiles – and particularly their attribute tables – into a single axis system corresponding to the median longitudinal axis of the street polygons defined by the BCR. The polygons of paths within parks and forests were also included. These operations aimed at integrating all attribute data within the same spatial visualization. They also contributed to spatializing the ruptures created by the railway and (pre) metro[5] infrastructures within the urban layout and the impact of various enhancers and impediments to the pedestrian metric, as described below.

5. *Merging data of all modes of transportation in each segment of the public space*

This merging of spatial data had, as its objective, the cartographic visualization of each street segment in relation to its affordance for walking when all modes of transportation present on it are considered together. As mentioned above, the railways and (pre) metro lines were integrated after the merging of the first five modes of transportation (i.e., pedestrian, bike, tram, bus, and car). In terms of the attribute table, given that each segment was given a score (from 1 to 4, from the least to the most hospitable to walking) for each mode it hosts, a simple ranking system was created. Each segment was given a ranking that corresponded to the sum of the scores of its different modes of transportation, i.e., a total value between 1 and 20.[6] This does not take into account the simultaneous presence of the same mode of transport in several configurations (e.g. suggested bike lane and segregated bike line). They are actually often counted with the mode dominating the public space design (e.g. suggested bike lane counted within the bus line or the car lane).

To compare segment rankings for streets that do not systematically host all the same modes of transportation, a normalization was necessary and was computed by dividing the total value of each street segment by the maximum value it could have, i.e., the number of modes of transportation it hosts times 4. Each street segment was then given a normalized score between 0.25 and 1. Consequently, the closer the score is to 1, the more the street segment has, according to our criteria, an affordance for walking.

The final result of our geomatic analyses, the normalized plan (Figure 2), is devised as a finer characterization of the BCR street network in terms of affordance for walking. This plan results from the merging of the different modes of transportation classified by levels of affordance, from the very unfavourable to the very favourable for walking, as it is represented in the synthetic table (Figure 3). The final result (Figure 2) produces a cartographic representation that, in our opinion, translates the complex combination of factors that potentially impact the pedestrian metric. In other words, this is a walkability plan of the BCR, as defined by the criteria listed above. It also features circulation spaces in which conflicting uses could emerge due to the coexistence of radically different walkabilities in a relatively restricted area. Such spaces could then be prioritized for interventions in terms of urban planning and/or regulations. More generally, the plan summarizes the spatial distribution of walkability throughout the BCR, emphasizing one aspect of its urban structure. Practically, the plan is based on the ranking of each individual segment in terms of affordance for walking from one lateral limit of the public space in question to its opposite lateral border whatever their materialization (building's façade, infrastructure, natural border, etc.)", represented by a colour scale ranging from green – Highest affordance potential – to red – Least affordance .

6. *Adding enhancers and reducer values*

To refine this approach, we integrated various elements that could potentially have an impact on walkability. These elements are divided between enhancers and impediments, selected, depending on the availability of data, among a list of factors listed by the

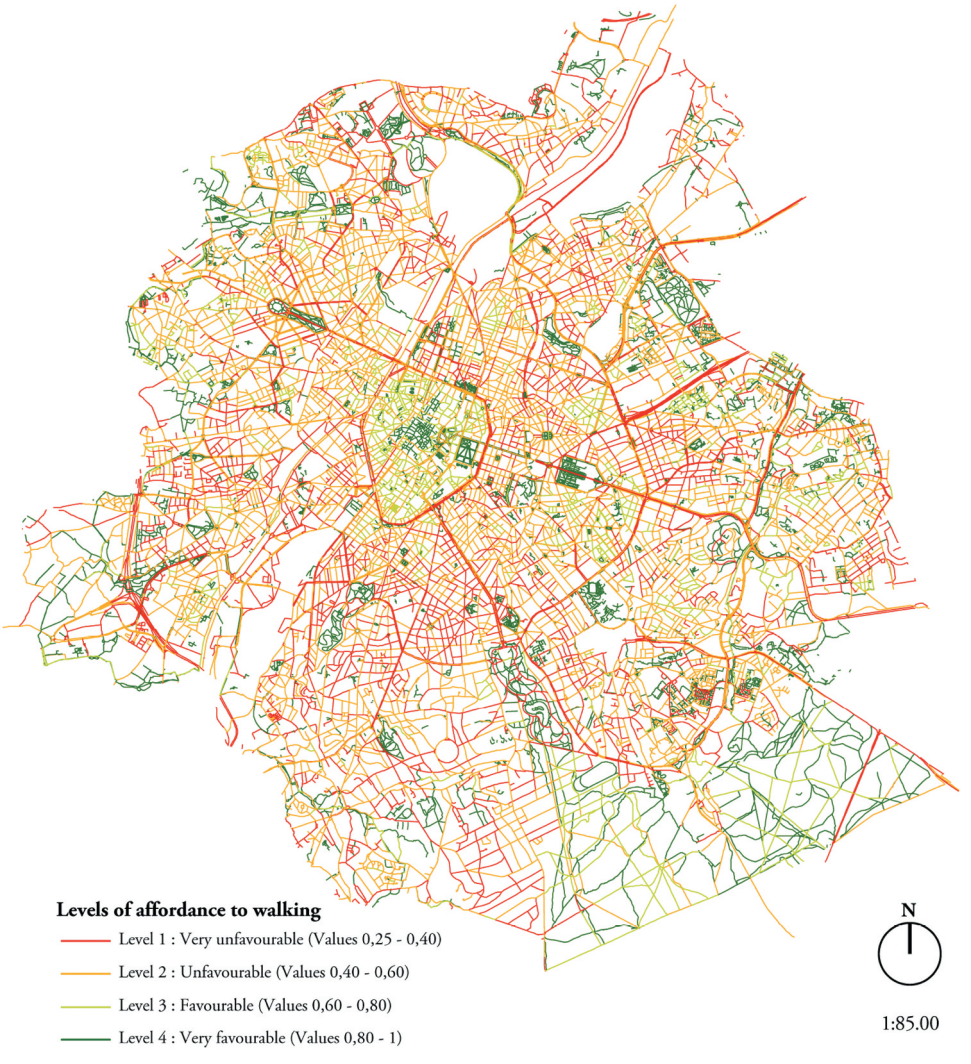


Figure 2. The normalized plan of Brussels' public spaces walkability (Affordance to walking without enhancers and impediments). Data sources : URBIS, Mobigis, OpenStreetmap, Stapas.

literature as having potential impacts on pedestrian movement (Table 1). When they exist on a street segment, enhancers such as trees, public lighting, benches, pedestrian crossings distant from traffic lights on streets with a 50 km/h speed limit, and public transportation stops add a bonus to the normalized value of the segment. In parallel, we also considered the existence of factors that could have a negative impact on active mobilities, such as the presence of cobblestones[7] and ruptures in the street networks created by railways, pre-metro lines and associated road structures, such as bridges and tunnels. These impediments consequently negatively affect the normalized values of the segments in which they exist. Finally, due to Brussels' hilly nature, we also added topography as a modifier of the normalized value (Table 1).[8] In the plan resulting from the integration of enhancers and impediments (Figure 4), the number of street



Figure 3. The synthetic table or the spatial deployment of mode of transportation according to the four levels of affordance to walking. Data sources : URBIS, Mobigis, OpenStreetmap, Stapas.

segments that appear that do not have a high potential of affordance for walking. In other words, the data are strongly influenced by the bonuses and maluses chosen to express the effect of enhancers and impediments on the walkability of street segments.

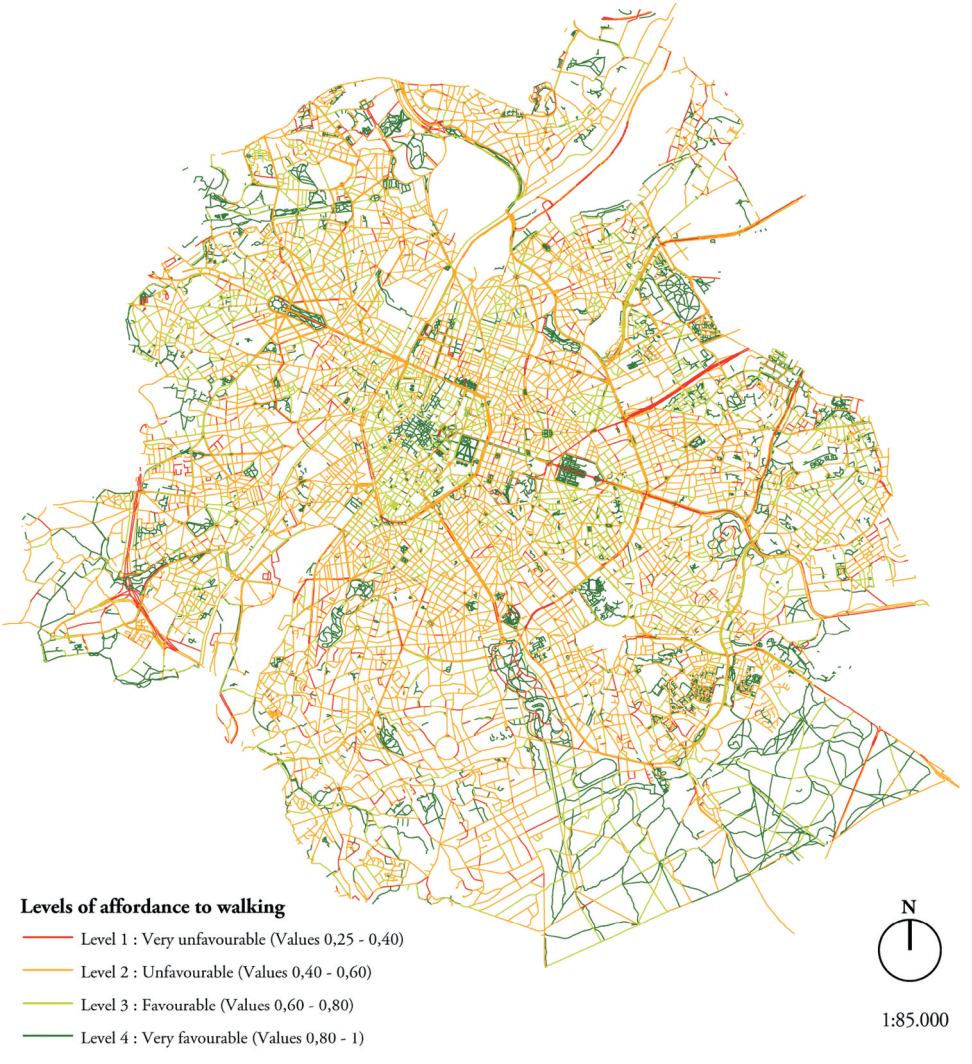


Figure 4. The global plan including enhancers and impediments to walking. Data sources : URBIS, Mobigis, OpenStreetmap, Stapas.

Judging by the fact that the plan clearly turns green (Figure 4), the impact of bonuses seems to largely overshadow the maluses selected in the analyses. The most important factor in terms of score modification relates to slope gradients, which can be considered as having a decisive impact on the pedestrian metric. Nevertheless, we concede that the use of enhancers and impediments should be better integrated and that the evaluation of their actual impact should be more clearly defined.

Although the global plan and the synthetic table (Figure 3) provide a first overview of the problem of the sharing of public space and highlight the pitfalls with which the articulation of different modes of transportation (and their metrics) are potentially confronted in urban settings, they are nonetheless lacking in some aspects. This

research is preliminary, and some of its limitations warrant further elaboration before discussing the potential usefulness of this geospatial tool.

The first problem revolves around the choice of the enhancers and impediments and the weighting of their respective impacts on walkability. At this stage of the research, pending a more systematic evaluation of these factors, it seems almost preferable not to include these variables in the ranking of street segments. Luckily, there is a vast literature dedicated to the evaluation of the impact of urban morphology on pedestrian movements (Pafka, Forsyth et al. 2008; Frank et al. 2010; Rodríguez and Joo 2004; Newman and Kenworthy 2006; Flitti and Piombini 2003; Foltête and Piombini 2007; Genre-Grandpierre and Foltête 2003; Pafka and Dovey 2017), on which the implementation of these factors could be based. (Table 1) summarizes these findings and ranks them in descending order in regard to their relative importance as attested to in the studies listed above. In parallel, to allow a first evaluation of their relevance, we also listed the enhancers and impediments that were selected and implemented in our analyses.

The second pitfall of our research is, on the one hand, the fact that our preliminary results have not yet been compared to data related to the actual use of urban space and, on the other hand, the lack of a more qualitative approach. Focusing the research on the urban morphology of street segments without comparing these results to field observations or survey data confines our research to a theoretical and relatively abstract level. We nonetheless argue that our results show potential as an innovative exploratory tool. Hence, it is possible to compare our geospatial data to survey data focusing on the effective use of these different street segments. These surveys could be conducted in different ways: gate counts, semi-directive interviews, online questionnaires, GPS tracking, etc. Subsequently, these data would clearly benefit from a more qualitative approach. Ranking street segments on the basis of purely physical elements (infrastructures, amenities, street furniture, etc.) clearly overlooks the subjective character of human perceptions. The next logical step of our research would then be to focus on perceptions associated with pedestrian movements. Several methods can be used in that regard: mental maps, audio and video recordings, interviews, participant observation, etc. These approaches could ultimately allow a finer understanding of individual differences in the appropriation of the pedestrian metric (Cresswell 2010) while considering other factors such as sounds and smells that also characterize urban environments and potentially influence behaviours and uses of public spaces (Francou and Van Hollebeke 2015).

Discussion

Our creation of an analytical methodology to evaluate the walkability of public spaces is only part of a larger research project aimed at approaching the Slow Metropolis in an isotropic, non-segregating and comprehensive way. It is therefore important to emphasize that our geospatial tool is a first step that clearly deserves further development. Our generic modal table could be used in other cities, and the tool, considered an open-source project, will be made available in the hope that other researchers might develop it further, adapt some of its functionalities, etc. In this paper, methodology and its implementation are indeed key aspects of the research. The way of considering the

walkability by taking into consideration the affordance for walking of all the modes of transport is the basis of the process. Therefore, based on this methodology, the tool can be adapted in any context, provided the availability of certain basic data sets.

For Brussels, our research is the starting point of the 'Brussels Slow Metropolis' project; it will ultimately be combined with the results of other ongoing or completed analyses: on the one hand, qualitative approaches to the uses of public space and pedestrian movements, on the other hand, space syntax analyses to identify street segments that have the potential to be preferential destinations or to host more movements (Letesson 2018).

Our geospatial tool and its results for Brussels can nonetheless be operationalized in several ways: a tool – potentially cooperative – for evaluating the affordance for walking of public spaces, a tool to support decision-making in urban management and finally, a tool for urban design.

An evaluation tool for the affordance of public spaces

The analytical table and its cartographic visualization can first allow, at a glance and for the whole BCR, the identification of locations that have high walkability potential. Used in this way, our cartography can, for example, be used to supplement the ongoing work on Brussels slow mobility networks. Our work could also be mobilized for the creation of cartographic documents dedicated to leisure or more functional activities linked to pedestrian mobilities. We could also imagine turning our tool into an app allowing users to plan their trips according to the walkability of particular itineraries.

By refining the enhancers and impediments and calibrating them on specific parameters, affordance could be evaluated with regard to particular types of users (elderly or disabled people, users with impaired vision, children, etc.) or uses of public spaces. For example, the 'jogging plan' the BCR is currently working on could be designed on the basis of the affordance of public space for walking. Through the identification of specific enhancers or impediments to running (sidewalk width, pavement flooring, presence of water fountains, air pollution, etc.), our geospatial tool could be tailored to identify street segments with good walkability. Linking them together in a coherent network would then define potential itineraries for the 'jogging plan'.

The cartographic visualization can also form a collaborative evaluation tool. For example, it could be made available online for people to rank their own streets in terms of walkability on the basis of their experience and perceptions. We could then feed these observations back into the geospatial tool, hence progressively implementing a more qualitative score to complement our approach, essentially based on permeability and security.

Decision-making Tool

Our results, as preliminary as they are, could also be used as a decision-making tool for different types of stakeholders or actors. This tool could, for example, provide public authorities with a broad overview of the quality of public space, which could be instrumental for strategic planning. Furthermore, the tool could easily be used to evaluate projects from different public services, network operators (Dupuy 1991), and project creators with regard to the impact of each intervention on each area's overall

affordance for walking. Operators of the first level (Dupuy 1991) can, for example, evaluate the different sections of their public transportation lines. With the input of the synthetic table (Figure 3), they can act on the existing network while balancing operational requirements with impact on the pedestrian metric, used as a reference. Similarly, they could use the graphic visualization as an indicative framework for the extension or creation of new lines within the network.

Urban design tool

Finally, we believe that our geospatial approach and its results could be successfully used as an urban design tool. This tool could help us to envision the public space of the Slow City without promoting a total slowing down of the different modes of transportation, the exclusive pedestrianization of central spaces or a Twin Tracks strategy (Tjallingii 2012). In our opinion, rethinking street sharing should first imply a modification of the car system and a re-territorialisation of its associated spaces. In other words, what matters here is to diminish the negative effects of this metric and the spatial ruptures created by the infrastructures it requires (Jacobs 1961; Genre-Grandpierre 2007). The total or partial diminution of circulation speed can only engender positive results on the quality of pedestrian movements if qualitative arrangements are made concomitantly. These modifications need to be adapted to each particular street segment, depending on its size, overall layout and the presence of various modes of transport. Sometimes, modifying the speed limit is enough to transform the spatial quality, although it might also be necessary to widen sidewalks, to insure the continuity and even nature of pedestrian areas, or to create dedicated spaces for public transport, etc. The balance among these types of interventions also depends on the activities taking place in the area and the overall connectivity of the segment within the global street network.

The value of such an approach is to manage all modes of transportation while using the pedestrian metric as a frame of reference. This could help create 'walkability surfaces' (Frank et al. 2010) where pedestrians can freely use all of the public space, without formal boundaries or limits, while allowing the deployment of other modes of transportation and speeds. In such a scenario, the car system and the place of public transportation need to be reconfigured. They will indeed need to be adapted to this new logic and reinforce their adherence to the local urban environment, for example, through pedestrian continuities (Mezoued 2016). Furthermore, one needs to keep in mind that using the pedestrian metric as a reference implies more than reconsidering people's movements. The circulation of goods and objects is also of crucial importance and often overlooked (Cochoy, Hagberg, and Canu 2015). In that line of reasoning, the use of cargo bikes, cargo trams, platforms for alternative delivery systems, etc. can clearly constitute additional enhancers to slowness.

Limits of the study

Beyond the potential of the methodology and the analytical tool developed in this paper, this study nevertheless has some limits and drawbacks.

The first one is the way in which modes of transport were classified in the first stage of the process. The ranking was done on the basis of an objectification by the researchers based on the literature, the evaluation of the adherence of the modes of

transport and the spatial extent of the infrastructures in the public space. The experimental nature of the process and the lack of time did not allow the verification of this ranking in relation to real practices or feelings. Therefore, a complementary study on the perception of the walkability of the different configurations of transport infrastructures would be a significant addition which could, if necessary, lead us to re-adapt this classification.

The second limitation concerns the tool's dependence on the availability of GIS data. This makes the replicability of the method limited and more complex in contexts where data are lacking, the production of the latter being a work in itself. Moreover, step 4 of the process, concerning the transfer of attributes on the same spatial visualization, is a heavy step in terms of data processing. At that stage, the risk of information loss is real without rigorous and systematic control of the GIS process. It could certainly be simplified with access to better data sets and the automation of the process.

The third limitation concerns the work scale. Working on the scale of the entire region makes data processing more complex, on the one hand, and does not allow for different spatial configurations to be taken into account on the other. For example, it was not possible, at this scale, to include, in our GIS tool, the calculation of sidewalk widths and their contextual variations, such as widening, depressions and others, along the same segment of public space.

Finally, considering only the enhancers and impediments available in the data set and not all the elements having a potential influence on the walkability of public spaces can undoubtedly introduce several biases in the final results.

Conclusion: the slow metropolis, a walk-oriented development project?

The analytical table, its associated cartographic visualization and its potential as an urban design tool bring us back to our initial question: is it possible to conceive and materialize slow mobility at the scale of a large city, and what type of project would embody such an approach?

To fully answer this question would ideally require comparing our results with an in-depth analysis of uses and their spatial distribution. The articulation of speed and slowness indeed largely depends on the requirements of particular lifestyles and economic activities. Whereas Tjallingii's (2012) 'Twin tracks strategy' can establish an optimal link between fast and slow lanes and their respective spheres of activities, it is not devoid of negative counterparts, especially because of the potential disruptive effects of the infrastructures of speed (Graham and Marvin 2001). In our approach, fragmentation and boundaries linked to such elements are minimized. Furthermore, streets do not need to remain monofunctional or mostly adapted to a single mode of transportation. Although the pedestrian metric is the reference, other modes are present, and different speeds coexist. In other words, when a street segment appears green on the cartographic visualization, it does not mean that it is exclusively pedestrian. It could comprise for example two fast lanes each way, wide and well-furnished sidewalks, and green and accessible median strips. This is the synthesis of infrastructures that ultimately defines the affordance of public spaces.

A radical design option aimed at turning the whole map of the BCR green – that is, giving priority to pedestrian mobility – would then imply a skilful combination of actions and configurations of infrastructures adapted to the activities that are present or that need to be developed in the area considered for modification. This approach would correspond to some sort of walk-oriented development (WOD), linked to transit requirements but where priority is given to creating a qualitative urban space for all and in all parts of the city. Such spaces, allowing a slowing down of mobilities could, on one side, contribute to the slowing down of lifestyles without imposition (Datta 2020; Paiva 2016;) and, on the other side, create the conditions for the pooling of activities and emergence of commons in which society can reinvent itself (Mezoued, Kaufmann, and Nasdovisky 2019). Furthermore, the relationship between speed and slowness is transformed. As hinted at by Lévy (2008), pedestrian mobility, labelled as 'slow' in our original premise, can become fast in a dense and diverse city by comparison to other metrics.

Considered as such, the Slow Metropolis as a walkable city implies a reconfiguration and a re-territorialisation of its spaces and activities. It must strive to evolve towards a sustainable urban context with all its associated implications in terms of environmental, economic, social and mobility aspects.

Notes

1. A term coined by Lévy (2008), *métrique* in French. A 'metric' could be defined as a modality of defining and managing distance. In other words, the metric of a particular mode of transportation encompasses various aspects such as its points of connection with the territory, its spatial distribution, its speed, its propensity to allow perception of the surrounding environment, etc.
2. Another concept introduced by Lévy (2008) which could be translated as 'adhesion' and defines the capacity of a mode of transportation to offer a large number of points of contact (i.e. entry or exit points, or stops) with public space on their trajectories.
3. Most of the data were downloaded from the GIS data platforms of the Brussels-Capital Region: URBIS for basic data relating to public spaces and their various components (https://urbisonline.brussels) and Mobigis for data relating to mobility (http://data.mobility.brussels). For the classification of the four pedestrian categories in (Figure 1) (Row 1), we used data from the Brussels slow lane guide (STAPAS – be walking, be brussels: https://www.stapas.be). These were produced by the non-profit organisation Trage Wagen, on behalf of Brussels Mobility, using OpenSteetMap data and field observations conducted by them, which they classified based on the participation of volunteer observers in the field.
4. Levels 1 and 4 for the tramway and level 1 for the bus do not exist in BCR.
5. The (pre)metro is a peculiarity in Brussels. It comprises tunnels hosting tramways rather than actual subway cars.
6. These extreme values are of course theoretical. A score of 1 would correspond to a street segment hosting only one mode of transportation, which would be very inhospitable to walking, whereas a score of 20 would represent a street where the five modes of transportation are present and in a configuration that is characterized by its extremely good walkability.
7. Brussels Mobility carried out a study on floor coverings, which it classified according to the comfort provided to a variety of pedestrian users, including the elderly and people with reduced mobility. The cobblestones register relatively low variable values. Their implementation requires a special attention that is not often encountered and their degradation over time reduces comfort: https://mobilite-mobiliteit.brussels/sites/default/files/charte_sur_les_revetements_pietons.pdf
8. Slopes > 5.1% and < 14.9% did not get any bonus or malus.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Fédération Wallonie Bruxelles Internationale –WBI.

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