Assessing Walkability Conditions

Contributions of the Space Syntax methodology

Extended Abstract

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Abstract - Pedestrians are the fairest mode of transportation, as it is inherent to every person and there is no cost associated. Nevertheless, during the last century, pedestrians were left aside, due to the ascension of the motor vehicle. That choice, made by society, has caused great transformations in the city, particularly, in less walkable environment. Nowadays, the many challenges that cities are facing are leading to an emerging mindset, aligned with the sustainable planning, where active modes (pedestrians and cyclists) are regaining importance, due to the numerous benefits it encompasses.

This work aims to understand the walking environment and pedestrian behavior and to develop a tool to assess this context, therefore, supporting the urban planning toward a more inclusive and walkable city. That was accomplished by an extensive research about the pedestrian mode and the state of art regarding walkability. Based on that, two methods were employed to build up the assessing tool, "IAAPE walkability score" (IAAPE) and "Space Syntax" (SS). The former is a walkability index, that deals with the walking environment and was built upon the perception of different types of pedestrians. The latter corresponds to a well-known method to analyze the urban configuration and flows.

A SS model and measures were adapted to be incorporated within IAAPE, resulting in an improved walkability index, easier to handle and more efficient. Other than analyzing a single environment, the tool can be used for other purposes, being of help to the urban planning and design fields.

Keywords: walkability, walkability index, pedestrians, space syntax, IAAPE, Lisbon

I. Introduction

When do we, as pedestrians, have a great experience walking in the cities? How should a comfortable and attractive walking environment be thought and designed? The answer, an urban planner would say, is far too complex. Indeed, the issue involves many dimensions of urban life. Walkability, the subject of this dissertation, corresponds to the extent that an urban space supports and encourages walking and meets the pedestrians' needs (Southworth, 2005). It is, therefore, at the core of pedestrian planning.

The importance of the subject comes from its benefits. Walking helps reducing traffic congestion, which impacts positively on the environment, in terms of pollution reduction (air, noise, soil) and, therefore, it is also reflected in public health. Health, in turn, is fostered due to a reduced exposure to pollution and for walking being a physical exercise. All these effects influence the economy, given the reduction on health and congestion expenses, whereas pedestrians are the mode that boosts the most the local economy (ARUP, 2016; OECD/ITP, 2012).

Notwithstanding the importance of walking to society, this mode has lost priority and space along our recent History, mainly due to the appearance of other means of transportation (Southworth, 2005). This fact has caused not only a lack of investments for pedestrians but also resulted in an aggressive and dangerous environment for them (Norton, 2008). On the other hand, because of changes in paradigm, especially related to a sustainable planning, active modes are once again receiving attention and priority (Lo, 2009).

The pedestrian mode depends on a wide range of issues, from the individual characteristics to some global ones, like local culture, context, and the built environment. Every single aspect helps to determine walking behavior, encouraging it or inhibiting it (Moura, Cambra, & Gonçalves, 2017). Consequently, many fields of study have been researching this subject caring for its different dimensions (Ewing & Cervero, 2010; D'Arcy, 2013).

This dissertation deals with the pedestrian topic within the fields of urban planning and design and intends to bring some contributions to the understanding of the walkable environment. The research starts by outlining important facts and studies about pedestrians and walkability and, based on this knowledge and on already established methods, it aims to bring the discussion to a pragmatical level.

Many methods and tools are currently being used to evaluate the pedestrian environment, however, none of them has been taken as a standard procedure. Other than creating more tools, this dissertation takes advantage of the existing ones, exploring methods that can be combined to achieve better processes and/or outputs.

This work focuses on two main objectives, which complement each other:

1. Understanding the walkable environment, minding its political, social, economic and environmental importance, as well as its transformation over the years.
2. Combining existing and complementary methods (IAAPE walkability score and space syntax) to deliver a more comprehensive and efficient tool to support urban planning, decision-making and urban design towards a more walkable and more inclusive urban environment.

The methodological steps to answer these objectives are the following:

1. A literature review regarding the pedestrian environment and the state of art of walkability; followed by a review of the methods that support this study, IAAPE and space syntax;
2. The development of the model, pointing out some hypotheses on how the methods can be used to contribute to the walkability field: the adaptation of the space syntax model and the combination of both methods into a single tool.
3. The application of the model in a case study in Lisbon (Portugal), comprehending a sequence of tests to be developed and validated;
4. A final exercise to test the flexibility of the tool;
5. The discussion of the outcomes and the conclusions of the study.

II. Pedestrian Research and Walkability

Throughout History, mobility technologies had appeared, entailing transformations in the urban environment and on how people live in cities. Walking, as the first mean of transportation of the human being, has shaped the first settlements. (Gondim, 2014).

Depending on the historic period, pedestrians had either an important role or were left aside in favor of other modes. Invariably, it resulted from the prevailing socio-political mindset, that defined the priorities for cities, which can be observed in the rules and in the built environment of each period (Southworth & Joseph, 2003).

It was, however, in the last century, with the introduction of the individual motor vehicles, that the greatest transformation of the urban history took place. In the beginning, cars were seeing as a hazard, due to their externalities (noise, pollution, congestion, accidents, fatalities) and were strictly regulated. Nonetheless, soon after, some players related to the car industry organized themselves into an important political voice, turning the tide in favor of cars and against pedestrians (Norton, 2008). That situation was later endorsed by architects and engineers from the Modernist movement, who played an important role to set the car-centric culture (Southworth & Joseph, 2003).

This shift set the bases of transport planning for the rest of the century and, from then on, pedestrians became a kind of "second-class" citizens, being disregarded in the planning process (Vasconcellos, 2001). It has led to consequences in the way pedestrians navigate in the city, being restricted in terms of rights and space, which has resulted in a fragmented and unpleasant pedestrian environment.

However, over the last decades, a series of issues related to urban mobility have emerged, confirming the inconsistency of the traffic management decisions taken in the last century. They refer mainly to environment preservation concerns, social concerns (inequalities), and technical concerns (congestion and its consequences) (Pozuela, 2000). These issues have been tackled by researchers and institutions and are causing a shift in the transportation mindset, where the active modes (walking and cycling) are regaining importance (ARUP, 2016).

This change is also based on the many benefits that have been associated to active modes and, specially, to walking. For instance, social benefits, related to health and wellbeing, safety, placemaking and social cohesion and equity; economic benefits, including local economy, urban regeneration, cost savings, and city attractiveness; environmental benefits, which are linked to ecosystem services, virtuous cycles, livability, and transport efficiency; and political benefits, like leadership, urban governance, sustainable development, and planning opportunities (ARUP, 2016).

Because of that, walkability, a relatively new term, meaning "the extent to which the built environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journeys throughout the network" (Southworth, 2005), has been receiving increased attention.

Nowadays, researchers from many fields are studying walkability through different perspectives, proving its advantages and trying to understand what makes people walk. Studies have been carried out regarding the built environment, social interactions, pedestrian perception and behavior (Whyte, 1980; Ewing, 1999; Ewing & Handy, 2009; Gehl, 2010).

Different models have been created to address these topics, although there is no consensus about the set of concerns that must be included. Furthermore, the operationalization of the more subjective factors has been a great challenge for researchers. And that is understandable, since pedestrians form a heterogeneous group, not only with respect to their physical and mental conditions, but also diverse in gender, age range, nationality, and socioeconomic level (Melo, Torres, & Jacques, 2004), and, therefore, with different need, interests and perceptions.

Finally, walkability is at the core of pedestrian planning, what makes it an essential knowledge to be developed to support urban policies and/or design towards a more inclusive and equal environment.

III. Review of methods

This dissertation draws upon existing methodologies, IAAPE and space syntax, to work the case study out. Instead of searching for a new set of variables on walkability, which can be by itself an exhausting task, the study relies on pre-selected variables of selected methods.

Indicators of Accessibility and Attractiveness of Pedestrian Environments (IAAPE)

IAAPE is a walkability index, i.e., a tool that combines a set of variables to measure the quality of the walking environment and the walking behavior. It has been developed at Instituto Superior Técnico (UTL, Lisbon) and aims to combine factors of pedestrian accessibility and attractiveness and to assemble them in a GIS-based tool. The resulting walkability score can be used to support urban planning and design (Moura, Cambra, & Gonçalves, 2014). The selection and weighting of the factors had derived from a participatory process, that was carried out through an expert panel and stakeholders' sessions. The IAAPE method was applied in two case studies located in the Municipality of Lisbon, the parishes of Arroios and Avenidas Novas.

The selection of this method for this work was based on the following: its broad and careful choice of factors concerning walkability; its social inclusive and participatory nature; the possibility to combine other tools within IAAPE structure; and for the convenience of the proximity and easiness to work and exchange information with the authors.

IAAPE comprehends a set of factors that influence walking, which were sorted into seven groups, the 7Cs layout (Cambra, 2012), as follows:

1. Connectivity: to what extent the pedestrian environment is connected. It refers to the existence of a pedestrian infrastructure and the intermodality;
2. Convenience: how appropriate, useful and time-saving the pedestrian environment is. It relates to the accessibility and to the mix of land-uses;
3. Comfort: how easy, protected and untroubled the environment is. It deals with street characteristics and the quality of street elements;
4. Conviviality: how pleasant the environment for social life is. It has to do with the opportunity for interactions and social encounters;
5. Conspicuousness: how easy it is to walk around. It relates to legibility and wayfinding;
6. Coexistence: how pedestrians and other transportation modes exist in the same place and time. It relates to conflicts and safety issues;
7. Commitment: the existence of engagement and liability toward the pedestrian environment, e.g., policies and walking promotion.

For each of these dimensions, the stakeholders elected key-concerns, which were translated into indicators by the researchers. Then, data were collected for these indicators, weighted and summed to a final score for each pedestrian group. The results, assigned to the sidewalk segments of the case study, could be visualized in maps where the scores were sorted out in five ranges (from the worse to the best scores).

Later, IAAPE final scores were also validated through a home-based survey and through pedestrian counts, resulting in significant and positive association.

Lastly, IAAPE walkability index considers a wide range of quantitative and qualitative data related to several aspects of the pedestrian environment, however, the construction of its pedestrian network and the calculation of the spatial indicators are very time-consuming. Thus, there is space for improvement of the tool.

SPACE SYNTAX (SS)

Space syntax is a theory of space, as well as a tool, developed by Bill Hillier, Julienne Hanson and other colleagues at the University College London in the 1970s. Its main purpose is to investigate the relationship between the built environment and social existence through the study of the space configuration and the movement of entities (Hillier, 2007).

In the framework of SS, the city is represented as a network of spaces, which are the voids between buildings (or other physical barriers). Among the forms of representation used in SS, this work adopted the map of segments, that has a better correspondence to pedestrian analysis.

The systemic approach of SS has demonstrated great potential to study walkability. It has already been used to evaluate pedestrian movement and, in fact, several studies showed that configuration approaches can predict 55 to 75% of pedestrian flows (Lerman, Rofè, & Omer, 2014).

On the other hand, SS focuses on the collective or aggregate approach and not individuals. Therefore, it analyzes the big picture, not the small specificities of society, where some nuances do appear. Also, SS does not consider the physical qualities of the urban grid, such as pavements, slopes, façades, etc. However, these are substantially influential on how pedestrians perceive the walkable environment. Then, in order to deal with walkability, SS must be used in association with other analyses or tools.

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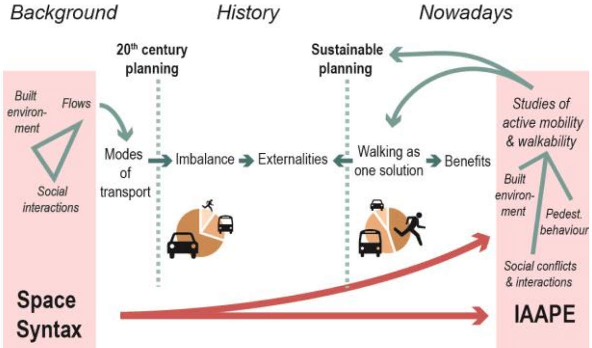

Figure 1. Framework of the pedestrian chapter and how the selected methods are related to it. Source: author.

Erro! Fonte de referência não encontrada. illustrates an overview of the background of this work, pointing out important fact about the mobility and pedestrian, and highlighting how the selected methods relate to this framework.

IV. CASE STUDY

The case study corresponds to the same one used within IAAPE, which comprehends two areas located in Lisbon, Portugal (Figure 2).

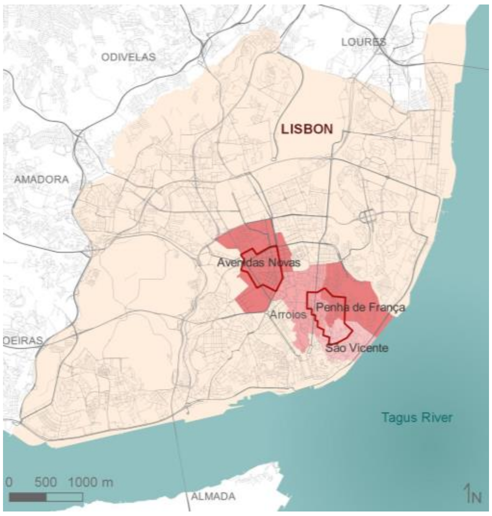

Figure 2. Map of Lisbon and the location of the case study area. Source: author

Both areas are densely occupied, with a mix of uses and well served by equipment and infrastructure. The differences consist of the configuration of the network and the topography (one lays over a flat terrain and presents an orthogonal grid, while the other has an irregular grid, adapted to the steep slope).

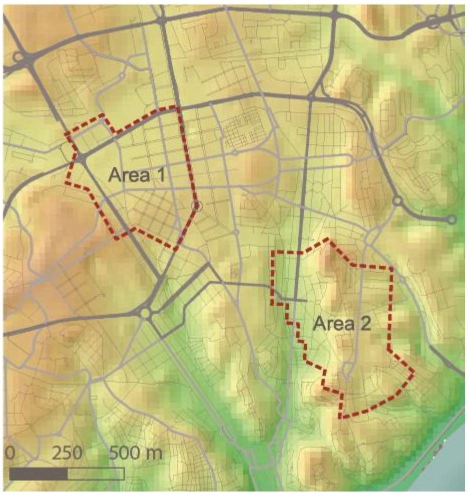

Figure 3. Case study areas, their network configuration and topography. Source: author

V. RESULTS AND DISCUSSION

The exercise involved two methodologies, space syntax and IAAPE walkability score, that are complementary to each other, as well as having a comprehensive and multidisciplinary approach. The exercise had an exploratory nature, in which variations of the space syntax parameters were tested to set the indicators to be combined with the IAAPE method.

The first test was an adaptation of the road-centerline network (RCL network) – commonly used in SS – to a pedestrian one, denominated sidewalk-centerline network (SCL network). The hypothesis was that a SCL network would correspond better to the movement of pedestrians.

The most effective way to build it has proved to be the manual digitalization of the network over a satellite image of the city. Although the quality of this outcome is much dependent on who is digitalizing it, this approach was preferred instead of the automatic generation of the lines-of-sight, because the latter took more time to be settled and resulted in an excess of lines, which would mislead the calculation of the syntactical measures (Figure 4).

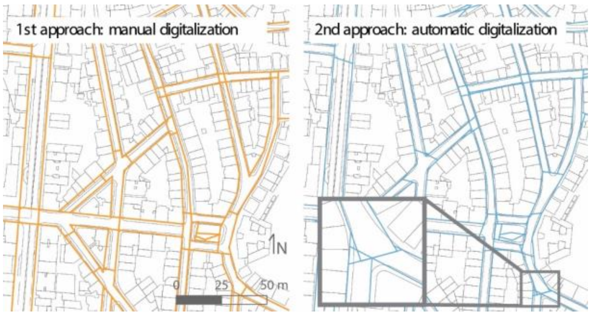

Figure 4. Example of the segment maps. Source: author.

The SCL network was then compared to the default RCL one. The correlations between the pedestrian counts and the integration values of both models resulted better for the SCL network in lower radii of analysis (R600m to R1000m). However, the Fisher's r-to-z test revealed that the difference of the results was not statistically significant (for a degree of confidence of 95%). Thus, through this validation, it was not conclusive that the SCL network is a better representation of pedestrian environment. Nonetheless, it was considered that more data are necessary to validate or reject the approach. Specially because the available pedestrian counts were done for only one side of the street (one sidewalk), and to correlate them with the RCL network, ideally, the counts should be a sum of the pedestrians from both sides.

Still, the SCL network was adopted for it matches the network used by the IAAPE method, and because all the available data corresponds to the sidewalk segments. Also, it was considered that treating a network with more detailing renders more importance to pedestrians.

The validation of the SCL network comprehended two steps: some tests to define its parameters and a visual comparison with the characteristics of the area.

Regarding its parameters, tests were carried out with respect to the extent of the buffer area that must be digitalized around the case study to avoid the edge effect, and the definition of the radius of analysis. Three buffer areas were tested (500m, 1000m, 2000m) and from 1000 meters on the results remained stable, indicating that the edge effect had disappeared (Figure 5). The buffer area must be carefully defined because there is no standard value for it. Additionally, it is particularly important for local analyses, what makes it dependent on the used radii of analysis (Gil, 2015). In fact, the 1000m-buffer was also accepted, because it matches the results for the radius.

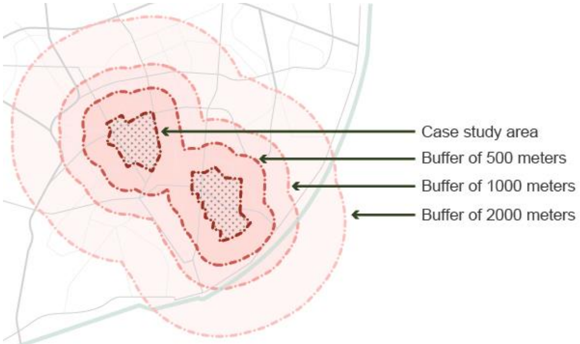

Figure 5. Case study area and the tested buffers.

Different radii were testes (400m, 600m, 800, 1000m, 1600m, 2000m, Rn) and the greatest correlations with pedestrian counting were achieved using radius 1000m for Integration. Choice, on the other hand, presented better correlation for higher radii, which can be explained for it being more sensitive to the number of segments of the model, instead of its size (Gil, 2016). Since choice has either very high or very low values, the correlations are very much dependent on where the counts were made. In this case, these locations were chosen randomly, based on cluster analyses, which prevents major bias.

The second validation was the visual comparison between the syntactical measures and the characteristics of the area. Data about topography (slopes), land use (commerce density) and equipment and facilities were used. These analyses do not intend to demonstrate any mathematical precision but were useful to visualize how the syntactical values indeed reflect some physical and social aspects of the area. Nevertheless, when more data or more detailed information from the site are available, further comparisons can also be tested.

Finally, the syntactical measures were introduced in the IAAPE walkability index. First, the indicators "continuity" and "path directness", from the Connectivity dimension, were replaced be "integration R1000" and "choice Rn", respectively. Then, the measures "synergy" and "intelligibility" were added to the Conspicuousness dimension.

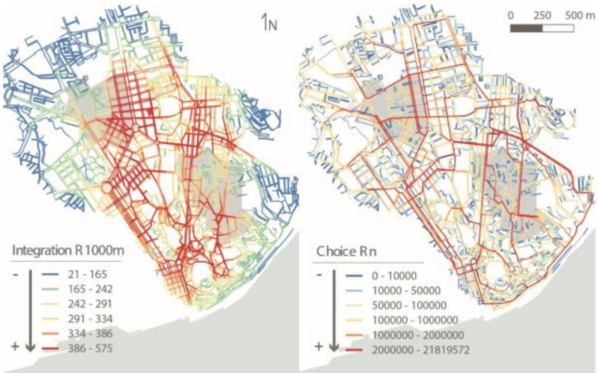

Figure 6. Maps of the syntactical measures of integration radius 1000m e choice radius n.

The syntactical measures of Integration R1000 and Choice Rn were normalized to fit within IAAPE walkability score. A linear function and a logistic function were used to transform the values to a 0-100 range. Three walkability scores were, then, compared: (1) the original IAAPE walkability score – $IAAPE_{WScore}$; (2) IAAPE + space syntax measures with linear transformation – $IAAPE+SS_{linear}$; and (3) IAAPE + space syntax measures with logistic transformation – $IAAPE+SS_{logist}$.

The linear transformation was tested as it is the function used in the IAAPE method. However, considering the distribution of the values, the logistic transformation was thought to translate better the perception of the pedestrian. The reasoning was that for pedestrians, the group of sidewalks with the highest values (well integrated or with higher choice) or the lowest values (very segregated or with lower choice) would impact less in their path decision than the middle ranges. The sigmoid from the logistic function translated this argument, while the linear function treated the values homogeneously (Figure 7).

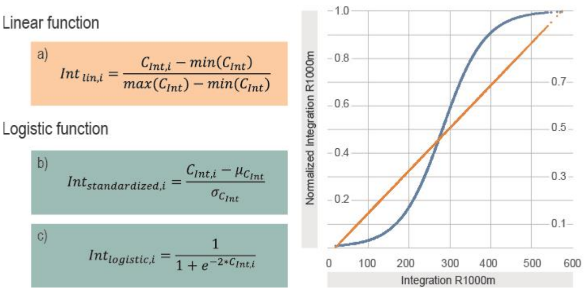

Figure 7. Functions used to rescale Integration R1000 data and the respective chart.

The final scores of each were validated with the pedestrian counting. The three performed similarly, although $IAAPE+SS_{logist}$ resulted in slightly better correlations. Again, to confirm if the differences were relevant, the Fisher's r-to-z transformation was applied, revealing that the correlations are statistically the same (for a degree of confidence of 95%). Ideally, and to be more precise, the pedestrian counting should have been differentiated by types of pedestrians to proceed the correlations. If that was possible, then this exercise could be further validated.

Furthermore, regarding the syntactical measures of synergy and intelligibility, there was no clear contribution to the walkability index. Since there was no correspondent indicator in the index, these measures were summed within the Conspicuousness dimension and, differently from other indicators, they resulted in one value for each area, instead of one per segment. Although these measures are closed related to the perception of the environment, this approach did not impact significantly the outcome of the index.

Regarding the final scores of the new walkability index ($IAAPE+SS_{logist}$), the results showed consistency with respect to the syntactical measures. When integration was used (adult and elderly groups), most of the segments' score increased, in the same proportion (Table 1); meanwhile, when choice was introduced in the index (children groups), most of the scores decreased, in the same proportion. On the other hand, when analyzing the score by ranges of 20, most of the segments remain within the same range as in the original $IAAPE_{WScore}$. This can be explained by the little variation of the values.

Table 1. Rise and fall in walkability score, in absolute terms, for each pedestrian group and trip purpose.

Group:	**Adults**		**Children**		**Elderly**	
Purpose:	Utilit.	Leisure	Utilit.	Leisure	Utilit.	Leisure
Rise ↑	837	837	275	275	837	837
%	75.5%	75.5%	24.8%	24.8%	75.5%	75.5%
Fall ↓	271	271	833	833	271	271
%	24.5%	24.5%	75.2%	75.2%	24.5%	24.5%

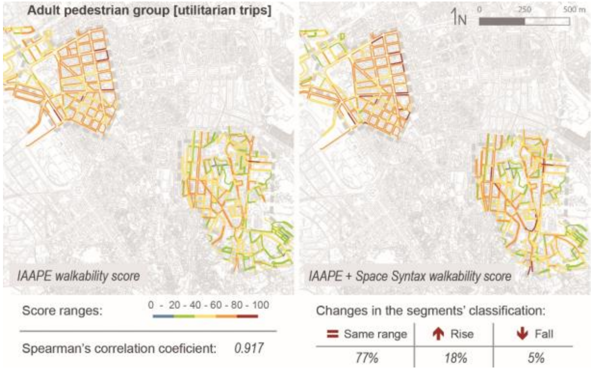

Figure 8. Maps illustrating the score ranges for the adult-pedestrian group from two indices: the original IAAPE and the new IAAPE + space syntax.

All in all, the inclusion of the syntactical measures helped to improve the IAAPE walkability index and are worth using. The replacement of the indicators did not modify significantly the final scores, nevertheless, the use of space syntax renders the index efficiency, as it is less resource-consuming to produce and calculate, other than being a well-stablished methodology. Furthermore, the replaced IAAPE indicators (path continuity and path directness) need more data to be calculated and more time to be built and require a licensed software.

Lastly, the final exercise tested the use of the walkability index for a different purpose. The attempt was to understand the impact of little changes in the urban configuration in walkability. As expected, the improvements in the pedestrian network resulted in higher integration values and, consequently, higher walkability scores for almost all segments, with an increase up to 12% (adult and elderly groups). Conversely, the choice values varied differently from integration, resulting in higher and lower walkability scores. It occurred because the addition of new links in the network made some path lose attractiveness and, in some cases, the choice values dropped dramatically. Therefore, the walkability scores for the children groups both increased and decreased.

Table 2. Rise and fall in walkability scores, in absolute terms, for each pedestrian group and trip purpose.

Group:	Adults		Children		Elderly	
Purpose:	Utilit.	Leisure	Utilit.	Leisure	Utilit.	Leis.
Rise ↑	742	742	275	275	742	742
%	99.7%	99.7%	24.8%	24.8%	99.7%	99.7%
Max. increase	12%	3%	19%	9%	8%	5%
Fall ↓	2	2	275	275	2	2
%	0.3%	0.3%	37%	37%	0.3%	0.3%
Max. decrease	0%	0%	19%	9%	0%	0%

Some limitations of this study are related to the data that can be considered outdated, such as the pedestrian counting from 2015, and/or to the lack of data, such as more parameters for validating the results (information about the area and the number of pedestrian counts). Also, it must be considered that most of the data produced by the author, such as the networks, are susceptible to subjective interpretations or even to human errors.

Moreover, it is important to point out some outcomes of the exercises that remained without explanation or need more investigation:

- Regarding the pedestrian counting, only the averages of moving pedestrians were considered, because their correlations were higher; however, attention must be paid to sojourning pedestrians, who are part of this system and should be further addressed;
- The 1000m radius of analysis presented the best correlations with the pedestrian data, although it is higher than the radii from the cited literature. Despite the lack of evidence on which radius to use for pedestrian analysis, the studies previously mentioned pointed smaller radii, such as 600 and 650 meters (Bielik et al., 2017; Larsen et al., 2010). Some possible explanation for such a difference can be either the different contexts analyzed or some bias due to the pedestrian counting. More research should be done specific about this topic;
- Synergy and intelligibility also deserved more attention to perceive if and how they could be included in a walkability index. For example, using other forms of representation, such as isovists;

Other than that, it is worth pointing out that, the results from the disabled people group could not be properly worked out, because their selected indicators for the first dimension (Connectivity) did not include any indicator that could be replaced by syntactical measures. The first intention of the exercise was to maintain the selected indicators of each group, still, it can also be considered that the configuration of the network should be always addressed among the indicators, because it is an inherent aspect in a mobility system, without which the system would not exist. In fact, it has been defended that configuration plays a major role in walkability (Cambra, Moura, & Gonçalves, 2017), thus, further variations of the walkability index can be tested, in which integration and choice measures are considered for all groups' walkability score.

VI. Conclusion

This dissertation dealt with the pedestrian in the city, studying the issue from a global perspective to a specific point. It outlined the dimensions of a walkable environment and how it was transformed over time, who the pedestrians are and how they perceive and behave in this context. Then, a comprehensive tool was worked out and applied in a real case study, to evaluate the theoretical capacity of the tool and demonstrate its relevance and, ultimately, to prove itself useful for planners and decision makers.

It was defended that everyone is a pedestrian, therefore, a key-player in urban planning; and that pedestrians are a heterogeneous group, whose diversity must be respected and addressed by policies, plans and tools.

As a matter of fact, the urban environment has been shaped by the political vision of some groups according to their interests, resulting in the current car-centered cities, away from the pedestrian needs. This prioritization, reflected in street design and traffic codes, is nowadays being questioned. The change for a pedestrian-centered paradigm comes associated with a myriad of benefits and plays an important role in a sustainable development. In this direction, this dissertation searched to subvert the dominant model, bearing in mind what has shaped the current walking environment and looking the urban space through the eyes of the pedestrians.

Pedestrians and their environment have been studied for a while now, by many fields. Regarding walkability, the state of art comprehends three main research subjects: the built environment, social interactions, and pedestrian perception and behavior. This dissertation addressed these topics when working out a tool, or better, the improvement of a tool, which is intended to be pragmatical and useful for planners and decision-makers.

The tool presented in this dissertation is a combination of IAAPE method and space syntax methodology. IAAPE counts for many aspects of both the built environment and the pedestrian perception, including a participatory phase with different groups of pedestrians; space syntax, on the other hand, allows many analyses regarding the urban configuration and flows, which are easy to handle, besides being a consolidated field of study. The inclusion of space syntax measures into IAAPE resulted in a walkability index easier to handle and more efficient.

The walkability tool developed in this dissertation is one way to check the quality of a space for walking, opening space to envision improvements, which can, once again, place the pedestrian at the top of the priority list.

Contributions to the walkability field

Although no innovative idea was created, the theoretical part brought together many facets of walkability, setting up the big picture and putting into perspective many concepts that are normally taken as absolute in the planning field. How the pedestrian environment got to the current configuration and how the laws got to be settled are points somewhat foggy in the literature. Compiling those issues together restated the importance of the pedestrian mode and brought arguments to discuss established priorities.

The case study of this dissertation resulted in different outputs, indicating some paths that are either worth following or, that can be avoided. Moreover, it brought attention to parameters regarding pedestrians that lack evidence in the literature and contributed to give an answer to them. In sum, it set results that can serve as a reference for researchers from space syntax and walkability fields.

The usability of the final walkability index (IAAPE + space syntax) may comprise other studies and analyses. Besides its direct application in other contexts, it can be a useful tool for analyzing the evolution of an area along the time and to test different scenarios. By being supported with evidence IAAPE + space syntax can inform short-term decisions with strategic medium- to long-term objectives. For example, the tool can be used to understand the impact of a new legislation/guideline, to test different solutions for an urban project design, to find out which changes would cause the greatest improvement for pedestrians, etc.

The reflections and findings of this work did not intend to establish fixed parameters, instead, they can be used as references, always considering the context (scale, time, culture) of the study.

FUTURE DEVELOPMENTS

An effort can be made to continue improving the walkability index tool. From a sociological and inclusive perspective, other forms of participatory processes can be tested, in order to embrace a greater diversity and/or to facilitate its application. From a more technical point-of-view, further investigation on the improvement of indicators could be made, possibly incorporating other syntactical measures not yet tested.

Another path to follow is to continue applying the tool and continue testing/proving its effectiveness. This can be done in different forms: reapplying it in the same area, which configures a diachronic analysis, and which allows an evaluation of the changes made to favor pedestrians; or testing it in a different context (city, country), which would also enable to perceive differences on the understanding of walkability.

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