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Measuring walkability for distinct pedestrian groups with a participatory assessment method: A case study in Lisbon

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HIGHLIGHTS

- A walkability assessment method suitable for various pedestrian groups is presented.
- Stakeholders and decision-makers were involved in indicator selection and weighting.
- Application to a case-study produced detailed walkability score analytics.
- Results show clear differences in walkability scores for distinct pedestrian groups.
- The tool can support policies/actions towards more inclusive pedestrian environment.

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ABSTRACT

Walkability has been defined as the extent to which the urban environment is pedestrian friendly. By measuring it, planning professionals may be able to address the quality of the pedestrian environment, supporting more objective, effective and comprehensive walking-related strategies and interventions.

This work presents a participatory framework for the assessment of walkability based on local circumstances and expertise, replicable on distinct urban contexts. The framework takes into account distinct pedestrian groups (adults, children, seniors and impaired mobility pedestrians) and trip purposes (utilitarian, leisure), expressing walkability in terms of seven key dimensions (7C's layout). From this conceptual framework, a methodology to evaluate walkability through GIS-based and street auditing indicators is presented. It was applied to an area in central Lisbon, Portugal, in order to evaluate the ease or difficulty that different types of pedestrians can face in their walking activities and, potentially, providing an insight for intervention and improvements.

The results show clear differences in walkability scores for different pedestrian groups, namely between adults and seniors or impaired pedestrians. Besides, a validation of the results is presented by comparing street performance, as measured by our process, with home-based surveys conducted within the study area. Validation results confirm that the evaluation framework proposed is reliable in the representation of the pedestrian environment qualities as perceived by the public.

1. Introduction

Walking is now gaining attention as a key factor in the promotion of healthier, environmental friendly and socially active communities. Various fields of research have pointed out the benefits of walking for the individual, associated with physical activity and related to obesity, cardiovascular and mental benefits. Walking can also be considered the basis of the sustainable city, providing social, environmental and economic benefits, often being the only way many people can access daily activities. It also brings life to streets and liveable streets contribute to safer urban environments. The contribution of walking to community safety, accessibility and social inclusion has emerged as a particular challenge to the design of the urban environment, as over the past century pedestrian access has declined steadily in most cities (Abley, & NZ Transport Agency, 2009; Evans, 2009; Forsyth & Southworth, 2008; Frank

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et al., 2005; Jackson, 2002; Krambeck & Shah, 2006; Lee & Talen, 2014).

Besides encouraging more people to walk more, adequate inclusion of impaired mobility people is needed. Although sufficient evidence has been presented on the relation between built environment and walking behaviour (Handy, 2005; Kalakou & Moura, 2014), its characterization has been mostly intuitive, as there has been insufficient quantitative evidence in supporting the extent and intensity of such relation (Park, 2008). As such, the focus should be set in identifying and assessing the built environment attributes that make up a pedestrian friendly environment. Furthermore, if pedestrians' abilities can be affected by design, then urban designers and planners should seek to collect a variety of information on those abilities for different settings of built environment. Ultimately, the main aim of sidewalks, paths and other pedestrian infrastructures should be to create accessibility for all users (Asadi-Shekari, Moeinaddini, & Shah, 2013), not disregarding the more disadvantaged.

Although many definitions of walkability can be found, Leslie, Butterworth, and Edwards (2006) have proposed the following one: "the extent to which characteristics of the built environment and land use may or may not be conductive to residents in the area walking for either leisure, exercise or recreation, to access services, or to travel to work". Implicitly, the idea is also that more walkability can lead to more people walking in open urban environments. By assessing (and measuring) it, urban designers and planners may be able to address the quality of the pedestrian environment, which may facilitate the progress towards more integrated, appealing, inclusive and walking conductive cities.

We believe that beyond adequate pedestrian accessibility indicators, attractiveness indicators are key in the process of walkability assessment. Pedestrian accessibility has now been fairly extensively addressed by the literature (Asadi-Shekari et al., 2013; Gehrke, 2012; Lo, 2009; Maghelal & Capp, 2011). Besides being accessible, making a pedestrian environment attractive is fundamental. Hence, measuring walkability with an additional attractiveness perspective besides pedestrian accessibility enriches the modelling and evaluation procedure. Recently, Talavera-Garcia and Soria-Lara (2015) have proposed a Quality Pedestrian Level of Service (Q-PLOS) method that seeks to introduce measures of quality of the pedestrian environment, besides the standard LOS that measures the degree of pedestrian accommodation in a roadway environment as a surrogate for quality of service (TRB, 2000). This method was applied to Granada (Spain) and one important achievement was the streamlined procedure that is less resource intensive, basing the data collection on ready-to-use data (which, in turn, can be a downside if data is not available).

However, we argue that walkability cannot be definable as a single and universal entity. In fact, the built environment factors that affect walking likely differ according to other factors: pedestrian characteristics (young/old, male/female, fit/unfit), walking purpose (utilitarian/leisure), urban context and other environmental and cultural aspects. Although many models and indicators have been put forward and address these issues, like the Q-PLOS, integrated and structured analysis that bring together these concerns is still lacking.

The aim of this paper research is to present a participatory walkability assessment framework for distinct pedestrian groups, which we named IAAPE (Indicators of Accessibility and Attractiveness of Pedestrian Environments) and that aims to support urban planning and design for more walkable environments. The presented methodology is replicable to distinct urban contexts as it is based on the expertise of local stakeholders in the ranking and selection of indicators. After the literature review presented hereafter, we describe briefly the IAAPE tool and the case study considered here: two districts of Lisbon's central area (Portugal) were selected to apply the IAAPE procedure and measure the walkability of the streets' segment. Then we evaluated the easiness or difficulty that different types of pedestrians can face in walking in the analysed area, for both utilitarian and leisure trips. Next, we present and discuss the results of our walkability analysis, validating the obtained results (street performance in a walkability scale) with home-based surveys to pedestrians in the analysed areas. We end this paper by drawing some conclusions and suggestions for future research.

2. Literature review

With proven benefits, and with sufficient evidence on the influence of built environment factors in encouraging and promoting walking, there has been an increased engagement from researchers, authorities and policy makers in addressing the conditions and quality of the pedestrian environment. Many measures were developed in the past decade to provide an objective answer to the question "*how walkable is my street/neighbourhood/city?*".

Walking, being a simple way of getting around and with less infrastructure requirements for special infrastructure when compared to other modes, has lagged behind in terms of research. These other modes of transport, especially private car, have undergone significant study over the last decades and have a high degree of measurability. Furthermore, there is a generalized lack of consensus on the meaning of walkability. As Lo (2009) points out, many researchers evaluate the relations between urban environment and pedestrian behaviour, and all have a different definition on how to measure walkability.

If walking is a simple way of getting around, addressing the variety of environmental factors that may encourage or deter walking is neither that simple nor unanimous. The complexity of relations between the built environment factors and walking behaviour, the role of individual perceptions, the importance of attitudes, lifestyle and transportation alternatives (Handy, 2005; Moudon et al., 2006) lead to an intricate frame of reciprocal influences that researchers are just starting to untangle. Albeit the impressive developments in walkability measurement studies, some practical issues are found to remain unaddressed:

1. Dispersion of concepts and measurement methodologies
2. Scale of analysis
3. Urban context and origin of studies
4. Multiplicity of indicators used for assessment, and
5. Model validation.

Many different methodologies have emerged from various fields of study (public health, social sciences, transport engineering, urban planning and architecture) to measure the built environment quality and urban walkability. Likewise, tools and methods have been put forward, including: audit tools, checklists, inventories, level-of-service scales, surveys, questionnaires and indices. Although they may differ in their implementation these methods have two major types of outcome: either a single number that categorizes the environment as high vs. low suitability for walking; or the number of features that support or hinder walking. Moreover, there have been techniques developed to address different scales, from the neighbourhood area to the street segments and even intersections (Ewing & Handy, 2009; Leslie, Cerin, duToit, Owen, & Bauman, 2007; Maghelal & Capp, 2011). The most popular tools are perhaps web-based applications: for city areas, examples are *Walk Score* (available at www.walkscore.com, which uses a patented system that computes the distances from the location for which it is calculated to various nearby amenities, yielding a final score from 0 to 100), and *Walkshed* (with an interactive heatmap available at www.walkshed.org and based on the distance to user-