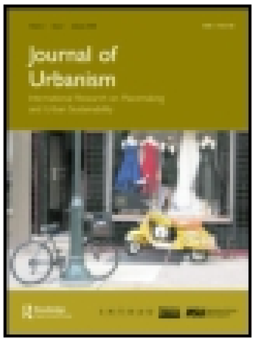

Journal of Urbanism

ISSN: 1754-9175 (Print) 1754-9183 (Online) Journal homepage: http://www.tandfonline.com/loi/rjou20

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To cite this article: Ria Hutabarat Lo (2009) Walkability: what is it?, Journal of Urbanism, 2:2, 145-166, DOI: 10.1080/17549170903092867

To link to this article: https://doi.org/10.1080/17549170903092867

Published online: 22 Jul 2009.

Journal of Urbanism
Vol. 2, No. 2, July 2009, 145–166

Routledge
Taylor & Francis Group

RESEARCH PAPER

Walkability: what is it?

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In order to understand walkability, it is important to consider how pedestrians are defined and the discourses that shape the development of pedestrian space. This paper examines both these issues and identifies points of agreement and disagreement between metrics for walkability. Convergence points include the notion of sidewalk access, street connectivity, and land-use density and diversity. On the other hand, contradictions are identified between prominent pedestrian level of service (LOS) measures which emphasize personal space and those which advocate safety – and comfort – in numbers. Recommendations are made to encourage more multidisciplinary and research-based development of metrics for walkability.

Keywords: walkability; pedestrian planning; transportation; metrics; level of service

What is a pedestrian?

pe·des·tri·an (pə-děs'trē-ən)

A person traveling on foot; a walker.

adj. 1. Of, relating to, or made for pedestrians: *a pedestrian bridge.*
2. Going or performed on foot: *a pedestrian journey.*
3. Undistinguished; ordinary: *pedestrian prose.*

(*The American Heritage Dictionary* 2004)

It may seem excessive to define something as pedestrian as pedestrians, but in the field of urban planning the definition of what is a pedestrian strongly influences how they are accommodated in the design of infrastructure and the urban environment as a whole.

According to the *Compact Oxford English Dictionary* (2006), a pedestrian is "a person walking rather than traveling in a vehicle". Pedestrian activity is therefore defined as a mode of transport comparable to vehicular modes such as driving, cycling and catching the train. Pedestrians walk for different transportation-related reasons including getting from origins to destinations – like commuting from home to work; transferring from one mode to another – like at a transit interchange; and accessing destinations – like going between the garage and the house at the end of a trip.

The American Heritage Dictionary makes no reference to pedestrians as a mode of transport, but simply defines a pedestrian as "a person traveling on foot or a walker", thereby expanding the definition to those walking for non-transportation purposes such as exercise, recreation, leisure, shopping, social interaction, spiritual rejuvenation or even

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ISSN 1754-9175 print/ISSN 1754-9183 online

DOI: 10.1080/17549170903092867
http://www.informaworld.com

fundraising for charity. This more multifaceted definition of pedestrians is supported by advocates and researchers in the area of healthy communities, active living and aging in place. According to these advocates and researchers, both cultural and built environmental factors are needed to promote regular exercise, active transportation and non-automobile access to opportunities for employment, civic engagement and social interaction, especially in minority, low-income and aging communities (Partners for Livable Communities 2007, Orleans *et al.* 2009).

On the basis of social equity, the definition of pedestrians could be further expanded to include those using wheelchairs or other aids, as supported by legislation such as the Americans with Disabilities Act (ADA) and the Australian Disability Discrimination Act (DDA). Policy documents reinforce and implement this inclusive definition of pedestrians, with Title 23 of the US Code (USC) defining a pedestrian as "any person traveling by foot and any mobility-impaired person using a wheelchair" (§217) and the Wisconsin Pedestrian Policy Plan defining a pedestrian as "any person walking, standing or in a wheelchair" (Wisconsin Department of Transportation 2002, p. 19).

While the inclusion of wheelchair users is widely supported by laws and policies (though sometimes lacking in practice), the status of stationary pedestrians is more ambiguous. Many urban designers and preventative health advocates praise places with large numbers of people walking, using wheelchairs and standing – as well as running, shopping, sitting, working and watching – because of their contribution to street life, active living and sense of place (Figure 1). In other locations, however, a person standing in a public area

Figure 1. Non-transportation-based pedestrian activity along Market Street, San Francisco, California. Photo: Hutabarat, 2006.

with no apparent purpose is labeled a loiterer, and can be removed or fined for such an act. Historically, many cities have discouraged the act of standing in public areas in order to prevent unregulated commerce, vagrancy, civil disturbance, criminal activity or the image of the above.

If the definition of a pedestrian is somewhat ambiguous, the idea of walkability is much more so.

Why is this important?

Over the last 60 years, enormous amounts of work have been done to understand and institutionalize the design of transportation space for motorized vehicular modes. Pedestrian transportation, however, is a much more recent addition to planning processes and is still addressed with far less intensity, seriousness and funding. This relative inattention to pedestrian planning suggests that either it is not viewed as an important part of the transportation system, or that it is seen as too *pedestrian* to warrant serious investment in research, planning and design.

Only in the post-modernist planning era has walkability been identified as an important component of efficient, accessible, equitable, sustainable and livable communities. In the United States, the era of modern highway planning is generally seen as lasting from after World War II (though some would argue that it started during the railway era of the late 19th century) through to the enactment of the more multimodal ISTEA[1] legislation in 1991. Since ISTEA, greater emphasis has been placed on planning for smart growth, bicycles, pedestrians and transit, yet automobile-centric planning is still firmly embedded in local, state and federal transportation codes, regulations and standards. In Northern Europe, the decline of modernist planning and automobile-dependent transportation systems occurred somewhat earlier with the energy crisis of the 1970s. And in some countries, such as China and Thailand, it might be argued that the modernist planning era and automobile dependence continues to flourish and even grow.

Irrespective of these differences in timing, one of the apparent features of post-modernist planning is a relative increase in attention to non-motorized transportation, which in turn necessitates a more nuanced understanding of what constitutes walkability. For example, recent efforts to understand and institutionalize planning for pedestrians in the United States can be seen in its coverage within the ubiquitous American Association of State Highway and Transportation Officials (AASHTO) *Green Book*. According to the *Green Book*:

> Pedestrians are a part of every roadway environment, and attention should be paid to their presence in rural as well as urban areas. The urban pedestrian, being far more prevalent, more often influences roadway design features than the rural pedestrian does. Because of the demands of vehicular traffic in congested areas, it is often very difficult to make adequate provisions for pedestrians. Yet provisions should be made, because pedestrians are the lifeblood of our urban areas, especially in the downtown and other retail areas. (AASHTO 2004, p. 96)

While the *Green Book*'s inclusion of pedestrian standards represents progress in the treatment of walking as a part of urban life and transportation, the rather lukewarm "should" language belies the immaturity of this part of the field, and contrasts sharply with the definite terms that characterize automobile-oriented standards.

In addition to these guidelines, pedestrian planning is also encompassed under recent versions of the Federal Aid Highways Act (Title 23 of the USC). This Act requires that all modes of transportation – including bicyclists and pedestrians – must be considered in the development of comprehensive transportation plans by each metropolitan planning organization and State (23 USC §134(c)(3), §135(a)(3) and §217(g)(1)). According to Federal Highway Administration officials, the Title 23 requirement means that – at minimum – the design of all federal aid projects for new and improved transportation facilities must be undertaken with the presumption that pedestrians and bicycles are to be accommodated, unless a justification is provided regarding "exceptional circumstances" (Umbs 2008).

Alongside these policy and legislation requirements, walkability has emerged as a popular topic in various forums related to transportation, planning and urban affairs. Yet, despite these requirements and writings, there is a lack of consensus on what walkability actually is and how it translates into specific metrics for evaluating or planning urban space.

To shed light on this issue, this paper therefore provides a review of academic and planning literature that explores the range of different metrics used to describe, measure and assess walkability. Based on these different metrics, points of convergence and divergence between metrics are considered as well as prospects and recommendations for furthering agreement and understanding of walkability.

What is walkability?

In considering the question of "what is walkability?", what is important seems to depend on who is asking. A wide range of different actors are involved in discourse that relates to pedestrians and all have a different definition of how to measure walkability.

Gaps and disagreements in discourse

In many cases, however, the question of what is walkability is not even asked and pedestrian space is implicitly planned through efforts to achieve more dominant goals of facilitating vehicle flow, accommodating fire trucks, regulating land uses, or making money. These implicit influences may not appear to conflict with pedestrian planning since they do not even address the topic, yet they regularly dominate outcomes for the production of pedestrian space.

For example, as mentioned previously, the 2004 AASHTO *Green Book* highlights the importance of paying attention to pedestrians as part of every roadway environment, and it allocates 16 pages to the geometric design of pedestrian facilities. In its remaining 851 pages, however, the *Green Book* recommends that the streets in which pedestrians operate should be designed according to their *vehicular* function (Figure 2) (AASHTO 2004, pp. 7–12). There is therefore an explicit compromise between providing traffic mobility and access, with no adjustments or explanations of how to reinterpret street performance on the basis of its *pedestrian* function – nor its function for transit and other modes. If an arterial or collector road also happens to be an important pedestrian route due, say, to its proximity to a school, retail district, transit stop or housing, the pedestrian function is inherently compromised in the process of designing the street for vehicles.

The conflicts currently embedded in design standards and guidelines become clearer when we consider a sample of recommended policies: For each element displayed in Table 1, vehicle function trumps the interests and safety of pedestrians for most street types when one considers implications on traffic speed, pedestrian crossing distance, and human scale. Lane widths, sight distances and landscaping specifications all facilitate travel speeds in excess of design or posted speed limits; and instead of providing design cues to encourage slower driving (Clarke and Dornfeld 1994, Engwicht 1999), the *Green Book* suggests that

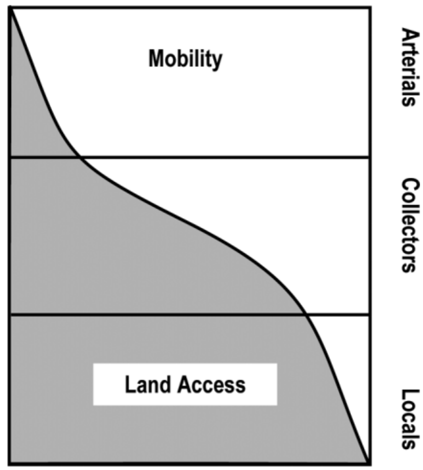


Figure 2. Relationship of functionally classified systems in serving traffic mobility and land access. Source: American Association of State Highway and Transportation Officials (AASHTO) (2004, p. 7).

pedestrian crashes in higher speed environments be prevented through median barriers that make the street impenetrable to pedestrians (AASHTO 2004, p. 475).

In addition to street design standards, land-use zoning and parking requirements also influence the design of spaces in which pedestrians operate. In the United States these municipal requirements have encouraged segregated land-use zones, low maximum densities, abundant free parking and cul-de-sac-style suburban development (Shoup 2005, p. 58, Levine 2006). The resulting environments tend to be car-oriented, out of human scale and characterized by prohibitively long walking distances between destinations.

The effect of these requirements is exacerbated when combined with the influence of the US Federal Uniform Fire Code which requires a 20 foot (6 m) clear travel way on all newly developed streets – meaning that a 35 foot pavement width would be required along a lane with parking on both sides. While this code facilitates access and maneuverability to new fire engines during times of emergency, it inadvertently reduces pedestrian safety day in day out by providing overly generous street widths that encourage speeding.

As seen above, walkability is often undermined by guidelines that address street design and shape pedestrian environments without acknowledging implicit conflicts for pedestrian function. Even when spaces are explicitly designed for pedestrians, there are conflicts between different performance measures used to evaluate these facilities.

Different pedestrian performance metrics have been put forth within the context of discourse on traffic engineering, transportation planning, urban design, public health and sociology. All these fields have some interest in the space or activity of walking, and different definitions of how to measure walkability. The rest of this paper will therefore focus on those who are engaged in the discussion of pedestrian metrics and how these ideas interact or translate to pedestrian space itself.

Flow capacity

The primary walkability metric in the United States is underpinned by the flow capacity discourse, which perceives that pedestrian space is best when pedestrians can move in an

Table 1. American Association of State Highway and Transportation Officials (AASHTO) *Green Book* recommended practices.

Street type Parameter	Local urban	Urban collector	Urban arterial	Freeway
Design speed	30–50 kph (20–30 mph)	50 kph (30 mph)	50–100 kph (30–60 mph)	≥ 80 kph (50 mph)
Stopping sight distance	30–60 m (100–200 ft)	Varies with design speed		
Lane width	3.3 m (11 ft)	3.3 m (11 ft)	3.6 m (12 ft)	3.6 m (12 ft)
Number of lanes	Two plus parking	Greater than or equal to two plus parking, bikes, median	Greater than two plus shoulder, median	Greater than two plus shoulder, median
Parking	Desirable	Undesirable but acceptable	Highly undesirable	Prohibited
Sidewalk	Both sides ≥ 1.2 m (4 ft)	Both sides 1.2–2.4 m (4–8 ft)	Should be provided	None
Crossings	Curb ramps at crosswalks	Intersection open to pedestrians unless offset by traffic/safety benefits	Pedestrian provision through urban interchanges	
Landscaping	In keeping with street character, pedestrian or bike needs, sight distance and clearance guidelines, e.g. vegetation < 1.0 m (3 ft) in sight triangle		Not addressed	
Lighting	Luminaries mounted at a height of 10–15 m (35–50 ft)			

Source: AASHTO (2004), pp. 291, 390, 392, 400, 430, 433, 470, 472, 478, 503–504, 864–865 unimpeded manner with as much space as possible. This metric is described in the Transportation Research Board's (TRB) *Highway Capacity Manual* (HCM), which was first published in 1950 in the context of new post-war spending on the Dwight D. Eisenhower National System of Interstate and Defense Highways. Originally, the manual focused on highway facilities by defining traffic flow, speed, density and delay in terms of level of service (LOS) grades A–F. It therefore provided intricate detail on how to assess vehicular and road conditions, with no equivalent thought or analysis to other modes such as public transit, bicycles and pedestrians.

In response to concerns about a bias toward motorized and road transportation modes, the 2000 edition of the HCM was expanded to encompass alternative modes such as pedestrians and bicycles. For pedestrians, a number of quantitative variables and associated descriptions were used to grade pedestrian LOS in an analogous manner to that of highways. Variables measured under this assessment include the amount of personal space that each pedestrian has within the sidewalk area (measured in square-feet per person); the flow rate of pedestrians (in people per minute per foot of sidewalk width); the speed of pedestrian flow (in feet per second); and the ratio of sidewalk volume to capacity. These parameters are displayed in Table 2.

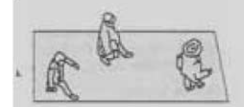
The basis of these standards is a doctoral dissertation by John Fruin, which was published in 1971. According to Fruin, a mechanistic understanding of pedestrian comfort was developed based on personal space requirements for different pedestrian facilities by different types of people including men, women, prisoners, and "potentially violent, schizophrenic types of prisoners" (pp. 24, 71). The apparent thoroughness of this work suggests that results are universal and that sidewalk capacity is the only factor affecting pedestrian comfort. On the contrary, the limited range of parameters fails to acknowledge a wide range of other factors that may be important to pedestrians.

While the HCM pedestrian LOS allows comparison between the performance of pedestrian and other transportation facilities (and is therefore a step up from no standard at all), it reflects a gross lack of understanding about the difference between vehicles and people. The standard treats pedestrians as atomistic and antisocial entities. It requires a space to be maintained at all times between pedestrians and shop frontages or other pedestrians in order to prevent them from bumping into walls or other people. It also rates busy pedestrian sidewalks in urban settings as lower value than empty sidewalks in industrial superblocks, monotonous suburban locations or dark city alleys. And it makes no consideration for contextual factors such as the building form, land-use context, street connectivity, amenities or vitality. In fact, the very notion of vitality is reversed in the HCM since chance meetings and the presence of other people are measured as inherently undesirable sources of potential "conflict". In cultural contexts where privacy and individualism are less valued than in the United States, the metric is even more inappropriate.

The pedestrian LOS standards may be helpful in defining failing grades for high-pedestrian volume locations such as in and around transit interchanges, airports, sporting venues or built-up business districts during the peak. However, these applications are more akin to adaptations than the general applicability of the HCM standards.

The distinction between adaptation and general applicability of the standards can be understood by considering the implicit trade-off implied within the HCM. For vehicular LOS, grades A–F represent sequential levels of *service* at which motorists can undertake more comfortably maneuvers at higher speed. The benefits of higher service levels are balanced against costs for providing increased (potentially redundant) capacity and compromises to other objectives associated with slower traffic speeds. By contrast, pedestrian LOS grades A–F represent little that is meaningful to pedestrians since they suggest

Table 2: *Highway Capacity Manual* (HCM) pedestrian level of service.

LOS \ Parameter	Ped space (ft^2/p) (*m^2/p*)	Flow rate (p/min/ft) (*p/min/m*)	Speed (ft/s) (*m/s*)	Volume/ Capacity Ratio	Description	Illustration
A	>60 *>5.6*	≤5 *<16*	>4.25 *1.30*	≤0.21	Pedestrians move in desired paths without altering movements in response to other pedestrians. Walking speeds freely selected, & conflicts between pedestrians are unlikely.	
B	>40–60 *3.7–5.6*	>5–7 *16–23*	>4.17–4.25 *1.27–1.30*	>0.21–0.31	Sufficient area for pedestrians to select walking speeds freely, bypass other pedestrians, & avoid crossing conflicts. Pedestrians begin to be aware of other pedestrians & to respond to their presence when selecting a walking path.	
C	>24–40 *2.2–3.7*	>7–10 *23–33*	>4.00–4.17 *1.22–1.27*	>0.31–0.44	Space sufficient for normal walking speeds, & for bypassing other pedestrians in primarily unidirectional streams. Reverse-direction or crossing movements can cause minor conflicts, & speeds & flow rate are somewhat lower.	
D	>15–24 *1.4–2.2*	>10–15 *33–49*	>3.75–4.00 *1.14–1.22*	>0.44–0.65	Freedom to select individual walking speed & bypass other pedestrians is restricted. Crossing or reverse-flow movements face high probability of conflict, with frequent changes in speed & position. Reasonably fluid flow, but friction & interaction between pedestrians likely.	
E	>8–15 *0.7–1.4*	>15–23 *49–75*	>2.50–3.75 *0.76–1.14*	>0.65–1.00	Virtually all pedestrians restrict normal walking speed, frequently adjusting their gait. At the lower end, forward movement only possible by shuffling. Space is insufficient for passing slower pedestrians. Cross- or reverse-flow movements possible only with extreme difficulty. Design volumes approach walkway capacity, with stoppages & interruptions to flow.	
F	8 *0.7*	Varies	≤2.50 *0.76*	Variable	All walking speeds severely restricted & forward progress made only by shuffling. Frequent unavoidable contact with other pedestrians. Cross- & reverse-flow movements virtually impossible. Flow is sporadic & unstable. Space more like queued than moving pedestrian streams.	

Source: Transportation Research Board (TRB) (2000).

that sidewalk capacity and unimpeded movement are *the* key concerns, and that the most comfortable or attractive pedestrian environments are those with the fewest pedestrians using them.

Given this limited applicability, New York City may be one of the few places where the HCM standards could aid planning for high volumes of commuting pedestrians. Even in this location, however, pedestrian density is apparently affected by more than just sidewalk capacity and there is therefore a need for more understanding of what affects pedestrian attractiveness in this context. In an early study, Pushkarev and Zupan (1971) suggested that street and land-use context were important factors affecting pedestrian tolerance or appreciation for crowding in New York. They therefore recommended that walkability factors be broadened from sidewalk capacity to encompass land-use intensity, retail activity, distance to transit, street type and time of day.

More recent work by the New York City Department of City Planning (2006) further adjusted the HCM pedestrian LOS standards to incorporate personal characteristics such as gender, age, person size, distraction (like talking on a cell phone), group size, and trip purpose. By making context-specific adjustments, the study advocated adjusting the LOS standards while still operating within the paradigm of flow capacity. For most other US cities this kind of translation of HCM procedures is probably a less than effective means of capturing and evaluating variables of interest to pedestrians due to the fact that sidewalk capacity is not usually the main constraint. Even in New York, some authors argue that the performance of pedestrian spaces is actually influenced by many factors unrelated to capacity, such as the presence of seating, shade, water and junction points (Whyte 1980).

Multimodal connections

After 40 years of focusing on highways, automobility and modernist planning, the 1990s represented a time of transition in US planning, with the introduction of ISTEA and subsequent federal transportation legislation[2] emphasizing more multimodal approaches to transportation. Under this legislation, funds that had previously been reserved for interstate highways and bridges were able to be used for transit, non-motorized transportation and integrated transportation and land-use planning. While this shift represented a considerable breakthrough within the transportation field, a Congressional Research Service report indicates that highway and automobile-oriented programs continue to represent between 68 percent and 80 percent of federal transportation funding (Fischer 2005, pp. 33–36). Qualifications aside, the shift toward more multimodal transportation approaches was echoed in many countries such as Australia and the UK, and was foreshadowed by European cities where energy concerns and the environmental movement had gained traction in the planning field since the 1970s.

Under more multimodal programs for transportation planning, greater acknowledgement, emphasis, and requirements were given to multimodal approach encompassing pedestrians, bicycles, public transit and integrated transportation and land-use planning (Kittelson & Associates, Inc. 2003). The ISTEA legislation specifically recognized walking as a key component of multimodal transportation systems and required agencies to consider pedestrians in regional planning processes. It also made pedestrian planning projects eligible for federal highway funding.

In conjunction with this shift, a number of regional agencies developed criteria for evaluating walkability within the context of wider multimodal transportation planning. By comparing different cities, a number of commonalities can be seen in these criteria, including the following:

- Presence and continuity of sidewalks and pedestrian routes.
- Accessibility of facilities to people with different abilities.
- Directness of pedestrian paths and connectivity of the street network.
- Connections to frequent transit services.
- Ease and safety of crossings.
- Visual interest.
- Perceived or actual security.

In Portland, Oregon, these factors were outlined in two indicators: the Pedestrian Potential Index (PPI) and the Pedestrian Deficiency Index (PDI). These indices built upon Pedestrian Environmental Factors (PEFs), which were developed by the 1000 Friends of Oregon (Parsons Brinckerhoff Quade and Douglas *et al.* 1993) as part of their research on land use, transportation and air quality (City of Portland 1998, p. 2). A comparison of Portland pedestrian performance criteria is provided in Table 3.

In 2003, the City of Kansas City furthered the work of Portland in their efforts to develop the Kansas City Walkability Plan. In conjunction with this plan, the city rejected the HCM classifications to develop their own pedestrian LOS metrics for five parameters considered relevant to pedestrians, which included: directness, sidewalk continuity, street crossings, visual interest and amenity, and security (City of Kansas City 2003, p. 15). Two of these metrics are illustrated in Figure 3. For each parameter, specific variables were outlined at various scales from project to citywide assessments, with explanations on data collection and threshold values for levels of service A–F (pp. 17–34). Finally, in order to evaluate the significance of this grade and priority of projects, LOS requirements were defined on the basis of the context including the following (p. 16):

- Pedestrian zones and great pedestrian streets.
- Mixed use and transportation centers or transit zones.
- Neighborhood activity centers and corridors.
- Schools and parks.
- Routes to/from transit.
- All other areas within the city.

This categorization allows planners to introduce an understanding of the relationship between pedestrian behavior and land-use context – as examined by various researchers including Huang and Cynecki (2001) and Huang *et al.* (2000).

In another multimodal approach developed by World Bank interns, area categorizations assume a more national nature with walkability indices used as a basis for comparing different cities around the world (see Table 4). The resulting *Global Walkability Index* (GWI) includes "universally applicable" variables such as crossing safety, perceived security and accessibility which also correspond to the Portland and Kansas indices (Krambeck and Shah 2006, p. 6). What the GWI omits, however, is land-use variables and their effects on the convenience, directness, and connectivity of the pedestrian network. These variables were ignored because the index:

> only targets those aspects of walkability that can be improved upon in the short and medium terms (e.g. availability of infrastructure and relevant policies), as opposed to those that may only be affected in the long term (e.g. prevailing land uses). (Krambeck and Shah 2006, p. 5)

The GWI therefore prejudges which aspects of walkability can be addressed by local, national or international policies, while filtering out elements identified by authors such as

Table 3. Portland pedestrian planning parameters.

Source Parameter	Pedestrian design principles	Pedestrian potential or deficiency indices (PPI/PDI)	Pedestrian environmental factors (PEFs)
Presence of sidewalk network	Ease of use	Not missing sidewalks	Infrastructure in place, interconnected network
Accessibility	Accessible		
Safety	Safety	Absence of difficult and dangerous crossings based on traffic speed, volume, road width, and pedestrian crashes	Ease of crossings
Connectivity	Directness	Not lacking a connected street network based on block length	Street connectivity (grid)
Destinations	Versatility	Land-use mix, destinations, density and average parcel size. Proximity to schools, parks, transit, neighborhood shopping	Destinations within walking distance
Sense of place	Sense of place	Scale	
Topography		Topography or slope	Topography
Policy factors	Economy	Pedestrian-related street classification under transportation element. Regional land-use area	

Source: City of Portland (1998).

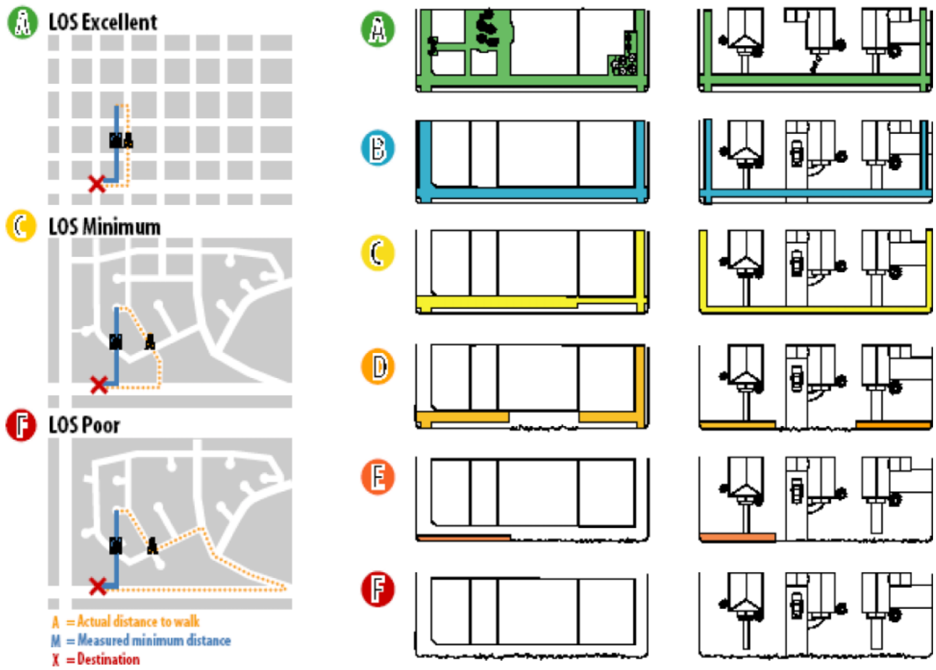


Figure 3. Kansas City pedestrian level of service (LOS) for directness and continuity. Source: City of Kansas City (2003).

Pushkarev, Jacobs, and the City of Portland as having a powerful influence on pedestrian behavior and satisfaction.

Compared with flow capacity metrics, multimodal measures of walkability seem to provide a more nuanced understanding of pedestrian activity and its relationship to land uses and the physical environment. By focusing on the physical environment, however, the multimodal approaches may downplay operational factors such as pedestrian volume and

Table 4. Components of the Global Walkability Index (GWI).

Component	Variable
Safety and security	Proportion of road accidents that resulted in pedestrian fatalities Walking path modal conflict Crossing safety Perception of security from crime Quality of motorist behavior
Convenience and attractiveness	Maintenance and cleanliness of walking paths Existence and quality of facilities for blind and disabled persons Amenities, e.g. coverage, benches, public toilets Permanent and temporary obstacles on walking paths Availability of crossings along major roads
Policy support	Funding and resources devoted to pedestrian planning Presence of relevant urban design guidelines Existence and enforcement of relevant pedestrian safety laws and regulations Degree of public outreach for pedestrian and driving safety and etiquette

Source: Krambeck and Shah (2006), p. 10.

traffic volume (City of Kansas City 2003, pp. 32–33). The scale of analysis also seems to be important, with the GWI probably focusing on too coarse a scale to provide a meaningful metric of local walkability.

Sense of place and aesthetics

Urban design discourse provides examples of walkability metrics that consider the physical environment at a more fine-grained level. In this field, theorists have analyzed pedestrian quality of service from the perspective of user satisfaction with places, rather than the transportation efficiency or connectivity of pedestrian facilities.

One of the preeminent authors in this field is Kevin Lynch who described performance dimensions of cities in general – and pedestrian spaces by extension (Lynch 1984). These dimensions encompass vitality, sense, fit, access and control, with efficiency and justice as meta-criteria for good urban spaces (Table 5). Lynch's notion of *sense* is especially relevant to what multimodal theorists label vaguely as *sense of place* and he provides much greater depth on what this dimension encompasses as well as identifying landmarks, paths, centers, districts and edges as sites of analysis. Lynch's descriptions are strongly qualitative and he does not attempt to translate his ideas into metrics that may be grasped by more quantitative audiences such as those participating in the flow-capacity discourse. As a result, his work is all but unknown to many influential actors involved in policy and development for streets and traffic control devices.

Table 5. Lynch's Performance Dimensions.

Component	Subcomponents and explanations	Analysis
Sense	Identity: Distinctness of place due to character, engagement of senses, familiarity	Landmarks, paths, centers, districts, edges
	Structure: How different parts fit together	Image maps, orientation tests
	Congruence: Match of spatial and non-spatial structure	Match of expected and actual function
	Transparency: degree to which one can directly perceive the operation of processes	Survey of symbolic messages Content analysis
	Legibility: communication via symbolic features	
	Significance: Places as symbols of values, processes, history and nature	
Vitality	Sustenance: Adequate supply of food, energy, water and air, and proper disposal of wastes	Resource analysis Hazards analysis
	Safety: hazards are absent or controlled, and fear of encountering them is low	Identifying extremes of temperature, noise, pollution
	Consonance: Spatial environment is consonant with basic biological structure of human beings	
Fit	Adequacy: Supply of housing, open space, etc.	Quantity of land uses
	Adaptability: Ability to use spaces in ways for which they were not originally designed	Costs of modifying or reversing changes
Access	Relative cost of reaching people, jobs, housing, material resources, places and information	Flow capacity, patterns, barriers, time costs and potential
Control	Rights to ownership, presence or exclusion, use or action, appropriation, modification and sale of places	Power and control of space and its communication
Efficiency	Cost of achieving environmental quality level	Relative costs and benefits
Justice	Distribution of dimensions among groups	Distribution of costs and benefits

Source: Lynch (1984), pp. 111–235.

In order to overcome this disciplinary chasm, other urban designers attempted to translate design ideals into LOS grades that can be readily understood and evaluated by more quantitative practitioners. One such author is Jaskiewicz (2000) who compiled qualitative pedestrian LOS factors specifically designed to supplement the HCM flow capacity approach. Jaskiewicz focused on factors that influence the aesthetic appeal of the pedestrian environments including street definition or enclosure; complexity of spaces and paths; building articulation and variation; the presence of overhangs and varied roof lines; buffering between pedestrians and traffic, presence of shade trees and lighting, transparency of the transitional zone; and the physical condition of sidewalks (Table 6). According to Jaskiewicz's methodology, each item is graded (presumably by a panel of urban designers) on a scale of 1 to 5 and then scaled to fit on a scale from A to F.

In attempting to bridge the gap between quantitative and design discourses, Jaskiewicz's methodology is less than satisfactory from either standpoint. His use of pseudo-scientific language such as "The addition of large street trees to landscaped strips exponentially increases their value as buffers" is hardly convincing to those with quantitative training. At the same time, his design ideas possess an obvious aesthetic bias toward more varied elements, such as "frequent variation in orientation and character of public spaces" and "varied roof lines", which might result in gaudy and cluttered streetscapes from a design perspective. In sum, Jaskiewicz's criteria provide an example of how design criteria could be incorporated into quantitative evaluation processes, but it is not clear that the factors presented are scientifically derived, aesthetically pleasing or culturally neutral.

Part of the problem of developing aesthetic metrics for walkability is that design criteria are subjective by definition, with the history of city planning revealing shifting ideals about the merits and beauty of different urban, rural and suburban environments. These shifting ideals are exemplified by the town-country trade-offs described by Ebenezer Howard in his classic piece on garden cities (Howard 1902). Based on Howard's initial treatise, Garden Cities were supposed to be voluntary self-governing communities that overcame the ills of both squalid Victorian cities and depressed Victorian countryside (Figure 4). Howard's vision was one of economically self-sufficient communities that combined farming with

Table 6. Jaskiewicz's qualitative pedestrian level of service (LOS) factors.

Factor	Explanation
Enclosure or definition	Degree to which street edges are defined by buildings or street trees
Path network complexity	Availability of numerous route choices between pedestrian origins and destinations, including routes that represent the shortest distance
Building articulation	Degree to which varied application of shop front/housing materials, design, color and décor add interest to pedestrian experience
Complexity of spaces	Frequent variation in orientation and character of public spaces
Overhangs and rooflines	Presence of overhangs, awnings, varied roof lines and street trees
Buffer	Presence of buffer zone between sidewalks and moving vehicles
Shade trees	Presence of shade trees
Transparency	Provision of transparent transition between public and private space through widows, outdoor displays and sidewalk cafés
Sidewalk condition	Level of completeness, maintenance and obstruction of sidewalks
Vehicular speed	Posted speed limit and design speed created by lane widths, paved widths, sight lines, corners, street parking and crossing treatments
Lighting	Level of lighting along street

Source: Jaskiewicz (2000), pp. 3–8.

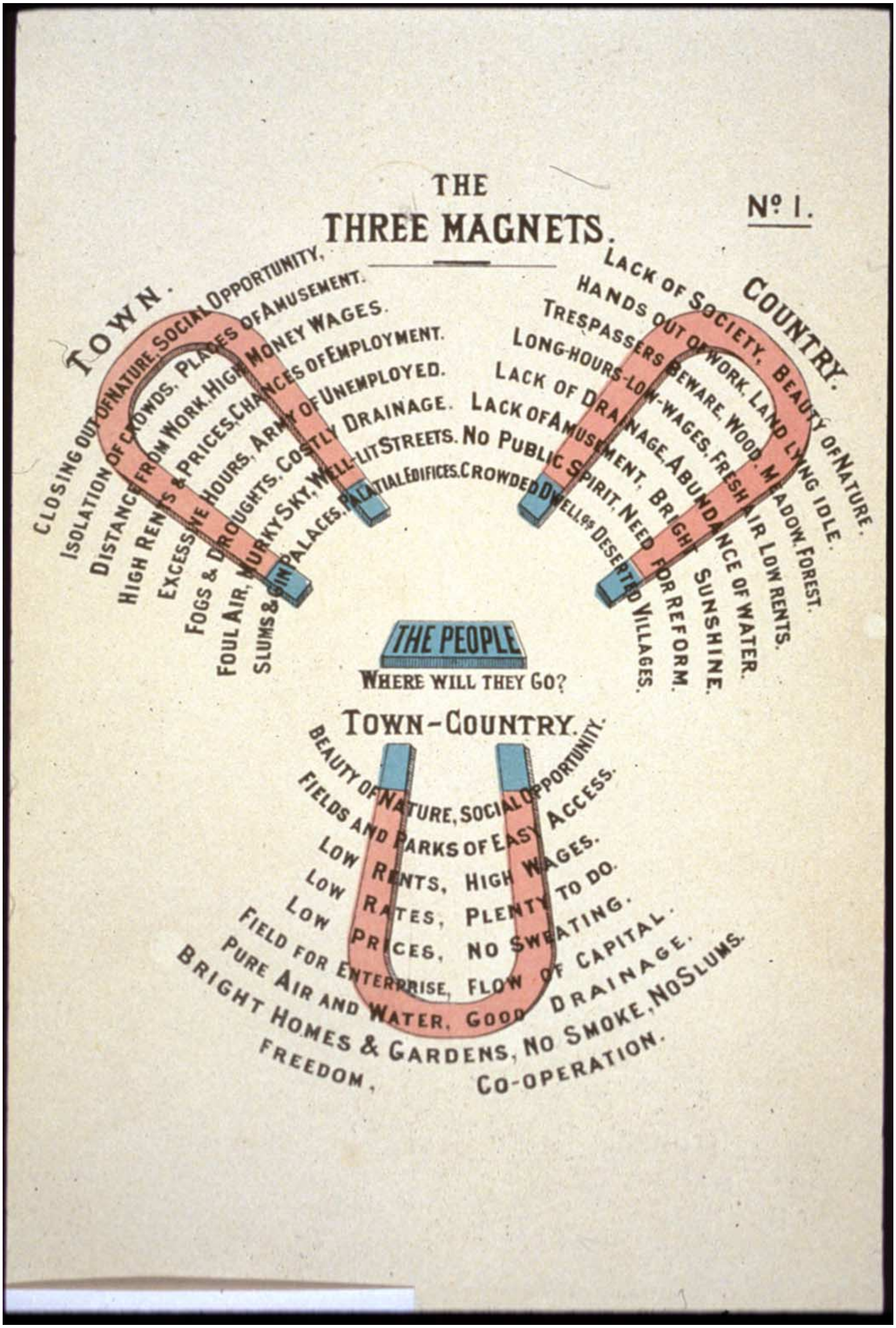


Figure 4. Howard’s Three Magnets. Source: Howard (1902).

housing, light industry and diverse urban institutions – all within walking distance and connected to the larger city via rail transit. His vision was as much a social vision for progressive reform as it was a design for a new urban form (Hall 1996, pp. 91–93).

As Howard's ideals were implemented, however, the emphasis often shifted from social reform to artistry, with the resulting designs proving less affordable for the working classes for whom they were initially intended (Hall 1996, p. 100; Phillips 1996, p. 482). Communities such as Unwin and Parker's Hampstead Garden Suburb and Olmsted's Forest Hills Gardens became garden *suburbs* for affluent commuters, with no industry, no agriculture, and no collective ownership of community assets. These initial garden suburbs did achieve something of a walkable quality, however, with sidewalks lining relatively narrow, pleasant streets, a mix of shops, open spaces and civic uses, transit stations, and houses clustered around village greens or along pedestrian paths – although the paths were not particularly useful for reaching jobs.

Subsequent development of post-World War II American suburbs would radically depart from the garden suburbs produced in response to Howard's town-country trade-off. These new suburbs were facilitated by the mass production of cars and housing, government-guaranteed mortgages for detached single-family houses, federally subsidized inter-urban highways, and a post-war baby boom (Hall 1996, p. 291). Unlike Howard's utopian vision of integrated social reform and physical design of walkable urban spaces, post-war suburban development in the United States destroyed countryside while failing to produce towns or walkable urban spaces. Additionally, in contrast to their predecessors, post-war suburban developments were almost exclusively car-oriented, with little thought given to pedestrian design or the implications of low-density design for walkability.

At the same time, the exodus of investment to the suburbs drained resources from existing urban centers thereby exacerbating the decline of urban places. Freeway development proved a more direct threat to urban spaces, with federal highway funds used to subsidize the demolition of "blighted" areas while improving suburban accessibility to downtown jobs and shops (Hall 1996, p. 292). Ultimately, this threat triggered a countermovement that emphasized urbanity as the site of sense of place.

One of the early urbanist writers and activists was Jane Jacobs who criticized contemporary highway planning practices for destroying urban vitality and expending "extraordinary governmental financial incentives [to achieve] monotony, sterility and vulgarity" (Jacobs 1961, pp. 10, 23). In a reversal of values expressed in the HCM pedestrian LOS, Jacobs and other urbanists held that greater concentrations and diversity of people contribute to, rather than detract from, the quality of pedestrian space. They also highlighted the merits of an intricate and close-grained diversity of primary land uses and enterprises such as buildings that do not turn their backs or blank sides to the street or leave it blind, and sidewalks that are heavily and constantly used by people of every race and background (Jacobs 1961, pp. 19, 42, 45, 54). While Jacobs was successful in opposing the highway development that threatened demolition of New York's Greenwich Village, her ideas were not yet translated into changes in how pedestrian LOS is measured by the dominant flow capacity discourse.

In the 1960s and 1970s, researchers made efforts to evaluate the quality of urban pedestrian spaces in a more systematic manner. These efforts included Appleyard's work to evaluate the effects of vehicular traffic volumes on pedestrian activity and social networks, as well as Whyte's work on observing pedestrians and public spaces in New York City (Whyte 1980, Appleyard 1981). In more recent years, urbanists have built upon this foundational work as well as amending Jacobs's focus on primary diversity to emphasize the need for secondary diversity to attract optional pedestrian trips and activities in an area. For example, Danish architect Jan Gehl used observational techniques to argue that high-quality pedestrian environments are those with a higher ratio of "optional" to "necessary" pedestrian trips and a high proportion of people staying rather than simply passing through the area (Gehl and Gemzøe 1996). While Gehl's ideas share some commonalities with Jacobs's, his focus on optional activities betrays a social bias toward predominantly middle-class populations who have the leisure time and discretionary income to spend on optional activities.

More recently, New Urbanists draw upon earlier work of neighborhood designers such as Clarence Perry to emphasize the transportation and physical design aspects of urban communities as a predicate of walkability – in addition to seeing walking as a predicate to sense of place. Authors, architects and designers such as Peter Calthorpe, Andrés Duany, Elizabeth Plater-Zyberk, Stefanos Polyzoides, Elizabeth Moule, and Dan Solomon used New Urbanist principles to design transit-oriented developments or neo-traditional neighborhoods. These neighborhoods provided *design cues* to reinforce the goals of traffic calming, transit ridership and pedestrian activity, rather than simply relying upon altruism and legal traffic signs for these purposes. Significantly, many of the designs were enshrined in form-based codes that dictate various aspects of the street design and building form while providing flexibility and diversity in land use (Calthorpe 1993, p. 17; Southworth 2005, p. 249; Schmitz and Scully 2006, p. 16). By codifying their principles in alternative land-use codes, the New Urbanists challenge the power of authority of prior pedestrian performance metrics and their associated discourse.

Civic engagement

While many of the aforementioned theorists comment on the positive social benefits of designing more walkable environments, far less work has been done to examine the veracity of this relationship between the socio-political factors and walkability. The exception to this condition includes the work of Mason and Fredericksen (2006) as well as Enrique Peñolosa who claims that "transport is not a technical, but a political issue" (Peñolosa 2000, p. 128). A summary of their findings is provided in Table 7.

As a former planner and mayor of Bogotá, Colombia, Peñolosa argued that walkable environments are associated with more democratic and "civilized cities" since pedestrian facilities provide accessibility benefits to a greater portion of the community than that of roads or rail improvements. This argument is particularly relevant to developing world cities where low average incomes disqualify many people from owning or operating private automobiles.

The claim is also supported by the work of Mason and Fredericksen who found that more walkable environments were positively associated with higher rates of civic engagement in the US city of Boise, Idaho. As part of this work, Mason and Fredericksen undertook regression analyses of physical, demographic and social factors in three broad categories of neighborhoods, including:

Table 7. Metrics for social parameters.

Parameter	Description
Equity and democracy	Portion of population benefiting from pedestrian or transportation policy
Cost effectiveness	Relative cost effectiveness of different transportation policies
Community interaction	Casual community interaction and participation
Civic engagement	Voting behaviors and voluntarism of different communities

Sources: Peñolosa (2000), Mason and Fredericksen (2006).

- Traditional pre-World War II neighborhoods with higher densities, mixed land uses, grid-patterned streets, narrower streets and integrated public spaces.
- Transitional pre-1970s suburban subdivisions with larger lots, lower densities, larger setbacks, and a mix of grid streets and cul-de-sacs.
- Contemporary post-1975 conventional subdivisions with low densities, big box commercial destinations, and pods of housing connected by arterials.

After controlling for income, race and other factors, Mason and Fredericksen found that the former, more walkable communities had significantly higher rates of civic engagement in the form of voting behaviors and voluntarism. On the other hand, it was not clear from the study whether walkable physical conditions encouraged civic engagement, or whether those who were more likely to walk and engage in social activity self-selected into such communities. Likewise, the study did not provide information on whether walkability was the only factor associated with civic engagement within the community. As a result, the existence of high levels of social engagement is unlikely to be particularly helpful as a metric of walkability, though it does highlight the importance of walkability to non-transportation related fields.

Public health and active living

Finally, in the field of public health, similar contributions are made to metrics for walkability or pedestrian quality as a basis for addressing obesity, cardiovascular disease and other prevalent conditions.

One study within this field was undertaken by Boer *et al.* (2007), who drew upon transportation data sources in order to identify neighborhood types that are more conducive to pedestrian activity. Not surprisingly, the study identified areas with more four-way intersections, a diverse mix of businesses, and a higher density of housing as having a greater proportion of walking trips.

In contrast to transportation sources that focus on commuter and mobility-related pedestrian trips, literature from the field of public health highlights a distinction between factors that affect commuters and those simply walking for exercise. For example, recent work by Rosenblatt Naderi indicated that physical factors, such as sidewalk width, are important for commuters but not for health walkers, while more aesthetic and phenomenological factors are of importance to those walking for health reasons (Rosenblatt Naderi and Raman 2005, p. 156). In a study from College Station, Texas, these factors were found to include the weather, the presence of sound, proximity to water, and previous experiences and preconceptions of the surrounding area (Table 8).

Table 8. Route choice factors for health-based walkers (Texas, summer 2002).

Parameter	Description
Initial bias	Previous experience and site reputation
Definition	Well-designed spatial edge
Sound	Sound sources including water and music
Temperature	Appropriate weather for walking, water features and shade trees
Amenities	Proximity to potable water and places to sit, light
Traffic context	Removal from traffic

Source: Rosenblatt Naderi and Raman (2005), pp. 161–164.

The above factors contrast sharply with those that have been discussed so far in that they reveal more experiential factors affecting the choice of whether to walk for recreational purposes. The apparent emphasis of interviewees on temperature, shade and water also highlights the time- and site-specific nature of pedestrian preferences – especially when considered in light of the geographic and seasonal context of the study.

Conclusions and recommendations

How we define walkability has enormous implications for our understanding and design of urban transportation networks and public spaces, yet little effort has been expended to understand how to optimize spaces for pedestrians. By contrast, billions of federal research dollars have been spent on understanding how to plan, design, and engineer streets and highways to improve their safety and efficiency for motorized modes. By default, it is these standards that currently serve as the implicit design standards for spaces in which pedestrians live and move.

By scanning the literature from different fields that deal with pedestrian performance and preferences, there appears to be some convergence of opinion and research on land use and streetscape factors that influence the quality of the pedestrian environment and the quantity of pedestrians using the space. Factors that appear in a number of different walkability measures or metrics include the following:

- Presence of continuous and well-maintained sidewalks.
- Universal access characteristics.
- Path directness and street network connectivity.
- Safety of at-grade crossing treatments.
- Absence of heavy and high-speed traffic.
- Pedestrian separation or buffering from traffic.
- Land-use density.
- Building and land-use diversity or mix.
- Street trees and landscaping.
- Visual interest and a sense of place as defined under local conditions.
- Perceived or actual security.

While this list represents considerable contributions from the field of urban design, as well as a consensus across different disciplines that affect pedestrian planning, a number of elements stand out as either unique or contradictory within the literature. First, as the authoritative source of transportation planning guidance, the *Highway Capacity Manual* (HCM) pedestrian level of service (LOS) criteria contradict almost every other planning and research source on pedestrian quality of service. Under the HCM, an implicit bias toward lower volumes of pedestrians – and, by inference, lower density land-use contexts – conflicts directly with urbanist values for both accessibility and security, as well as recent literature promoting the idea of "safety in numbers" for non-motorized transportation (Jacobsen 2003). Given this conflict, it is recommended that the HCM level of service standards be revised to reflect better the convergence of other literature and research on what constitutes walkability or what contributes to pedestrian comfort and safety. If some of the present HCM measures for pedestrian LOS are retained, a clear proviso is needed to indicate their limited applicability to all but capacity-constrained situations with respect to pedestrian volume.

Likewise, design guidelines of the AASHTO *Green Book* conflict both internally with recommendations for pedestrian accommodation and externally with discourse on walkability. *Green Book* standards for various aspects of street design, such as sight distance, design speed, lane width and lighting are provided on the basis of the vehicular function, with almost no reference to potential conflicts with the pedestrian function of the street. The result of this mismatch is a compromise in pedestrian safety, comfort and accommodation for the sake of facilitating vehicular mobility. Where pedestrian guidelines are provided, lukewarm and non-compulsory language used within stridently highway-centric guidelines is likely to have little effect on achieving substantive change. It is therefore recommended that the *Green Book* specifically incorporate direction on how to design streets to balance different modal functions and priorities. The Institute of Transportation Engineers (ITE) *Proposed Recommended Practice: Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities* (2006) may provide a good starting point for this effort, along with the work of Tumlin *et al.* (2005) on balancing different modal goals along transit priority and other streets in the City of Seattle.

In addition to these conflicts, a number of unique contributions to knowledge of walkability can be seen from the fields of public health, urban design and transportation analysis. For example, research on health-related walking provides useful insights into phenomenological elements that influence choice walkers (Rosenblatt Naderi and Raman 2005), while efforts to adapt HCM pedestrian LOS to New York highlight the role of personal characteristics in shaping pedestrian preferences and activities. Urban design theory also provides more nuanced insights into the notion of sense of place that should be more earnestly integrated into pedestrian activity research.

The unique and valuable contributions made by various fields to the concept of walkability highlight the need to explore further the different facets of walking and its implications for pedestrian quality of service. In conjunction with this research, there is also a need for further investigation of the applicability of different operational or design metrics for walkability with respect to different social or geographical contexts.

Walking is a multidisciplinary activity, and therefore requires multidisciplinary metrics to measure the walkability of places. While considerable overlap exists between notions of walkability that exist *within* disciplinary discourses, a number of key metrics encoded in transportation planning handbooks conflict with the literature and research emerging from various other sources. As a result, the design of pedestrian spaces is optimized for other goals such as vehicular movement, fire prevention and revenue generation, to the detriment of pedestrians. While billions of dollars have been spent on research aimed at understanding and optimizing planning for vehicular modes, there is a need for a dramatic increase in funding that focuses on the pedestrian environment and developing scientific studies that will help drive policy changes in the direction of more nuanced factors that are most relevant to pedestrians themselves.

Note on contributor

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Notes

1. ISTEA stands for the Intermodal Surface Transportation Efficiency Act of 1991.
2. Subsequent acts include the Transportation Equity Act for the 21st Century of 1998 (TEA-21); and Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users of 2005 (SAFETEA-LU).

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