

On the Nature of Walking and Learning Pedestrian Environments

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Abstract:

This phase of a one-year urban design research project focuses on the question of how to measure variables that impact walking for health, spiritual renewal and commuting and how to design to encourage pedestrians to walk. The results of this phase of the research project contribute to (1) identification of significant environmental variables to which pedestrians respond, (2) the creation of a video and still imagery archive of ranked pedestrian spatial sequences, and (3) a data base for pedestrian design. The research project is attached to a landscape architecture design studio at Texas A&M University. A multi-disciplinary team of graduate students oversees the literature research, the technical video and graphic support and the development of software technology. A videographic data base of a variety of pedestrian spatial sequences, with both qualitative and quantitative attributes has emerged as a result of the research to date. The case studies used in the research are specific pedestrian routes that the students selected based upon their everyday experience of commuting, health and spiritual renewal walks.

Purpose of the Research

Leaders in the health community are now recognizing that our best hope for reducing obesity and associated health risks, one of the most challenging health risks we face (Wycoff, 2001), may be through enticing people to walk (Williamson, 1999). While the psychological and physiological benefits of walking have been thoroughly documented (Anshel, 1996; Kramer et al., 1999; Ulrich, in Marcus and Barnes, 1999), the spiritual or phenomenological benefits of walking are coming under investigation as well, witness the worldwide labyrinth movement (Verdita, URL [here](#)), and research into the neurological mechanisms of meditative exercise (Kamei, et al., 2000). Certainly the consensus across a wide spectrum of disciplines is that it is vital to create and support a safe and pleasant walking environment that is easily accessible and useful in the daily life of people.

While observers such as Alan Jacobs (1993) bring a rich perspective to the question of what constitutes great streets, researchers are just beginning to test design theories in a systematic manner, such as Isaacs' work testing pedestrian preferences relative to the "Urban Picturesque

Theory,” or Cervero and Radisch’s study comparing walking patterns in post-war and traditional street car suburbs in the Bay Area (Cervero and Radisch, 1996).

Land use relationships, distance between origin and destination and community design can set up the physical parameters which will meet the criteria long observed by transportation planners. The Federal Highway Administration has just completed a Best Practices Design Guide for Designing Sidewalks and Trails for Access which recommends allowing “mixed use developments with higher densities so that trip distances are decreased and walking is promoted as a mode of transportation” (FHWA. 2001) While this document was driven by a need to assist State Transportation Departments to comply with the requirements of Title II of the Americans with Disabilities Act, the Guide is intended to be used to design and construct pedestrian facilities with an aim to accommodating disabled users. This emphasis, while admirable, only addresses a part of the need to encourage walking. It is not just that a ramp is there that will encourage the able-bodied to walk. The complexities that surround pedestrian preferences relate not only to the nature of their reason for walking (i.e. walking for pleasure, for health or for commuting) but also to a holistic environmental design that sets up the sensual framework around a positive experience of walking.

For several years, the urban design and city planning community in the U.S. have been struggling with the conundrum of the walking environment in a car-dominated landscape. Many designers have entered the discipline of infrastructure planning and design, however many of these same designers are working within an engineering paradigm that does not fully recognize human experience as part of the design equation. In a close look at the negative aspects of the suburban world, Michael Southworth notes the complexities of the design matrix: “We need to pay more attention to the real tradition of places . . . In urban design that tradition includes fundamental environmental qualities such as scale, grain, transparency, the relation between buildings and streets, connectedness, and access to daily needs.”(Southworth 1997) However, the decisions that affect the pedestrian realm within transportation are not led by the landscape architectural, urban design, planning or architectural community; they are led by the engineering profession.

Transportation engineers and traffic planners have produced a large body of work pertaining to pedestrian/bike/automobile interaction, demographic/behavioral models, and street design as well. Walking safety and crossing interactions with cars are now identified as areas within the transportation engineering industry that have high research interest (Miller et al., 2000). The work within the industry and the design guidelines that emerge are struggling with numbers of members who are faced with “having to accommodate the pedestrian” (AASHTO 2000) in communities developed around the automobile. Needless to say, the tools that the engineers are using to understand how to design for the pedestrian are the same ones used for designing for the car: level of service (based on how many units can get through a given space within a given time) (Seneviratne and Morrall, 1985) (Mori and Tsukaguchi, 1987); congestion management (Dixon, 1996) (Sarkar, 1993); utilization forecasting technologies (Botma, 1995) (Schwartz, Porter, Suhrbier, Moe and Wilkinson, 1999). Transportation industry researchers are acknowledging that alternative approaches to pedestrian research might result in more relevant data for safety and human factors (Khisty, 1994). It is the sensual experience of the pedestrian that contains the option for spiritual renewal and health improvement in this mode of travel.

The question our research studio asked is what exactly constitutes an environment that is not only pedestrian-friendly, but proactively encourages walking in the context of public health, safety and welfare. We are trying to answer the question of what constitutes a successful walking environment within a transportation corridor. What are the underlying physiological/cognitive/social forces affecting pedestrian behavior? Researchers have been modeling pedestrian movement since the 1970's; for instance, Helbing et al. (2001) models pedestrian behavior based on Lewin's (1951) theory of optimal personal space, and provides predictive and prescriptive guidelines for improved pedestrian flow efficiency. As a mathematician, his work describes quantifiable patterns of movement along corridors, through hallways, within intersections. His models allow introduction of physical barriers that affect the flow of the pedestrians. Assuming fluid dynamics as a metaphor for his observations, Helbing makes an admirable although weak attempt to jump the divide between math and architecture and suggest ways to increase efficiency of movement through an intersection so that pooling will not occur. Collaboration with this type of research is advantageous to our studies, although there is limited direct application to the design of pedestrian facilities because of the oversimplification of the sensuous nature of the human being. Gibson (1958) and later cognitive psychologists describe the complex interactions between perception, cognition, and locomotion.

The literature review gave us an overview of physical, psycho-physiological and aesthetic theory that led us to spatial sequence design inquiry into the nature of walking on three platforms: commuter walking, walking for health and walking for spiritual renewal. Bringing these diverse bodies of knowledge together into the design studio require an imaging tool powerful and versatile enough to represent diverse pedestrian environments. Bishop's (2001) investigation into the validity of subject response to virtual environments provides cautious optimism that such a tool may be used to test human response to the landscape.

It was clear to us at this point, that transportation and health industries would naturally turn to urban design and landscape architecture for research contributions on aesthetic and sensuous assessment of pedestrian environment. From a design communication perspective, the use of multi-media in generating first an accurate representation of the nature of pedestrian environments and then developing design proposals in collaboration with the medical and transportation communities has exceptional value. The issue in large part was how to bridge the gap to conduct our inquiry using technology that could communicate sequential space determinants in a manner that could be quantified without losing a sense of the holistic nature of the pedestrian experience.

In the design of pedestrian spatial sequences that are integrated within transportation corridors, we are dealing with a treacherous and dangerous environment. Developing a research and design tool in the form of a Pedestrian Simulation Laboratory was initiated at Texas A&M University last year. This research contributes to the PEDSIM validation phase at TTI as researchers struggle with the accuracy of simulated data versus field realities (Naderi, Raman 2001). During our research, we generated data comparing representations with field assessment to begin to determine the magnitude of the difference between field and simulated environments that will further the research associated with the PEDSIM as well as give other designers insights into representation technologies that might be more appropriate for urban design use.

Kevin Lynch pointed out that designers are always faced with the dilemma of how to communicate a simple spatial sequence using traditional architectural communication graphics

and technology (Lynch 1976). Thiel went so far as to develop a notation, somewhat like ballet choreographers use, to communicate sequential space. (Thiel, 1961) Videography and advances in simulated animation technology now have greater potential as both a design and design communication tool. Our research will ultimately provide designers with technological tools that facilitate communication and exploration of sequential spatial design proposals.

Because people walk for different reasons, we divided the investigations into three categories of inquiry: health walks, walks for spiritual renewal and commuting walks. The health walk and the walk for spiritual renewal were both loops and circuits with similar environmental variables. The spiritual renewal walk meandered more and included options for sitting individually and in groups. We offer detail explanation of the three modes of walking that designers are most often trying to encourage or at least accommodate on sidewalks and trails within transportation corridors.

A representative health walk was selected as a target landscape (Fig. 1 – 1.d). Health walks are an important part of many public and semi-public spaces. Witness the circuit markers and mall walkers clubs found at many large shopping centers. Natural elements such as distant mountains and vegetation are cited by various researchers as factors assisting in patient recovery (Ulrich et al, 1991b; Ulrich and Addams, 1981). Health clubs have implemented circuits outside and inside buildings as have community centers, recreational parks, etc. Environmental variables are very controlled inside but offer clues as to how to design sidewalks for healing walks. Pedestrian accident statistics indicate high incidences in early morning and late evening. People are much more difficult to see at this time of day, commuting vehicular traffic can tend to be very focused on their ultimate destination and it is before and after work that many people who walk for health around a circuit in their neighborhood are experiencing crashes. Many of the longer distance walkers and runners use the travel way of the vehicles rather than the concrete sidewalk for many reasons including resiliency, evenness, unrestricted width. Health walk for health purposes whether preventive or curative, are becoming more and more prevalent. Access to idealized health club circuits or parks is not always available and streets will be used as an alternative.

A representative spiritual renewal walking environment was selected as a second target spatial sequence (Fig.1 – 1.g.). The pedestrian seeking spiritual renewal is specifically seeking a pedestrian experience that removes one from everyday spatio-temporal dimensions. Barrie theorizes that the world's great sacred paths have certain elements in common: an entry point that establishes a point of decision as to whether or not to begin the journey, a sequence of defined spaces, places, or events long a path that grows increasingly more sacred, a manipulation of scale, distance, and time along the path, which creates the impression that the journey is longer and thereby more eventful than it actually is; a consistent ordering of constructive and space-forming elements and materials, and overall a legible architectural language. These criteria were reflected in the design and assessment criteria used by subjects while evaluating sequences that were defined as spiritually renewing walks.

The issue in selecting spiritual paths for us was that people often step into the world outside their home or work seeking reflection and renewal, taking “paths represent the willful leaving of one place and a journey to another . . . “the way is always directed from the known to the unknown.” (Norburg-Schulz in Barrie 1996). A legible path sequence not only orients one physiologically, but psychologically and spiritually as well. Traditionally it has symbolized a going forth from the known to the unknown, the content of which is still present today.” (Barrie) The sacred

path has been modeled by theorists and historians as a “sequence [that] acts as a marker of the sacred ground, as protection for the uninitiated, and as a trial to be endured for those seeking the divine. Walking along the path and the attainment of the sacred place repeats the sacred act enacted by the god in illo tempore or mythological time . . . the process is often contradictory, being simultaneously easy and hard, clear and obscured, close and distant.” (Barrie, 1996). The contemplative path of the Zen Buddhist tea garden also seeks removal from the daily world. Walking the path to the tea house, like walking a labyrinth, is a ritual of attention: “In the wabi tea ceremony...the path led guests through a succession of detailed views—from a formal entrance to a series of twists and turns past a washbasin and lantern to a path of stepping stones . . . stones, bridges, and turns were intentionally included to slow guest down, to encourage them to leave worldly concerns at the garden gate...to enter the tea garden is to remove oneself from the world beyond, focus on the immediate, appreciate the smallest details of life, and remind oneself of the essentials. To the Zen mind, all else is illusion.” (Bibb, 1991)

A representative commuting walk facility was selected (Fig. 1 – 1.a.) The commuter is typically following a path from A to B trying to get somewhere as opposed to being along the way. The standards for commuting are usually to move people through as quickly and without interruption as possible. Much of the transportation research in planning and design is based on accommodating pedestrians at Levels of Service that address capacity and flow as opposed to experience. Pedestrian sequences that included multi-modal transfer stations or were in an employment or school district were identified as having a lot of commuting traffic.

Hypothesis

Our primary hypothesis is that great pedestrian environments with specific physical attributes or combinations of attributes can actually encourage people to walk for health, spiritual renewal and/or commuting purposes. There are several assumptions behind our research at this point:

1. Attributes of pedestrian environments can be disaggregated and evaluated
2. Pedestrian experience uses all senses but visual perception is primary
3. Environmental expectations of a walk are shaped by the purpose of that walk

Method

The first step was to understand what makes up pedestrian spatial sequences and how people respond to common elements when they are walking for different purposes. An attribute list was developed using research by Jacobs, Bigelow, Lynch and personal interviews that attempted to define elements that were common to all pedestrian spatial sequence experiences. Value scales were then attached to each attribute. Quantifiable value scales were determined using previous research in design considerations of pedestrian environmental simulators (Naderi, Raman 2001). This preliminary attributes list and associated values was taken into the field and used by researchers to evaluate a series of pedestrian spatial sequences.

Spatial sequences were evaluated both on site and using video representation employing a fixed set of attributes using the same range of values. The spatial attributes that were evaluated were: walkable, sittable, length of the walk, width of the walk, accessibility from parking, slope, surface resilience, surface traction, handicap access, amenities, security, crossing safety, greenery, marked entry, focal points, adjacent built areas, noise level and adjacent land use. At the end of the attribute form, the student was asked to judge overall whether the spatial sequence was “great”, “adequate” or “bad”.

In theory, manipulation of the attributes will affect human behavior in the space. Ultimately, we can design to target landscapes. The big stumbling block in testing pedestrian spatial thresholds in simulation is how closely representations of spatial sequences really depict field conditions. In the Naderi and Raman research, the effort is underway to define the nature of the pedestrian experience and understand what needs to be simulated to accurately reflect the environmental variables which affect the pedestrian (Naderi 2002). Lynch, Appleyard, Thiel and others have discussed the limitations of videography as a device for illustrating sequential analysis and design proposals. To address the complexity of this issue, we asked student researchers to evaluate spatial sequences using comparative research methods:

1. on-site evaluation of a pedestrian spatial sequence;
2. evaluation of a life-size scale (1:1) video of the same sequence;
3. evaluation of a 1:1 videographic representation of a sequence by others;
4. evaluation of the difference of perception between a video of their site and on-site experience; and,
5. evaluation of 1:1 videographic representation while walking on a treadmill

The results of their evaluations helped define the level of validity around the use of remote data by comparing the performance evaluations of spatial sequences between the field, the video representation in a stationary position and the affectiveness of the treadmill on enhancing the realism of the video representation. This was done by asking researchers to answer a questionnaire after assessing both a field condition and a 1:1 scale video display of the same sequence in the lab (Fig. 1 – 1.b., 1.e., 1.h.). The questions we asked them were as follows: Did you find that the onsite conditions were easier or harder to assess than the conditions shown on the films that you evaluated? Did the pedestrian environment seem less pleasant, about the same or more pleasant on video? When you saw the film of your site, did you feel the same about the space as you did when you were on site? Were there any significant changes between the film of your site and your actual site and what were they? The last question specifically addressed using the video representation in conjunction with operating a treadmill. Because we are currently developing a Pedestrian Simulator (PEDSIM), it was important to determine the affect of physically moving while assessing a pedestrian spatial sequence using remote imaging.

The students in the design studio were then asked to design a spatial sequence associated with a new hospital complex being proposed by McGill University Health Center in Montreal Canada. The students selected sites that were integral with the McGill University Health Center proposal for a large-scale hospital project. The students selected sites that they designed and modeled using 3D hard models and plans. The designs reflected a natural emphasis on health, as they were part of the hospital complex (Fig. 1 – 1.f.). Commuter walks and walks for spiritual reflection were also designed (Fig. 1 – 1.c., 1.i.). The clients from Montreal were thrilled by the variety of ideas from the students.

The data generated from the site evaluations is currently being analyzed. A software tool named the Pedestrian Learner is under development that utilizes the data base to assess pedestrian design proposals. The Pedestrian Learner is an intelligent decision making software that makes use of the Machine Learning algorithm called Decision Tree for its decision making process. The decision tree is a hierarchical decision structure in which each node in the tree specifies a test for some attribute instance and each branch descending from the node corresponds to one of the possible value of the attribute. The main advantage of the Pedestrian Learner however is to predict the extent of the intended change on the usability of the environment. For example the

learner might be used to predict if we add more trees to the road with less sittable space, it is still an adequate pedestrian environment. The pedestrian Learner database draws directly from the data input of the students and other researchers working with the attributes form.

Step 1. Representative spatial sequences were used to establish the limits of the design inquiry.



1.a. Commuter walk



1.d. Health walk



1.g. Spiritual renewal walk

Step 2. Spatial evaluations in the field were compared with video presentations of the same sites in the lab.



1.b. Still image from student videography: commuter walk



1.e. Still image from student videography: health walk



1.h. Still image from student videography: spiritual renewal walk

Step 3. Students designed walks that respond to spatial sequence research.



1.c. Student model of commuter walk, proposal for McGill University project.



1.f. Student model of health walk, proposal for McGill University project.



1.i. Student model of spiritual renewal walk, proposal for McGill University project.

Figure 1: Studio Research-Design Sequence

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Findings

We are still evaluating the environmental variables assessed by fall studio. At this point in the study, we observe: (1) spatial sequences rated in the field received overall higher ratings than the same spatial sequences rated from videographic representation; (2) evaluations appeared to cluster – e.g. variables generated similar responses; and (3) all sites selected by the students were rated as either “great” or “adequate”. As a result additional “bad” sites had to be documented by the graduate students to develop a useable range.

Our original assumptions which underpinned the hypothesis were found to not be completely true. Our three assumptions were:

1. Attributes of pedestrian environments can be disaggregated and evaluated
2. Pedestrian experience uses all senses but visual perception is primary
3. Environmental expectations of a walk are shaped by the purpose of that walk

We found that the attributes of the pedestrian environments could be disaggregated but there were instances in the comparison between the video and in-situ evaluations where the students identified a lack of “genius loci” in the video imaging. They identified the walking experience depicted in the video as a “less pleasant” experience due to a loss of a sense of context. Thus there appears to be an experience of the whole which is itself a complex environmental variable. Pedestrian experiences were dramatically affected by the presence of a highly ranked negative experience of one of the senses, then this overrides all other considerations including visual quality. As an example, at a spiritual walk site, a heavy odour from fried chicken was identified as a single attribute which made the site a “bad” site overall.

Of the three experiences, walking for spiritual renewal appears to be the most complex in terms of the relationship between the sensory perception, the mental state of the walker and the physical spatial sequence. Heschel indicates that the marking of time may be the most significant part of the spiritual “walk”; the walk exists more in a temporal dimension than in the physical dimension.

We asked the students to write a short essay identifying positive and negative attributes of the walk they studied in the field. Positive attributes identified by the students included “contrasting patterns of light and shadow in sequence”, “smell”, “sounds”, “overall sense of peace....” These attributes clearly indicated that factors other than visual variables significantly contribute to the pedestrian experience. Negative attributes included “lack of natural light”, “lack of maintenance”, “feeling of insecurity,” and “no sense of enclosure”. From these observations and others, we will refine the attributes list for the next phase of the research. The data is currently being routed into the development considerations for the Pedestrian Simulator and the Pedestrian Learner.

The complexity of the walking environment experience was confirmed in the designs developed for the McGill University Hospital Center. Even though the design brief for the studio project asked that the student pick one or the other of the three types of walking environments to develop, a minority did so. Most of the designers created multi-purpose spaces for the health campus in Montreal. This positive finding indicated the complexity of the design inquiry into walking experiences in pedestrian spatial sequence designs.

Conclusion

Over the next few semesters, we will continue to gather video and site assessment data for pedestrian environments, including high accident sites, great streets, sacred paths and healing

walks. Using this data, we will build the knowledge base for the Learner and develop the virtuosity of the Pedestrian Simulator.

Broad categories of future inquiry include the mind-body continuum. Walking as aerobic exercise has been studied in terms of enhanced cardiovascular health, stress reduction, and improved cognitive performance. Is there a connection between movement and brain wave activity, which in turn affects cognitive, emotional and physiological functions? Can we learn more about this body/mind interaction and how we might design our city streets to encourage healthier mental state? Anthropological, religious and spiritual perspectives that call for design guidelines to integrate 'the sacred' in our homes, streets, and towns enrich the discussion of pedestrian well-being. Can this research tease out the emotional or cognitive effects of symbolic elements in the urban landscape? Is there a relaxation effect human being experience from traveling through a symbolic landscape? Is it measurable?

Our interest started with the idea that design matters and that the health and safety of pedestrians can be directly affected by the design results of our transportation corridors. We have begun investigation into quantifying elements which directly contribute to the perception of whether walking is desirable or not. Walking has become a number one public health concern, as so much disease is associated with overweight and obesity, weak cardiovascular conditions and the like. The health industry is becoming rapidly cognizant of the fact that walking environments are not readily available to most urban dwellers in the west and that their lifestyles may no longer permit a continuation of the lack of proper pedestrian facilities. It is the health community in fact that is calling on the architectural and landscape architectural community to consider appropriate design of walking facilities in our articulation of our cityscapes.

Research and Bibliographic References

- American Association of State Highway and Transportation Officials (AASHTO). 1995. A Policy on Geometric Design of Highways and Streets 1994. Washington, D.C.: American Association of State Highway and Transportation Officials.
- Anshel, M., 1996, Effect of chronic aerobic exercise and progressive relaxation on motor performance and affect, *Behavioral Medicine*, Winter 96, 21 (4), 86-197
- Appleyard, D., 1965, Motion, sequence and the city, in Kepes, G. (ed), *The nature and art of motion*, George Braziller, Inc., New York
- Barrie, Thomas, 1996, *Spiritual Path, Sacred Place: Myth, ritual, and meaning in architecture*, Shambala Books, Boston and London
- Bib, Elizabeth, 1991, *In the Japanese garden*, Starwood Publishing, Washington, D.C.
- Bigelow, J. "Determination of a Suburban Pedestrian Facility Level of Rating Scale." University of Virginia, Charlottesville, 1999.
- Bishop, I., Wherrett, J., Miller, D., 2001, Assessment of path choices on a country walk using a virtual environment, *Landscape and Urban Planning*, 52 (4), 225-237
- Brannon, L. and Fiest, J., 2000, *Health Psychology: an introduction to behavior and health*; Wadsworth, Belmont, CA.
- Cervero, R. and Radisch, C., 1996, Travel choices in pedestrian versus automobile oriented neighborhoods, *Transport Policy*, 3 (3), 127-141.
- Dixon, L.B. Bicycle and Pedestrian Level-of-Service Performance Measures and Standards for Congestion Management Systems. In *Transportation Research Record 1538*, TRB, National Research Council, Washington, D.C., 1996, pp. 1-9.

- Fruin, J.J. 1971. Pedestrian Planning and Design. Metropolitan Association of Urban Designers and Environmental Planners, Inc.
- Fruin, J.J. 1971. Designing for Pedestrians: A Level-of-Service Concept. *HRB*, Vol.308, pp. 1-15.
- Haklay, M., O'Sullivan, D., Thurstain-Goodwin, M. Schelhorn, T., 2001, So go downtown: simulating pedestrian movement in town centers, *Environment and Planning B; Planning and Design*, 20001/05. 28 (3), 343-359
- Hancock, T., 1993, The evolution, impact and significance of the healthy cities/healthy communities movement, *Journal of Public Health Policy*, Spring; 14 (1): 5 – 18
- Hall, E.T. 1966. The Hidden Dimension. Garden City, NY: Doubleday & Company, Inc.
- Helbing, D., Molnar, P., Farkas, I., Bolay, K., 2001, Self organizing pedestrian movement , *Environment and Planning B: Planning and Design*, 28, 361 – 383
- Huchingson, R.D. 1981. New Horizons for Human Factors in Design. New York, NY: McGraw-Hill.
- Isaacs, Raymond, 2000, The urban picturesque: an aesthetic experience of urban pedestrian places, *Journal of Urban Design*, 5 (2), 145-181
- Jackson, J.B. 1984. Discovering the Vernacular Landscape. New Haven: Yale University.
- Jacobs, A., 1993, Great Streets, MIT Press
- James, J.G. 1950. The Perception of the Visual World. Boston: Houghton Mifflin.
- Kaplan, R., Kaplan, S. and Ryan, R., 1998, With People in Mind, Island Press, Washington, D.C.
- Khisty, C.J. Evaluation of Pedestrian Facilities: Beyond the Level-of-Service Concept. In Transportation Research Record 1438, TRB, National Research Council, Washington, D.C., 1994, pp. 45-50.
- Kundera, M. 1991. Immortality. New York: Grove Weidenfeld.
- Kamei, T., Toriumi, Y., Kimura, H., Ohno, S., Kumano, H., Kimura, K., 2000, Decrease in serum cortisol during yoga exercise is correlated with alpha wave activation, *Perceptual and Motor Skills*, 90, 1027-1032
- Kramer, Arthur F; Hahn, Sowon; Cohen, Neal J; Banich, Marie T. McAuley, Edward; Harrison, Catherine R; Chason, Julie; Vakil, Eli; Bardell, Lynn; Boileau, Richard A; Colcombe, Angela, 1999, Ageing, fitness and neurocognitive function; *Nature*. 400(6743), 418-419
- Lynch, Kevin. Managing the Sense of a Region. MIT Press. 1976
- Maring, G.E. 1972. Pedestrian Travel Characteristics. Highway Research Record, Vol.406, pp. 14-20.
- Miller, John S., J. A. Bigelow, and N. J. Garber “ Calibrating Pedestrian Level-of-Service metrics with 3-D Visualization
- Mori, M., and H. Tsukaguchi. A New Method for Evaluation of Level of Service in Pedestrian Facilities.
- Transportation Research A, Vol. 21, No. 3, 1987, pp. 223-234.
- Naderi and Raman, “Design Considerations in Simulating Pedestrian Environments”, TRB Conference, 2002.
- National Cooperative Highway Research Program (NCHRP). 2000. Implementation of the AASHTO Strategic Highway Plan, "Initial Draft of a Compendium of Strategies. NCHRP Project 17-18(3).
- Older, S.J. 1968. Movement of Pedestrians on Footways in Shopping Streets. *Traffic Engineering and Control*, August 1968, pp. 160-163.
- Palmer, J., Hoffman, R., 2001, Rating reliability and representation validity in scenic landscape assessments, *Landscape and Urban Planning*, 54, 149-161

- Sarkar, S. Determination of Service Levels for Pedestrians, with European Examples. In Transportation Research Record 1405, TRB, National Research Council, Washington, D.C., 1993, pp. 35-42.
- Schwartz, W.L., C.D. Porter, G.C. Payne, J.H. Suhrbrier, P.C. Moe, and W.L. Wilkinson III. Guidebook on Methods to Estimate Non-Motorized Travel: Supporting Documentation. FHWA-RD-98-166. FHWA, U.S. Department of Transportation, McLean, Va. 1999.
- Seneviratne, P.N., and J.F. Morrall, Level of Service on Pedestrian Facilities, Transportation Quarterly, Vol.39. No. 1, 1985, pp. 109-123.
- Sitte, C. The Art of Building Cities, trans. Charles T. Stewart, Reinhold, New York, 1945 (orig. 1889)
- Southworth, M., 1997, Walkable suburbs, Journal of the American Planning Association, 63(1), 28-44
- Surgeon General's Call for Action "Toward a National Action Plan on Overweight and Obesity: The Surgeon General's Initiatives, HHS NEWS, U.S. Department of Health and Human Services. <http://www.surgeongeneral.gov/todo/pressreleases/obesitypressrelease.htm>. 2001
- Thiel, P., "A Sequence-Experience Notation," Town Planning Review, Vol. 32, No. 1 (April 1961)
- Transportation Research Board. 1985. Highway Capacity Manual, Special Report No. 209. Transportation Research Board.
- Untermann, R.K. 1984. Accommodating the Pedestrian. New York: Van Nostrand Reinhold Company, Inc.
- Ulrich, R. S., Effects of gardens on health outcomes: theory and research, 1999, in Marcus, C.C. and Barnes, M. (Ed), Healing Gardens, New York: Wiley, pp. 27-86
- William.H. Whyte, The Social Life of Small Urban Spaces, 1980, Conservation Foundation, Washington, D.C.

