Journal of Urban Design, Vol. 16. No. 4, 531–549, November 2011

Urban Design: Is there a Distinctive View from the Bicycle?

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ABSTRACT *Would urban design considerations and practices be different if the experience of bicycling was given a more central place? Drawing on a review of international literature and practice, this paper compares the characteristics of cyclists with those of pedestrians and motorists, showing that cyclists have a substantial number of unique characteristics that warrant further investigation in terms of a special urban design response. Focusing on four issues—community layout, cycling facilities, analysis and design processes, and detailed design—the paper offers a framework and central considerations for cycling-oriented urban design. It concludes with a call to take the experience of cycling seriously in urban design. This involves moving beyond a concern with safe and convenient facilities and complete networks to a more substantial interest in the experience of the environment from a cyclist's point of view.*

Urban Design and the Experience of Cycling

Would urban design considerations and practices be different if the experience of bicycling was provided a more central place in key dialogues regarding the future of cities?

Transportation via vehicles—bicycles, buses, trains, cars, motorbikes, etc.—is a domain dominated by traffic planners and engineers. To best serve such vehicles they have helped build and provide for landscapes of wide travel lanes, continuous rail networks, extensive safety and navigational signage, transit stops and vehicular parking. In contrast, urban designers have long been keen on attending to the pedestrian environment; many regard urban designers as key experts on this area. In so doing, urban designers have focused on the overall form, scale, materials, vegetation and furnishing of the street; and on sidewalks, footpaths and off-street pedestrian paths.

Urban designers do have a significant history of engaging with vehicles, however. Some have suggested vehicles as a central organizing principle. Examples include early 20th century parkway planning and mid-century discussions about the formal potential of freeways and shopping centre design. *View from the Road* by Appleyard *et al.* (1964) is representative, envisaging urban design from the perspective of the speeding motorist. On the other hand,

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1357-4809 Print/1469-9664 Online/11/040531-19
DOI: 10.1080/13574809.2011.586239

designers have also tried to tame the car—buffering pedestrians and cyclists from motorists—through Radburn planning, neighbourhood units, and the latest generation of shared streets, complete streets and traffic calming of various types.[1]

With a few exceptions, the focus of urban design in terms of cycling has most often centred on creating safe and/or attractive facilities such as cycle lanes and bicycle parking, or more recently on creating comfortable spaces to increase the amount of cycling as physical activity. However, this somewhat limited purview begs several questions. Should there be a more radical reconceptualization of urban design given the speed, height, exposure, lighting requirements and parking needs of cyclists? Are cyclists really just using another form of vehicle similar enough to the car to make many of the auto-oriented design strategies work? Alternatively, can they be seen as essentially a faster pedestrian, using basically the same infrastructure? Or are cyclists different to both motorists and pedestrians, with needs more complicated than safety and exercise, and with implications for urban design?

This paper proposes that cyclists have needs from the standpoint of urban design that substantially differ from pedestrians, motorists or transit users. Furthermore, it is contended that full provision for their needs is unlikely to come to fruition until their perspective is more formally acknowledged in research and through design guidelines. Therefore, this paper aims to respond to three questions. (1) What would it mean to create an urban design approach based on the bicycle in addition to, or instead of the motorized vehicle and the pedestrian? (2) What are the key dimensions of a *View from the Road* from the perspective of cyclists? (3) What are the implications for processes of city building, particularly sustainable design and urban redevelopment?

There are good arguments for cyclists deserving special attention. In practical terms, cyclists can move further and faster than pedestrians, making cycling more viable than walking as a mode of getting about in places that are large and with dispersed development. In retrofitting existing urban areas to afford more sustainable travel, particularly those places with lower densities and multiple activity centres, it is unrealistic to think that walking can be the whole solution. A more holistic approach would involve cycling; a more comprehensive urban design strategy would make that experience delightful as well as safe. If cyclists have substantially different experiences and needs then urban design needs to stretch its repertoire to acknowledge that; pedestrian-, auto- and even transit-oriented design is insufficient.

This paper addresses the degree to which cyclists have significantly different needs, and if so, what are the design implications. It is composed of four sections. The paper first compares the characteristics of cyclists with those of pedestrians and vehicles, suggesting several substantive differences such as speed and likely participants that warrant further investigation in terms of a special urban design response. It next outlines, through the lens of the cyclist, common approaches to designing roads, paths and other infrastructure associated with movement, as well as the surrounding buildings and landscape. In doing this it focuses on four issues—(1) overall layout of neighbourhoods and towns; (2) specialized cycling facilities; (3) urban analysis and design processes; and (4) detailed design. This part also examines existing cases of good practices in designing for cycling, generally reflecting the first two of the four issues above—layout and facilities. Drawing on this analysis, it proposes an approach to bicycle specific urban design in the form of key issues and design suggestions, and concludes with a call for giving the experience of cycling stronger consideration in urban design. In doing this cycling-oriented urban design would move beyond a concern with safe and convenient facilities and complete networks to a more substantial interest in the experience of the environment from a cyclist's point of view. However, not enough is known about the view from the bicycle. Research on cyclists' perceptions and experiences is an important area for future work.

Suggesting that urban designers more fully account for cycling is a relatively new contribution. Take two examples from exemplary texts on urban design. Jon Lang's (2005) excellent *Urban Design: A Typology of Procedures and Products* is richly illustrated, but only two images have cyclists in them (and these are in the distance); City Centre Chandigarh (p. 29) and an image titled "Weather protection for pedestrians Kyoto in 1992" (p. 367); bicycles are parked in two images from India (pp. 87, 159) and may be visible in one architectural rendering. Similarly, Carmona et al.'s (2003) *Public Places, Urban Spaces*, is exceptionally good at providing images of spaces with people in them. In the substantial number of images, however, there is only one cyclist, pictured in the distance in London (p. 151). Bicycle parking is pictured in images on facadism (p. 152) and paving and building materials (p. 159). The intention here is not to criticize these two works, which are some of the most humanistic texts on urban design available and are written by experts with substantial experience. Rather, the point is that the cyclist's view is typically *not* central in even the most comprehensive work on urban design.

The perspective and the paper overall draws on a review of over 300 articles examining how to encourage levels of cycling and increase safety, as well as dozens of review articles and manuals summarizing research or practice experience (Krizek *et al.* 2009; Forsyth & Krizek 2010). Throughout the work it became clear that cycling has been viewed in primarily functional terms in urban design. The review did not deliberately omit the more formal, experiential (perceptual), sensory, visual, temporal or social dimensions that are the focus of much urban design (Carmona *et al.* 2003). There was in fact a gap between more general work in urban design focused on pedestrians, work in transportation planning focused on motorized vehicles where cyclists posed potential conflicts with vehicles, and cycling research and practice addressing the importance of promoting safety and providing continuous cycling networks. This paper starts to fill this gap in urban design by sketching out current practice, offering a framework and other tenets to consider in understanding the experience of cyclists, and providing preliminary design recommendations.

Vehicles, Pedestrians and Cyclists

In most parts of the world, the bicycle is legally recognized as a vehicle, but its position in the vehicular hierarchy is often unclear. Such confusion is further related to culture. For example, in parts of Asia cycling is commonly relied on as a means of cargo transport; rickshaws and other similar devices physically compete with other modes. In parts of the Netherlands and Denmark, cycling enjoys a prominent role in the hierarchy.

In mainstream transportation planning for the Western world—the predominant focus in this article—cycling is often coupled with pedestrians under the moniker 'non-motorized' transportation. This is, however, a residual category that in some planning contexts has also included riding in a bullock cart, rowing a boat or riding a horse. Of non-motorized modes, in most places walking is dominant; in the US according to the National Household Travel Survey of 2001, 10% of trips were by foot, including trips by foot to a transit stop; a far smaller percentage is by cycling (Agrawal & Schimek, 2007). However, it can be questioned about the degree to which this classification—like a pedestrian, not like a motorized vehicle—holds up to more detailed scrutiny. Table 1 outlines some of the similarities and differences between bicycles, pedestrians and motorized personal vehicles. Certainly the similarities between cycling and walking are practically and politically important, but the differences are substantial.

Table 1 raises the issue of different levels of skill among cyclists. This issue of skill level is important as different types of cyclists travel in different parts of the roadway (or off road), at different speeds, and with different levels of awareness of their surroundings. For example, in the US practices employed by the Federal Highway Department clearly recognize diversity in cyclists' abilities and preferences, dividing cyclists into three classes: A = advanced cyclists who put a premium on speed and tolerate traffic well; B = other adult 'basic' cyclists who are 'less confident' about negotiating with traffic; and C = child cyclists (Wilkinson, 1994). Other guidebooks, such as those published by the *American Association of State Highway and Transportation Officials* (*AASHTO*) employ the same A-B-C distinction; furthermore this guidebook goes so far to as to suggest the diversity of different needs:

> No one type of bicycle facility or highway design suits every bicyclist and no designated bicycle facility can overcome a lack of bicycle operator skill. Within any given transportation corridor, bicyclists may be provided with more than one option to meet the travel and access needs of all potential users. (AASHTO, 1999, p. 6)

Table 1 further demonstrates while there are important similarities between cyclists and pedestrians, such as their modest parking requirements and unlicensed character, there are key differences. Cyclists may not be well catered for by typical pedestrian-type urban design responses given their location in the roadway, speed and need to attend to other moving objects (pedestrians and vehicles). While transportation planning has created a substantial body of work on transportation planning for the bicycle, drawing on research on topics such as accident rates, this does not make up for an absence of design thinking.[2]

Urban Design Approaches

Overall Layouts, Facilities, Processes, Detailed Design

Comprehensive theories of urban design address a number of issues; for example, Carmona *et al.* (2003) outlined six dimensions dealt with generally in urban design: function; morphology; perception; social issues; visual aspects; and time. In considering land use-transportation implications for design in communities, Levinson & Krizek (2008) suggested there are four key tenets—hierarchy; morphology; layers; and architectural content—that play out differently for transportation versus land use issues.

Upon considering these and other views, it has become apparent that work to date on cycling and urban design has focused on function (the top row in Table 2). A more sophisticated approach would engage with at least some of the other dimensions of urban design, which are outlined in the rest of the Table. Such an approach would need to do this at a variety of levels from overall layout and facilities to detailed design and design processes. Table 2 sketches out some of these issues and the text below examines the 'levels' of design attention in more detail.

Layouts: The arrangement of roads and paths is a key component of urban design at the site, district and city scale. At the smaller scale it falls under site planning; at the larger scale community design or physical town planning. Various approaches to overall layout have gained prominence in different periods—rectilinear and curved street patterns; circulation using a lattice or a tree-structure; pedestrian systems that are virtually identical to the road system or largely independent of it; arrangements with little hierarchy or a strong and well-defined hierarchy, etc. (Southworth & Ben Joseph, 2003; Marshall, 2004).

In some places the bicycle has been recognized in the initial layout of communities. For example, early materials from the Regional Planning Association of America often featured happy children cycling on separated paths in newly developed Radburn-style developments (*The City*, 1939; Stein, 1957, pp. 55, 64, 74, 214). Innovative planning strategies—largely carried out in the Netherlands and other Northern European environments—stress the initial layout of places, rather than their adaptation. This has often resulted in exclusive bicycle infrastructure, often reflecting the Radburn tradition of separate, largely independent cycling networks. Examples include Houten and Almere (Crewe & Forsyth, 2011; see Figure 1). Of course, cyclists can also share roads with other vehicles but existing cycling-focused practice at the overall community level has not tended to take that approach. Shared street approaches are more common in retrofits of existing residential or central city areas (European shared streets, complete streets in the US, etc.).

From a transportation planning perspective, motorized transportation networks are typically viewed as a hierarchy of local streets, collectors, arterials and freeways or tollways. Municipalities and metropolitan areas with widely heralded large-scale cycling environments have employed similar strategies for bicycle routes to design or retrofit their system over time (most communities have not been designed for cycling). For example, the Boulder, Colorado, *Bicycle System Plan* identified such a network with primary corridors spaced approximately one per 1.5 km except in higher density and high traffic areas where they are closer. Secondary routes target residential streets to support connections to destinations (City of Boulder, 1996; Krizek *et al.* 2009).

Typically, a cycle network is developed by prioritizing routes between key destinations. This is a substantial task of mapping—origins, destinations, routes—and assessing where improvements are needed (Lawlor *et al.* 2003; Krizek *et al.* 2009). On the transportation side, having a continuous network of cycling routes is increasingly seen as crucial. To date, these actions have focused on defining safe and continuous routes rather than creating comprehensively designed environments supportive of bicycling.

More could be done to explicitly consider the *experience* of the network—both separated areas and those integrated with other movement systems. For example, this may entail providing routes where cycling is uncomplicated enough to permit cyclists to spend time viewing the scenery. Or, it might involve focusing routes where the level of detail of the context is such that it can be easily perceived from the speed of a bicycle—less detail needed than for a pedestrian but more than for a motorist. Another key dimension—often absent in planning—is the degree to

Table 1. Cycling, vehicles and pedestrians

Dimension*	Bicycles similar to motorized vehicles	Bicycles similar to pedestrians	Bicycles are unique
Basic features			
Participants	Requires some training to use on roadways.	Unlicensed. No age limits.	Cyclists vary greatly in skill and have even been classified as classes A, B, C (see below). In most locations there are fewer cyclists than pedestrians; in richer countries there are typically far fewer cyclists than motorists.
Speed	Skilled and fit riders can go relatively fast (in excess of 30 km per hour) and can travel with vehicles in the same lane. Focus of rider attention is on traffic rather than details of the street environment.	Slower than motorized vehicles, and lack of enclosure, may mean they perceive more environmental detail. This will be particularly the case in off-road facilities and for recreational riders moving at a slower pace	On road riders move in the same direction as cars but at a slower speed; the opposite is true of shared paths with pedestrians. Riders in shared paths and roadways may need to pay more attention to pedestrians, motorists, and hazards (such as grates) reducing ability to perceive their surroundings in detail.
Distance or range	Can go relatively long distances.	Distance is still a factor with a limited range.	The range of cyclists is between the pedestrian and the motorist with implications for their perception of the 'neighbourhood' and other local areas.
Loads	Can carry luggage and passengers.	Loads and passengers limited and often require special gear, e.g. packs and trailers.	Bicycles have some unique business uses, e.g. bicycle couriers, deliveries in congested areas.
Safety concerns	On-road safety is a key concern as are intersections.	Like pedestrians, problem areas include locations where cyclists cross roads as well as buffering as they move along the side of the road.	Less concern about crashes involving similar vehicles (bicycles). Bicycles may pose a hazard for pedestrians; in some locales cyclists may have a propensity to ignore road rules (Thompson 1977, p. 202).

(*continued*)

Table 1. (*continued*)

Dimension*	Bicycles similar to motorized vehicles	Bicycles similar to pedestrians	Bicycles are unique
Environment			
Movement	Like motorized vehicles, cyclists can use the ordinary travel lanes on a road. Sensitive to road maintenance issues such as potholes.	Like pedestrians, cyclists often use special lanes and paths along the side of the road or away from the road altogether. Sensitive to slope.	Barring stairs or similar barriers, can ride both on and off road.
Parking	Needs secure storage at both ends of trip.	Parking requirements are modest.	Often ignored.
Mix with transit	Needs parking near transit stops.	Can often be taken onto transit vehicles.	Often an afterthought.
Institutions			
Who plans and designs	Often part of the transportation planning process.	May be integrated with urban and community design (e.g. with off-road paths, shared pedestrian and bicycling facilities).	In a growing number of locations there are specialist bicycle planners. Bicycles are rarely the top priority for mainstream transportation planners and urban designers.
Who funds interventions	National, state/provincial, and local governments provide funding through transportation and public works departments.	Trails may be funded through parks departments.	Many options but few dedicated funds.

Note:*Including mostly cars, motorcycles and buses. Column 1 in this paper reflects some of the categories described in Forsyth *et al.* 2009, Table 2. The rest of this Table is based on the literature reviewed for this paper.

Table 2. Issues for approaches to urban design focused on cycling

Dimension*	Overall layout	Facilities	Processes	Detailed design
Function (the current focus of design for cycling)	Complete cycling network.	Safe and well-maintained lanes, paths, and trails.	Opportunities for input from cyclists of different skill levels.	Well-lit and signed travel and parking areas, without obvious hazards.
Morphology	Land uses close enough to allow cycling, coarser grained than pedestrian-oriented design, finer grained than auto-oriented.	Cycling lanes, paths, trails and parking help maintain design intentions regarding enclosure/ openness.	Formal analyses could separately assess cycling environments.	Buildings and landscape define space at scale of bicycle (height and speed).
Perception	Cycling network forms a logical hierarchy with easy wayfinding.	Travel lanes allow safe and attractive views to surroundings; help focus cyclists attention on other vehicles where appropriate.	Cyclists' perceptions and mental maps are incorporated into planning.	Built elements can be perceived clearly from a faster speed than the pedestrian, i.e. detailed design is bicycle-scaled as well as human-scaled and/or auto-oriented.
Social issues	Cycling can be used to connect destinations for all types of cyclists from preschools to grocery stores and senior centres.	Allow for cyclists to ride side by side and in other groupings and for cyclists to interact socially with non-cyclists.	Engage with different types of cyclists—particularly stratified by age, income, skill level and purpose.	Allow for clusters of cyclists to park and interact.
Visual/ aesthetic	Larger environment legible at a cyclist's speed.	Avoid visual clutter from multiple facilities while still providing multiple options (mode, skill level, purpose).	Incorporate cyclist-eye view in visual preference studies.	Balance complexity and diversity with the need to understand the environment at cycling speeds.
Time	Lay out cycle paths considering use in different seasons and potential for changing patterns over time, e.g. if more seniors start cycling.	Plan for evolution of facilities over time, e.g. adding parking, adding on or off road lanes for riders of different skill-levels. Account for snow removal in colder climates.	Opportunities for adaptation and redesign over time.	Make seasonal change visible (e.g. falling leaves) without interfering with cycling safety.

Note: *Dimensions are from Carmona *et al.* (2003).

Almere **Houten**

Almere and Houten in the Netherlands are well known for their layout that provides continuous cycling networks, serving a variety of user skill levels and trip purposes, and integrated with transit. They also have typically well-designed and maintained facilities.

Figure 1. Almere and Houten

which a network links key urban places, important to different types of people, in a way that can contribute to public space use, vitality, and legibility.

Facilities: Facilities for cycling have received far more attention than network layout from urban design and even transportation. Numerous cycling design guidelines provide information. Many focus on designing the road carriageway and the larger right of way for safe cycling through on-street cycle lanes, separated bicycle lanes and street sharing approaches, as well as intersection signage and marking. Sometimes separate path systems have been developed that are either shared with pedestrians or not. Complete streets approaches are merely a recent example of this. Other design guidelines emphasize creating bicycle specific facilities such as bicycle parking, signage and lighting.

There are many types of such facilities, particularly different approaches to designing the road carriageway (see Figure 2). While it can be difficult enough to accommodate even one type of cyclist, it has been argued that from a user perspective it may be useful to have more than one type of environment in a given place—Class A cyclists mixing with the traffic; Class B on a separate lane; and children in Class C perhaps sharing paths with pedestrians (Krizek *et al.*, 2009). Examples of such 'redundancy of facilities' are further shown in Figure 2.

New York City's recent move to encourage cycling has involved a number of urban designers in their planning department (City of New York, 2007). Enthusiasm initiated by restricting autos from one of the busiest intersections in the US—Times Square—quickly spread to other corridors and bicyclists. Other examples of increasing cycling infrastructure typically involve planners as well as engineers. The London Cycle Network (2010), implementing the London Cycling Action Plan of 2004, is a partnership of many agencies and organizations, and is served by engineering consultants. The related London Cycling Design Standards focus on networks and facilities (Transport for London, 2005).

Shared facilities with automobiles

Shared Streets (shared with pedestrians and some cars) Stockholm, Sweden

Cyclists on low-speed roadways and neighborhood streets Sendai, Japan

Traffic calming, Utrecht, Netherlands

Wide kerb lanes Tsukuba, Japan

Combined (shared) off-road facilities for NMT (bicycles sharing with pedestrians) Izumi Park Town, Japan

Bicycle boulevards (lanes shared with cars) Berkeley, US

On-street bicycle lanes–counterflow Boulder, US

On-street bicycle lanes – same direction as traffic Atlanta, US

NMT mode specific facilities

Redundancy of facilities
for differing user types
Tauranga, New Zealand

Separated bicycle facilities
Almere, Netherlands

'Copenhagen' bicycle lanes
Amsterdam, Netherlands

Bicycle boxes and bicycle sheds
Hangzhou, China

Shared and rental cycling
facilities
Shanghai, China

Trip end facilities/stations
for cycling (parking plus
gear changing facilities, etc)
Milton Keynes, UK

Figure 2. Facility types. *Source:* Photographs by the authors.

For transportation planners (but also for other disciplines), the issue of separated facilities versus cycling on streets has been a topic of extensive debate. An emphasis on what has been referred to as 'vehicular cycling' argues that cyclists should be treated as vehicles in roadways and has subsequently resulted in decreased emphasis on dedicated cycle paths. Furthermore, separated cycle paths have been controversial as the research evidence, on balance, finds that they increase accidents where they intersect with roads (Wachtel & Lewiston, 1994; Summala *et al.*, 1996; Räsänen & Summala, 1998; Aultman-Hall, 2000; Pedler & Davies, 2000; Krizek *et al.*, 2009; Forsyth & Krizek, 2010).

On the other hand, most cyclists are unaware of such research and perceive dedicated facilities as safer (meaning that such paths may encourage people to cycle, and places where many people cycle tend to be safer places (Jacobsen, 2003). For example, in a study of 608 people in King County, Washington, Moudon *et al.*, (2005) found that closeness to trails—along with the presence of clusters of offices, clinics/hospitals and fast food restaurants—predicted cycling at least once a week. Other variables were not significant, including (on-street) bicycle lanes, traffic speed and volume, slope, block size and parks. Similarly, in a study in the Twin Cities of Minneapolis and St. Paul, Krizek & Johnson (2006) found those who lived near trails cycled more.

A central touchstone of the debate over the merits of separate facilities relates to the intersection, which is where most accidents happen. A difficult intersection can also create a crucial gap in the network. Various intersection treatments have been posited including: coloured markings to demarcate space for cycling; 'bicycle boxes' where cyclists get to wait at intersections in a special area at the front (specifically, a sideways extenuation of the bicycle lane in front of the adjacent vehicular lane); underpasses and overpasses. While often built, there has been surprisingly little research on how effective such treatments are in terms of safety (however, see Hunter, 2000).

Considering a more macro perspective (less focused on specific facilities but aggregated over an entire region) suggests countries that have invested in paths, markings and other facilities have heightened levels of cycling. It is worth noting, however, that countries such as the Netherlands and Germany pursue varied initiatives (including education, promotion, pricing, parking) to promote cycling. It is difficult to disentangle the contribution of facilities alone (German Federal Ministry of Transport, 1998; Pucher & Buehler, 2007, 2008; Ministerie van Verkeer en Waterstaat, 2007). Whatever the situation, such debates are focused on the safety of the facility far more than how it is experienced.

However, safety and separation are only two aspects of the design of cycling facilities. There is scant literature commenting on the experience of cyclists as they travel, such as how facility design can heighten social interaction. Safety—not so much in terms of crashes but violations from others—remains an untapped issue. Does providing more of a sense of enclosure for cyclists, or a cycle-eye street wall, have negative safety implications? It remains unclear if additional cycling infrastructure clutters the street environment, creates visual noise and undermines the experience of other users. Furthermore, in terms of the temporal dimension of design, how can facilities be designed to age gracefully as they evolve to support different kinds of users or levels of use?

Processes: The term 'process' refers to a variety of techniques—designer-led and participatory—used in the activity of doing urban design. Visual assessment techniques, part of some urban design analyses, have long engaged with transportation. These include work on: visual impacts of infrastructure such as highways; audit tools related to walkability with some mention of cycling; cognitive mapping techniques that often focus on street patterns and paths; and precedent types of studies focused on street patterns and dimensions of exemplary places.[3] There is also a modest amount of environmental psychology research, although much of such research on roads is focused on driver safety. However, some studies of user experience engage with more varied users of streets.

Urban designers could certainly use such tools to examine cyclists. However, typically cycling audit tools look at functional issues relating to facilities and networks (e.g. network completeness and routing, traffic volumes, hazards, latent demand) (Moudon & Lee, 2003). Similarly, with other tools such as participation (charettes, workshops) and visualization, design for bicycles is incorporated but typically in a functional way—locating paths, adding parking, locating areas of likely conflict with motorists and pedestrians. More could be done. One striking example, however, is the 'procedures' chapter in the London Cycling Design Standards (Transport for London, 2005). This deals with such topics as steps to create a cycling project, consultation with stakeholders, and various audit and assessment tools (risk assessments, road safety audits).

Such processes could be easily expanded beyond these functional issues to involve cycling-oriented visual assessments, mental mapping exercises, personal crime-related safety audits, and other urban design approaches. It may be important to incorporate cyclists' perceptions of paths, landmarks, districts etc.

Houten, Netherlands—a separated bicycle path leading to the downtown, a path that allows relatively high speeds. Buildings nearby are scaled to be interpreted from a bicycle with some human-scaled elements but also repetition.

Almere, Netherlands—two cyclists on a separated path pass through expansive green space that appears well scaled to their activity. It might be (perhaps) a little dull to pass through as a pedestrian but details would (again perhaps) be largely un-noticed by a motorist.

Utrecht, Netherlands—older streets in the central area mix pedestrians and cyclists at a slow pace. The two women cyclists can sociably converse and in this environment.

Nara, Japan—two women cyclists look around and engage with their environment. The streetscape demonstrates typical Japanese cluttered signage that provides a high level of visual complexity and diversity that is likely still legible to cyclists because of the slow speed of the street.

Melbourne, Australia—The bridge provides a moderate level of texture and visual variety. This is interesting enough for pedestrians but better scaled for cyclists.

Almere, Netherlands—Bicycle parking is scaled to be perceived when riding at speed and as public art it is comprehensible to pedestrians.

Figure 3. Cycling-oriented design. *Source:* Photographs by Ann Forsyth.

Table 3. Design guidelines

	Key issues	Design recommendations
Part 1: Networks and layouts	Create a seamless network without discontinuities. Provide options for those wishing to go at different speeds—(a) faster commuters or Class A recreational cyclists vs. (b) slower Class B and C cyclists and those who wish to do more sightseeing or ride in sociable groups. Connect to other modes, primarily transit.	1. Provide a hierarchy of cycling streets, linking key urban places, that overlaps but is probably not the same as the hierarchies for pedestrians and motorists. Make this legible through physical and other cues. 2. Conceive of slightly separate networks for what in the US context has been referred to as Class A versus B and C riders, with the former sharing vehicular roadways more often and the latter having separated bicycle paths or sharing paths with pedestrians, skateboarders, etc.
Part 2: Facilities	Create a mix of levels of separation appropriate to the place in the network and types of cyclists: separated completely, shared with cars, shared with pedestrians and shared with both. Decide how wide to make separated or shared lanes depending on volume or riders, need for sociable riding, and so on. Design the separation, if there is one (e.g. raised strip, striping, bollards, planting). Detail how separated paths meet shared routes at intersections and crossings (with implications for accidents). Use other strategies to avoid accidents at intersections. Provide clear signage and signals. Use space effectively for parking. Prevent visual and physical clutter in the pedestrian environment. Provide appropriate levels and forms of lighting.	3. Space the high-speed/bicycle-arterial part of the grid more closely than is typical for motorists. 4. Design carefully for potential conflicts on shared paths or lanes (auto/cycle or pedestrian/cycle). These will likely require additional width. 5. Duplicate facilities may be needed on key routes (e.g. on street lanes for Class A and B cyclists and off street paths for Class B and C folks). 6. Match detailing of adjacent buildings and landscape to cycling speed, considering visual quality and social interactions along with safety (see below for more on this topic). 7. Avoid making intersections too visually complex given that adding substantial cycling capacity will do that anyway through added striping, signals, and signs. 8. Provide for informal bicycle parking (e.g. poles), small-scale formal parking (e.g. racks), and large-scale parking lots as appropriate. In doing this it is important to consider the needs of pedestrians for free movement.

(*continued*)

Table 3. (*continued*)

	Key issues	Design recommendations
		9. Design smaller-scale parking to perform multiple functions (e.g. as public art, bollards, tree protectors) in order to reduce the perception of visual clutter. 10. Provide lighting that caters to cyclists in terms of height and the area illuminated (e.g. cyclists may need clearly lit road edges while pedestrians need lit paths and motorists the central part of the road carriageway). 11. Illuminate off-road paths that are meant to be used at night and clearly indicate those that will not be lit (considering their place in the network).
Part 3: Processes	Represent all types of cyclists in the urban design process. Use measurement and analysis tools that take into account the cyclist's experience. Allow for evolution over time. Acknowledge expertise from transportation and urban design.	12. Actively encourage participation of cyclists who vary in skill-level, age, income and cycling purpose because their experiences will differ. Participation would be in planning processes and also in changing the environment over time. 13. Perform at least some analyses from a cyclist's view. Appropriate tools could include 'windshield' surveys using a clip on microphone, urban design checklists, photovoice or day with a camera exercises, neighbourhood tours, crime-prevention through environmental design (CPTED) assessments and map-based analyses using the cycling network as the base network, e.g. accessibility assessments.
Part 4: Detailed design	Consider the experience of the built environment at a speed beyond the pedestrian but slower than the auto (or transit). Provide for the physical and social needs of the cyclists, through details such as lighting and parking, in a way that contributes to overall urban design, e.g. legible at cycling speed but also comprehensible for pedestrians.	14. Consider several urban design dimensions that vary in terms of the speed at which they are experienced such as complexity, texture. 15. Consider how the environment is experienced at different cycling speeds, e.g. low speed on mixed routes vs. higher speeds on separated paths. This will have implications for the level of complexity and scale of urban design elements. 16. Create visually interesting environments for cyclists but do not clutter the pedestrian or vehicular realms. Consider artful detail.

into data collection. There is also potential for designers to provide opportunities for cyclists to modify the environment over time—through a planning process, by creating movable parts, or via programming. Given that cycling lies squarely at the intersection of the domains of transportation planners and urban designers, planning and design processes have much room to acknowledge both areas of expertise.

Detailed design: It is at the level of detailed design that spaces are typically experienced: street volume or proportions; street wall transparency; building complexity; furnishing provision; planting character; material colour and texture; etc. This is also a key area where building and landscape style becomes apparent.

Detailed design is perhaps where design for cycling has the most to offer in developing a new perspective. Cyclists' speed, height and skill diversity present challenges and opportunities for urban design in terms of scale, texture and change over time. How can the scale of buildings and streets reflect cycling dimensions and views, particularly in dedicated paths? What level of visual detail (materials, plantings, openings, etc.) is most appropriate for cyclists given their speed and safety concerns? Could detailed design allow for more social interaction on the paths and at destinations through well-designed path pull offs, parking and alternative slower-paced routes? Can design for cycling make environments more artful, rather than more cluttered? What design details can reflect change (of time of day, season, and year)?

Examples in Figure 3 illustrate some possibilities, demonstrating the potential for cycling-specific urban design at the level of detailed design.

Design for Cycling: Redesigning Context and Detail

The central argument posited in this paper focuses on the degree to which urban design would be different if the experience of bicycling was given a more central place. It is argued that it would be different, although subtly so. Currently the literature on urban design and cycling focuses on increased safety and better connections, mostly as efforts to encourage use. There is little research or practice focusing on the quality of the cycling experience.

This final section proposes in more detail how urban design for cycling would differ from a focus on motorists and pedestrians. It lays out key issues that form the foundation for a series of guidelines. There are several similarities between general principles of good urban design and a form of urban design that would engage with more dimensions of the cycling experience. Relying on the categories introduced earlier—overall layout, facilities, processes and detailed design—Table 3 describes the implications for users with different skill levels and cycling purposes and proposes design recommendations.

Cyclists do not always require their own specially-designed neighbourhoods, facilities or processes, let alone multiple ones for different types of users. However, they should be considered as important users of many different types of environments. Where they have separated areas or processes, these should centrally consider the view from the bicycle along with others. Where they share streets and paths with others, there is additional room for their needs to be more prominent and not on the margin. Safety issues are an important part of this approach, with implications for intersections and crossings. However, safety is just one element. From lighting placement to the level of complexity of facades, the implications of cycling for urban design are substantial.

While the authors hesitate to call for more research, at present the design of cycling environments is hampered by an almost exclusive focus on functional issues and on cycling facilities and networks. Additional research could engage with several important topics related to key issues in urban design (see Table 2). What types of forms are best perceived by cyclists given their height, position and speed? How can social interaction between cyclists and others be best considering both safety and the quality of experience? What level of visual complexity is most appealing for cyclists in different contexts? How can cycling environments evolve over time?

In sum, there is need for additional research on the experiences of different types of cyclists, in addition to the more technical issues such as safety and route connectivity. Some of this investigation could be informal and incorporated into participatory processes. Other research may require more substantial personnel and funding. With such research findings urban designers will be in a better position to design with the cyclist in mind.

Notes

1. Classic early sources grappling with the implications of cars for cities include LeCorbusier (1973, orig 1943) and Great Britain Ministry of Transport (1964). For general work on street design see Jacobs (1993); Bosselman (1998); Southworth & Ben Joseph (2003); Marshall (2004). For pedestrian-oriented design see Cullen (1961); Jacobs (1961); Whyte (1980, 1988).
2. Basic bicycle planning texts include Forester (1994); Wilkinson (1994); Oregon Department of Transportation (1995); FHWA (2004).
3. References on visual impacts include Shepphard & Newman (1979); FHWA (1988); audit tools (Clemente *et al.*, 2005; Ewing *et al.*, 2006; Ewing & Handy, 2009; Boarnet *et al.*, 2006, forthcoming; Day *et al.*, 2006; Brownson *et al.*, 2009); cognitive mapping (Lynch, 1960); streets (Jacobs, 1993; Alexander *et al.*, 1977; Bosselman, 1998).

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