ASSESSING PUBLIC RESPONSE TO FREEWAY ROADSIDES: URBAN FORESTRY AND CONTEXT SENSITIVE SOLUTIONS

Submission Date: November 11, 2005

Word Count: 5,465 words for abstract, text and references; 3 figures and 5 tables @ 250 words each; total word count 7,465

Author:
Kathleen L. Wolf, Ph.D.
Research Social Scientist
College of Forest Resources
University of Washington
Box 352100
Seattle, WA 98195
(206) 616-5758
kwolf@u.washington.edu

Cite: Wolf, K. L. 2006. Assessing Public Response to Freeway Roadsides: Urban Forestry and Context Sensitive Solutions, Paper 06-1586. In Proceedings of the 85th Annual Meetingof the Transportation Research Board (January 22-26, 2006). Washington D. C.:Transportation Research Board of the National Academies of Science.

ABSTRACT
Social science methods can be used to assess public values for Context Sensitive Solutions. The roadside landscape is a public lands resource that can provide many functions and benefits. Diverse stakeholders may have varied expectations for roadside design. The urban forest is often a contested component of the urban roadside. Based on landscape assessment literature, two research surveys were used to assess and quantify public preferences and perceptions with regard to trees in high speed and freeway roadsides. One photoquestionnaire was distributed nationally and the other in Washington State cities. Each survey included design visualizations, constructed using digitally edited photographs, to elicit public attitudes about visual quality and community image. Research results were consistent across both studies. Respondents judged images with increasing amounts of roadside vegetation, including trees, to have higher amenity values. The presence of more extensive community greening was associated with positive consumer inferences and greater willingness-to-pay for goods and services. There was little variation in all responses across respondent demographics. The results provide an empirical basis for flexible highway design, and generate planning options for roadside urban forests that address multiple stakeholder interests.

Key Words: roadside, urban forest, context sensitive solutions, visual quality

Roadsides are an important landscape resource in the United States, comprising hundreds of thousands of acres. The public has ever-increasing experiences of roadside landscapes. In recent decades each American's average miles of yearly travel, number of trips and mileage per trip has increased 60 to 85 percent. Much of that road time is spent on urban high-speed roads. Americans currently travel about 2.3 billion vehicle miles per day on approximately 61,000 miles of urban freeways and highways (1).

Expanded functions and benefits are expected for all urban public lands, including roadsides. Roadsides were historically dedicated to providing clear zone and safety buffers. They are now designed to manage stormwater, enhance air quality, perform as wildlife habitat, and provide visual amenities.

The roadside urban forest provides extensive services and benefits. Roadside design may include conservation of existing trees, or incorporate new tree plantings. The policy and procedures of Context Sensitive Solutions (CSS) enables stakeholder input on freeway design. How does a transportation agency gauge public response to freeway roadside design? What is the driver's experience of the roadside, including urban forest elements?

This research report makes two contributions to transportation planning. First, based on results of two survey studies, it provides an empirical basis for decision-making about vegetation in transportation corridors. The project also demonstrates methods for eliciting stakeholder response using design visualization techniques.

BACKGROUND AND RESEARCH

Stakeholders within both the transportation industry and community groups are collaborating to achieve greater design flexibility and integration of community values in CSS. Highway projects once focused almost exclusively on faster travel times and safety, and were perceived as having adverse impacts on communities through which they passed (2). Recent AASHTO and FHWA publications provide ideas, options, and examples of ways to design more environmentally friendly highways without compromising safety and mobility. They stress the importance of early public participation, identifying community interests, and creative thinking to achieve community friendly highway design (3).

Landscape Assessment

Landscape assessment studies have been used in natural resource management since the 1960s, to explore stakeholders' perceptions and values with regard to specified landscapes. Data collection approaches include surveys, on-site assessments, visitor-employed photography, and visitor evaluations. Assessments have evaluated public response to urban residential settings and parks (4, 5) and various wildland landscapes (6), but have rarely been applied to the study of transportation landscapes.

Roadside plants contribute to highway visual quality. In California (7) people judged simulations of proposed roadside residential development for scenic quality. Drivers described roadside development as "Cluttered" and "ugly," while "pleasant" and "beautiful" were descriptions of highly vegetated highway corridors. Van passengers recorded attractiveness ratings for urban roadside views in Minnesota (8); highest values were awarded to road segments having nature features, and well-designed plantings and structural elements. The presence of perimeter foreground vegetation, wildlife and openness, and flowers were significant indicators of scenic beauty in a predictive model derived from public ratings of primarily urban roadside landscapes (9).

Landscape assessment theory includes psychological dynamics that are associated with visual quality, such as affect, cognition and behavior (10). For instance, roadside character can affect route choice. Drivers chose a scenic parkway route to a shopping center more often than a nonscenic expressway route, despite the parkway route having more stops and taking more time (11). Drivers enjoyed views of nature and reported feelings of relaxation while on the parkway route.

Nature Response

Stress is a public health issue. Stress response is documented for all driving experiences, though intensity varies depending on road and traffic conditions. Heart rate variability and blood pressure increase when a person is driving compared to non-activity situations. Demanding driving conditions, such as on-ramps, off-ramps and roundabouts, increase stress response (12).

Commuting may be one of the most stressful experiences of urban life. Increased blood pressure, higher illness rates, lowered job satisfaction, absenteeism and lower performance on cognitive tasks are all related to longer or more difficult commutes (13). Empirical studies have confirmed the restorative effects of passive nature experiences (14, 15). One study specifically addressed the effects of roadside character on stress response using physiological monitoring (16). Simulator scenarios containing built-up, strip-mall style roadsides both slowed down and impeded driver recovery from introduced stressors. Subjects viewing roadside nature scenes (forests or golf courses) returned to normal, baseline conditions faster and had greater ability to cope with stressors. An "immunization effect" was discovered; exposure to a natural roadside setting decreased the magnitude of stress response to a later task.

Trees and nature are also associated with positive, cognitive appraisals of urban places. Urban scenes containing trees (particularly large ones) are consistently highly preferred in urban landscape assessment. Positive meanings and values are associated with the urban forest (17, 18). Natural amenities influence perceptions of urban place and function (19).

Such non-conscious reactions have consequences for community economics. In a series of studies of consumer response to downtown business districts (20), shoppers report being willing to pay nine to twelve percent more for goods and services in districts having a quality urban forest. Rental rates of commercial office properties were about seven percent higher for sites having a quality landscape that included trees (21).

Research Program

Environmental benefits of having trees in urban freeway roadsides are generally recognized. Sparse social science studies hint at the psychosocial importance of the view from the road. Two studies were conducted to learn more about public response to urban roadsides. Three research questions guided the research:

1) How do the urban forest and other landscape elements contribute to the visual quality of the freeway roadside?
2) How does roadside landscape affect place perceptions?
3) Are differences in drivers' preferences and perceptions associated with demographic traits?

METHODS

Research data were obtained using two surveys, detailed in Table 1. The instruments were constructed to elicit public response regarding roadside vegetation design in urban and semi-urban high-speed roadsides. Each survey contained variable sets to capture attitudes about

aspects of roadside design and landscape. Response included visual images ratings, and indicators of agreement to verbal statements. Demographic variables characterized driving behaviors and socioeconomic conditions.

Design visualization is used to share design proposals with transportation clients. Built elements, as well as details of color and materials, can be depicted before major construction costs are committed. Engineers and laypersons can make better decisions about future transportation projects when considering "what if" scenarios. Artist renderings have been used for visualization historically; computerized digital tools now offer advantages of reduced cost and greater three-dimensional precision (22).

Simple computerized visualization approaches were used in each of the surveys to gauge public values for roadside elements. Each survey contained black and white images (as color reproduction was prohibitively expensive), utilized to prompt preference and perceptual responses. Using a computer paint program, images of vegetation were digitally copied from photographs and placed in base images to create composites showing hypothetical conditions.

RESULTS – ROADSIDE PREFERENCE

Image Preference and Categories

Multi-step analysis of preference ratings revealed public value for the roadside urban forest. Respondents were asked to indicate how much they liked the content of each scene using a

TABLE 1 Content and Methods of Two Research Survey Instruments

	Roadside Preference Survey	**Community Perception Survey**
Content	36 images with preference rating response. Verbal variables about roadside visual features. Demographics variables.	Image sets for two community scenarios. Perceptual descriptor variables-2 sets. Willingness-to-pay variables for goods and services. Demographics variables.
Visualization Images	Six base images containing ground level views of urban freeway roadside conditions. Each edited for six landscape treatments. Response ratings: 1 low –5 high for visual quality.	Base images digitally edited to depict two community scenarios, of low and high levels of community greening. One aerial and two ground level images used to depict each community.
Respondent Sampling	Geographic focus – residents of exurbs within the metropolitan areas of Seattle, Minneapolis, Detroit, Baltimore. Random selection of licensed drivers.	Geographic focus – residents of metropolitan areas of Washington State – Bellingham, Olympia, Vancouver. Random selection of licensed drivers.
Survey Return Rates	3000 surveys mailed, followed by one round of reminder cards. 404 responses. 421 were nondeliverable. Response rate of 16%.	1,000 surveys mailed, followed by one round of reminder cards. 113 responses. 285 were nondeliverable. Response rate of 16%.

Mean 4.52 (high), 0.76 SD

Mean 1.40 (low), 0.78 SD

FIGURE 1 Scenes of high and low preference.

scale, with "1" denoting "not at all" (low preference) while "5" indicated "very much" and high preference.

All 36 images were sorted by preference means; Figure 1 depicts high and low rated scenes. Scenes depicting roadsides having no trees received low ratings. Higher scores are associated with increased density of trees (and resulting screening of adjacent commercial land uses). The public associates trees and reduced views of built settings with higher visual quality, indicated by a three-point difference between high and low rated images.

Dimensional analysis techniques were then used to identify underlying response categories. Principal axis factor analysis with Varimax rotation generated categories that were further defined based on *a priori* decision rules (10, 23).

Five categories accounted for 57% of the total variable variance, and included 27 images. Category loadings are statistical indicators of the degree to which a variable fits in any category. Loadings range from "0" or low fit, to "1" or good fit. The threshold loading for inclusion in a category was 0.4. New dependent variables were constructed by aggregating mean values across all category items for each participant. Figure 2 presents the categories, in ascending order of mean preference.

The lowest rated category, Barren Edge, displays little roadside vegetation. Adjacent commercial property uses (buildings, large products) are highly visible. Buildings dominate the roadside view in the next low rated category. Higher ratings were given to Ornamental Frame, as installations of shrubs and trees soften visual obtrusiveness of built elements, and screen ground level views into the commercial zone. Dispersed trees visually buffer midground buildings or products and create a greater sense of visual balance between the built and natural elements of the scene in Tree Buffer. Having highest ratings, Tree Screen depicts opaque tree groves that obscure what lies beyond the right-of-way. The viewer detects buildings but can't discern their commercial purpose.

Roadside Views Features

Respondents also indicated their agreement on 20 statements about roadside features, using a scale of "1" (not at all) to "5" (a great deal). Descriptive statistics were generated, followed by dimensional analysis (Table 2).

The highest rated category, Vegetation Views, has a mean that is notably higher than the other four categories, demonstrating the importance of quality roadside landscape during the

Barren Edge
8 images
loadings .616 to .794
mean 1.56, 0.70 SD

Prominent Buildings
2 images
loadings .590 to.640
mean 1.66, 0.77 SD

Ornamental Frame
10 image
loadings .590 to .744
mean 2.71, 0.79 SD

Tree Buffer
2 images
loadings .497 to .674
mean 2.88, 0.86 SD

Tree Screen
7 images
loadings .419 to .797
mean 3.87, 0.74 SD

FIGURE 2 Image ratings categories

driving experience. The 3.64 rating for the second category, Built Attractions, is relatively high compared to public judgments of the built environment in prior urban studies (10, 24). Its high summary value indicates public interest in a driving environment that includes a blend of natural and built elements.

The latter three categories specify attributes of the view beyond the road. Large signs are NOT preferred in roadside views. Billboards, in particular, are judged to be detrimental to visual quality. MacGillivary (25) also found that as the density of billboards increases within a section of road there is a corresponding decrease in public opinion of visual quality.

Category 4, with a low rating, indicates that drivers do pay attention to the streaming landscape while driving. Finally, Trees and Safety responses suggest that trees are not considered to be safety hazards. This outcome merits further research as trees elevate injury risk in run-off-the road accidents.

TABLE 2 Roadside Features Categories

Factor Categories^ & Items	Mean Rating	Stan Dev	Factor Loading
Category 1: Vegetation Views	**4.37**	**0.57**	
I like to see a variety of plants in the roadside	4.43	0.73	.752
Having lots of plants creates a pleasing setting	4.46	0.76	.628
Having lots of plants along the road is boring*	1.42	0.79	-.560
The seasonal changes of roadside plants are interesting	4.53	0.67	.545
I enjoy seeing large trees while driving	4.52	0.67	.480
I often choose travel routes because they are scenic	3.86	1.21	.415
Category 2: Built Attractions	**3.64**	**0.70**	
I find the views of nearby architecture to be interesting	3.38	1.01	.585
There should be a blend of built and natural features near the road	3.57	1.05	.559
I find views of neighborhoods to be interesting	3.14	1.07	.548
I enjoy driving through communities with character	4.33	0.83	.474
Category 3: Large Signs	**2.18**	**0.90**	
Large signs are appropriate for roadside advertising	2.30	1.06	.635
Billboards and large signs should be regulated*	4.03	1.08	-.599
Category 4: View Attention	**1.86**	**1.03**	
I don't pay much attention to what's beyond the paved edge	2.04	1.19	.872
I rarely notice the view while driving	1.77	1.20	.659
Category 5: Trees and Safety	**2.22**	**0.97**	
Trees can block or distract me from seeing signs	2.39	1.19	.652
Trees near the road are a safety hazard	2.00	1.10	.514

^Principal Axis Factoring with Varimax Rotation
* inverse value used for category calculations

Community 1 - Little planning for landscape or green space occurred

Community 2 - Planning for quality landscape and green space occurred

FIGURE 3 Community scenarios using digitally edited images.

RESULTS – COMMUNITY PERCEPTIONS

Each survey respondent was asked to complete three sets of verbal variables for each of two community scenarios (Figure 3). Initial analysis was descriptive, followed by data reduction, then comparisons between scenarios.

Place Perceptions

Two sets of Likert scaled variables addressed what drivers thought of each community as a potential place to shop, and a general business environment. Ratings for the respective sets of 15 variables ranged from "1" indicating "strongly disagree" to "7" specifying "strongly agree" with 4 as a neutral center.

Principal axis factor analysis was used for dimensional derivation of both sets, using the same decision rules as for visual images. Three categories were derived for the “place to shop” variables, accounting for 67% of the total variable variance. Two categories emerged for “business environment” explaining 59% of variance.

Dummy variables were constructed by aggregating mean values by category items and participants, then compared across scenarios (Tables 3 and 4) using paired samples T-tests (*alpha*=.05/3=.015).

Comparative results were consistent across perceptual categories with higher ratings expressed for the “green” community. Business patronage and shopping experience were judged more favorably in the greener place. Commitment of merchants to community was also perceived to be greater in the green community. This is a remarkable outcome, as the presentations of community differed only in the degree and character of landscape. Green community images depicted roadside trees that framed views of the community beyond, as well as landscaped arterials and collectors within the community. Trees and vegetation were present in the other community but to a lesser degree. There were no direct descriptors of social interactions.

Urban vegetation provides cues about social factors that may influence patronage behavior. Retailing studies have compared "atmospherics" against consumer intentions and behavior. Indoor environmental elements such as music, product layout and store lighting contribute to store image (26). In turn, store image influences consumers' perceptions (27). In urban outdoor settings both evaluative appraisals (28) and affective response (29, 30) are boosted by the presence of trees.

TABLE 3 Place to Shop Categories

Factor Categories^ & Items (Loading)	Green Mean (sd)	Less Green (sd)	p <
Category 1: Local Shopper Appeal	**5.34 (0.99)**	**4.75 (1.27)**	**.001**
I'd stop here for gas and convenience goods (.57)			
local residents do much of their shopping here (.56)			
Category 2: Inviting to Visitors	**5.07 (1.12)**	**3.37 (1.37)**	**.001**
I'd stop here to see what shops are available (.80)			
is appealing to tourists (.67)			
Category 3: Shopping Experience	**5.02 (1.03)**	**4.23 (1.17)**	**.001**
business people are helpful and informative (.79)			
high quality brands are available (.72)			
wide selection of products and services (.70)			

^Principal Axis Factoring with Varimax Rotation, paired comparisons T-tests

TABLE 4 Business Environment Categories

Factor Categories^ & Items (Loading)	Green Mean (sd)	Less Green (sd)	p <
Category 1: Cooperative Merchants	**5.15 (0.83)**	**4.06 (0.92)**	**.001**
public & private organizations work together (.84)			
merchants care about the community (.81)			
businesses sponsor community events (.79)			
business people are community leaders (.77)			
Category 2: Fiscal Health	**3.27 (1.05)**	**3.89 (0.98)**	**.001**
seems to be struggling financially (-.54)			
the crime rate is high (-.66)			

^Principal Axis Factoring with Varimax Rotation, paired comparisons T-tests

Consumer Pricing

Retailing studies find that certain store settings and positive staff attributes produce higher price acceptability in consumers (31). Is it possible that the visual quality of a place has price behavior implications?

A set of response items assessed the non-market, non-utility values of trees in community settings using contingent valuation method (CVM). O'Doherty (32) regards CVM as a "monetized technique for eliciting public preferences." Contingent valuation surveys have been used to assess public willingness-to-pay (WTP) for urban and rural resource use, conservation, and restoration of environmental damage.

Respondents were asked to indicate the price they would be willing-to-pay for each of eight items (Table 5). Outlier values were removed, and means were calculated for each item by scenario.

TABLE 5 Reported Product Pricing Between Community Scenarios

Product/Service*	Green Mean (sd)	Less Green (sd)	% Diff	^p <
take-out sandwich for lunch	4.93 (1.71)	4.49 (1.52)	10	.001
flower bouquet	17.16 (10.97)	15.61 (10.64)	10	.001
pair of sunglasses	18.87 (15.30)	15.78 (12.36)	20	.01
sit-down dinner for two	34.08 (12.65)	30.69 (12.49)	11	.001
lightweight jacket	38.04 (15.90)	34.82 (13.85)	9	.001
pair of sports shoes	47.07 (21.45)	43.81 (20.25)	7	.005
motel room for 2, one night	62.78 (15.48)	57.09 (14.71)	10	.001
house, 3 bedroom/2 bath	145K (39.5K)	131K(36K)	11	.001

all means in U.S. dollars (1999), ^paired comparisons T-tests

Response was consistent across all pricing variables, and aligned with perceptual response patterns. From low-cost convenience goods to larger purchases, greater WTP was reported for the community having a greener landscape character, including roadsides having trees. Results are consistent with studies that indicate consumers are willing to spend 9 to 12 percent more for goods and services in central business districts having a forested streetscape (20).

RESULTS-RESPONDENTS

Roadside Preference Survey

Respondents were somewhat younger than the U.S. population. 45% of respondents indicated an age range of 40s or 50s, 32% were in their 30s or younger, and 23% were in their 60s or older. Gender distribution was approximately that of the U.S. population. Income was higher than the general populace with 25% of reporting households having incomes of up to $35,000, 43% indicating $35,000 to $75,000, and 32% earning more than $75,000.

When asked, “What is the size of the community you live in?” large city (>100,000 population) was indicated by 22%, small city (20,000 to 100,000) was chosen by 21%, and “suburb of a large city” registered at 42%.

Respondents were also asked to recall their weekly driving habits. Most drivers claimed to spend fewer than ten hours per week in a motorized vehicle (57%). Additionally, 36% claimed 3 hours or less per week on a high-speed road, compared to 28% for 4-6 hours.

Community Perceptions Survey

Sixty nine percent of the community respondents claimed to spend ten hours or less in a motorized vehicle per week. These respondents spent proportionately more time on urban freeways as 27% reported up to 3 hours per week on high-speed roads, 27% for 4 to 6 hours, and 27% for 7 to 12 hours. Increased time on freeways may be due to small city settings or the transportation configurations of Washington State cities.

With regard to size of community of residence more people lived in small cities than the preference survey. Nine percent lived in a large city, and 75% claimed to live in small cities. Rural dwellers numbered about 8%, and suburbs registered at 5%. Household income was

generally lower for this respondent group as 31% reported up to $35,000 annually, 41% for $35-75,000, and 23% reporting greater than $75,000.

Comparisons

Respondent characteristics were statistically compared to preference, perception, and pricing variables using one-way ANOVA and t-tests. Few relationships were identified, indicating that people of diverse age, income, residence location and driving behavior hold similar public values for the roadside urban forest. Highlights are presented.

Means comparisons were conducted on image preference categories for driver subgroups (*alpha*=.05). No significant differences across category means were detected for driver age, household income, time spent in a motorized vehicle each week, or time spent per week in a vehicle on high-speed roads.

Considering roadside view categories, age and income differences were detected. Older drivers are more likely to regard trees as safety hazards ($F=4.17$, $df=2$, $p<.02$), but do not find large signs to be as serious an issue as do younger drivers ($F=7.22$, $df=2$, $p<.001$). Higher income respondents (>$75,000) report paying more attention to the roadside ($F=5.38$, $df=2$, $p<.005$) and being less concerned about trees as safety hazards ($F=5.93$, $df=2$, $p<.003$).

Of particular interest was the relationship of respondent income to pricing response in the community survey. Budget bias can be an issue in contingent valuation surveys. Do respondents, in reacting to a hypothetical situation, take into account their ability to pay? Past research suggests that if indicated willing-to-pay amounts are nominal, the bias threat is minimal, and probably only comes into play when major and costly programs or products are valued (33). Such conclusions were borne out by pricing for most goods. Only one item of the list - flower bouquet - was valued higher by individuals having higher income at *alpha* =.05/8=.006 (one-way ANOVA $F=4.832$, $df=89$, $p< .004$). This suggests that the CVM instrument is income stable, making it valuable for future research.

DISCUSSION

The purpose of the two studies was to provide empirical input for planning and managing urban freeway roadsides. The roadside landscape, comprised of land ribbons that criss-cross the nation, may have a proportionally greater impact on drivers than more expansive public lands, due to the frequency and duration of driving activity. Multiple psychological responses were explored, starting with public preferences and attitudes concerning aesthetics, and extending to cognitive assessments of places that have varying degrees of landscape quality. Other social science studies contribute knowledge about how roadside elements influence driving cognitions, behavior and physiology.

Public preferences for blends of built and natural elements in roadsides were systematically assessed. Results can be used to address stakeholder conflicts. While businesses adjacent to freeways (such as car dealerships) may desire “commercial windows” for full property views, other stakeholder groups (such as neighborhood associations) may request full screening. Using digital editing, variations in amounts and arrangements of trees (and associated vegetation) were presented in surveys to licensed drivers in urban areas across the United States.

Results and Theory

Preference means are generally higher on image categories having both increased quantities of vegetation, and increased height and density of trees in relationship to commercial views. Scenes

containing barren roadsides and views beyond of prominent buildings or large products received lowest ratings. Unfortunately they depict the visual condition of many urban roadsides.

In the mid-range of preference are images with intermittent trees and/or a low-growing shrub masses. Plant materials create horizontally or vertically framed views of commercial uses, combining aesthetics with the opportunity to distinguish particular businesses adjacent to the road.

Full tree screening is most appreciated by survey participants, suggesting underlying tensions in roadside management policy, as business interests insist on open views while the public may prefer total screening. While some demographic traits are associated with variation in image response, the prevailing preference trend across all respondents is greater appreciation of freeway roadsides that contain trees.

Nature associated preference is consistent with prior studies of many landscape settings. Presence of trees generally enhances public judgment of visual quality (34, 35, 30). Kaplan (34) and Schroeder (37) concluded that trees are highly valued components of urban settings, and that unkept nature in urban settings is less preferred than well-maintained nature. A three-point difference in means between the highest and lowest rated scenes is a striking example of how plants can affect drivers' judgments of visual quality. The degree of built-to-nature balance of scenes influences public values. Modest and welcoming signage is judged to be suitable, while billboards and large signs are not acceptable in the roadside.

Respondents indicated psychological inferences based on landscape character. The "green" community was characterized as being a more appealing place for shoppers, including positive merchant traits and product quality. The greener place was also judged to be a more favorable environment for new businesses.

What are the fundamental cognitive processes that underlie these patterns of response? There has been little study of the mediating cognitive processes that result in place judgments. The discipline of social psychology offers insight, being defined as "the scientific study of how individuals think, feel, and behave in regard to other people and how individuals' thoughts, feelings, and behaviors are affected by other people (38)."

Social perceivers assemble various bits of information and, mediated by perceiver dispositions, form impressions of others (39). Humans rely on perceived traits to infer a person's behavior, influence evaluation of the person, and guide decisions about how to interact with a person (40). Diverse information about a person is integrated to form a coherent impression. The observer uses subsequent information and experience to confirm or modify the impression.

Survey results suggest that built settings evoke similar evaluative responses. Respondent's ratings extend beyond immediate physical traits, to include inferences about social and psychological interactions. Social psychological concepts of "social attribution" and "impression formation" readily translate to interpretations of urban space and place.

Opportunities and Limitations

A limitation of this research was the low survey return rate. Sommer (41) reported that 20 to 25 percent return is typically expected of mail surveys of city residents, and response rates have declined more recently (42). The possibility of non-response bias must be considered. These research findings, perhaps of limited generalizability due to sample self-selection, convey the positive public values of roadside urban forests. Additional methodologies could improve response rates (43). More direct delivery of surveys, including web-based choice tools and placement of computer kiosks (at rest areas, for instance), generate data for flexible design decisions.

Another concern is the degree to which one can generalize from the landscape context of these studies, containing coniferous forest plantings, to other landscape settings. Replicate studies are needed to demonstrate the degree to which these findings are applicable to other landscape and geographic types.

Are static images adequate to represent dynamic drive-by experiences? Budget limitations restricted survey materials to pencil-and-paper formats. Additional research is needed to corroborate response to still photographs versus views while driving at high speeds, perhaps using computer or driving simulators.

Surveys do offer advantages that justify efforts to improve response rates. Black and white photographs offer a low cost approach to providing visualizations for public response; color print technologies and 3D simulation are now more affordable. Studies have demonstrated that photo response procedures pose no problems in obtaining people's reactions to outdoor settings (34, 44). Preferences for places shown in photographs correlate highly with on-site responses (45).

Design and Planning

Agencies and organizations (e.g. U.S. Forest Service, Federal Highway Administration) have devised guidelines for managing visual quality in transportation corridors. Most guidelines focus on rural and wildland settings; few address urban and semi-urban (e.g. suburbs, strip development) contexts. Meanwhile, 80% of Americans now live in urban settings and most of their travel occurs in built environments. This research provides a scientific basis for urban visual guidelines.

Respondents most preferred having greater views of trees versus views of built elements. Yet, this design response is not always feasible. In some climatic zones such a landscape approach is extremely costly. Also, roadside designers must often juggle the demands of multiple (sometimes competing) stakeholder groups. While drivers may prefer screening vegetation, this practice may not be consistent with safety conditions, expectations of adjacent property owners, or the economic development plans of neighboring communities.

Mid-level responses on this study's verbal and visual variables suggest how to achieve compromise in design, as well as address safety concerns of roadside fixed objects. For instance, Ornamental Frame and Tree Buffer categories contain intermittent vegetation masses (vertical and horizontal) that exclude the visual impact of complex ground level elements (e.g. parking lots). Trees and vegetation then serve as a green "frame" to momentarily focus the driver's eye on adjacent elements. Placement of vegetation can be avoided in those road segments having a high propensity for run-off-the road accidents, such as the outside of curves.

Public input processes are used extensively in urban planning and resource management situations, to incorporate community values into policy, planning and design concerning both built and natural environments. This assessment project and others like it can advance the understanding of public response to roadside settings, including the urban forest. Empirical data can support more comprehensive and defensible Context Sensitive Solutions.

ACKNOWLEDGEMENTS

Appreciation is extended to the Landscape Architecture and Roadside Management professionals of the Washington State Department of Transportation for substantial contributions to this research. Projects were supported by a grant from the USDA Forest Service on recommendation

of the National Urban and Community Forestry Advisory Council (Grant No. WAUF-97-003). Additional project information can be found at: www.cfr.washington.edu/research.envmind/

REFERENCES

(1) Federal Highway Administration (FHWA). *Highway Statistics* (annual), 1998.

(2) National Cooperative Highway Research Program (NCHRP). *A Guide to Best Practices for Achieving Context Sensitive Solutions – NCHRP Report 480*. Transportation Research Board, Washington D.C., 2002.

(3) Moler, S. A Hallmark of Context Sensitive Design. *Public Roads,* Vol. 65, No. 6, 2002, pp. 6-13.

(4) Schroeder, H. W. Householders' Evaluations of Street Trees in Suburban Chicago. In Gobster, P.H. (ed.), *Managing Urban and High-Use Recreation Settings*. USDA Forest Service, General Technical Report NC-163. North Central Forest Experiment Station, Chicago, IL, 1992.

(5) Dwyer, J.F., H.W. Schroeder, and P. H. Gobster. The Deep Significance of Urban Trees and Forests. In R.H. Platt, R.A. Rowntree, and P.C. Muick (eds.) *The Ecological City: Preserving & Restoring Urban Biodiversity*. University of Massachusetts Press, Amherst, 1994.

(6) Ribe, R. G. The Aesthetics of Forestry: What has Empirical Preference Research Taught Us? *Environmental Management*, Vol. 13, No. 1, 1989, pp. 55-74.

(7) Evans, G. W., and K. W. Wood. Assessment of Environmental Aesthetics in Scenic Highway Corridors. *Environment and Behavior,* Vol. 12, No. 2, 1980, pp. 255-273.

(8) Nassauer, J. I., and D. Larson. Aesthetic Initiative Measurement System: A Means to Achieve Context-Sensitive Design. *Transportation Research Record: Journal of the Transportation Research Board, No. 1890,* TRB, National Research Council, Washington, D.C., 2004, pp. 88-96.

(9) Burley, J. A. Visual and Ecological Environmental Quality Model for Transportation Planning and Design. *Transportation Research Record: Journal of the Transportation Research Board, No. 1549,* TRB, National Research Council, Washington, D.C., 1997, pp. 54-60.

(10) Kaplan, R., and S. Kaplan. *The Experience of Nature: A Psychological Perspective.* Cambridge University Press, Cambridge, 1989.

(11) Ulrich, R. S. *Scenery and the Shopping Trip: The Roadside Environment as a Factor in Route Choice*. Unpublished doctoral dissertation. University of Michigan, Ann Arbor, 1974.

(12) Rutley, K. S., and D. G. Mace. Heart Rate as a Measure in Road Layout Design. *Ergonomics*, Vol. 15, No. 2, 1972, pp. 165-173.

(13) Novaco, R. W., D. Stokols, and L. Milanesi. Objective and Subjective Dimensions of Travel Impedance as Determinants of Commuting Stress. *American Journal of Community Psychology*, Vol. 18, 1990, pp. 231-257.

(14) Ulrich, R. S., R. F. Simons, B. D. Losito, E. Fiorito, M. A. Miles, and M. Zelson. Stress Recovery During Exposure to Natural and Urban Environments. *Journal of Environmental Psychology*, Vol. 11, 1991, pp. 201-230.

(15) Kaplan, S. The Restorative Benefits of Nature: Toward an Integrative Framework. *Journal of Environmental Psychology*, Vol. 15, 1995, pp. 169-182.

(16) Parsons, R. L., G. Tassinary, R. S. Ulrich, M. R. Hebl, and M. Grossman-Alexander. The View from the Road: Implications for Stress Recovery and Immunization. *Journal of Environmental Psychology,* Vol. 18, 1998, pp. 113-140.
(17) Chenowith, R.E., and P.H. Gobster. 1990. The Nature and Ecology of Aesthetic Experiences in the Landscape. *Landscape Journal,* Vol. 9, No. 1, 1999, pp. 1-8.
(18) Hull, R.B. How the Public Values Urban Forests. *Journal of Arboriculture,* Vol. 18, No. 2, 1992, pp. 98-101.
(19) Herzog, T. R. A Cognitive Analysis of Preference for Urban Nature. *Journal of Environmental Psychology,* Vol. 9, 1989, pp. 27-43.
(20) Wolf, K. L. Business District Streetscapes, Trees And Consumer Response. *Journal of Forestry,* in press.
(21) Laverne, R. J., and K. Winson-Geideman. The Influence of Trees and Landscaping on Rental Rates at Office Buildings. *Journal of Arboriculture,* Vol. 29, No. 5, 2003, pp. 281-290.
(22) McDaniel, R. E. See It Before It's Built. *Public Roads,* Vol. 65, No. 6, 2002, pp. 28-31.
(23) Wolf, K. L. Freeway Roadside Management: The Urban Forest Beyond The White Line. *Journal of Arboriculture,* Vol. 29, No. 3, 2003, pp. 127-136.
(24) Herzog, T. R., and T. A. Gale. Preference for Urban Buildings as a Function of Age and Nature Context. *Environment and Behavior,* Vol. 28, No. 1, 1996, pp. 44-72.
(25) MacGillivary, C. I. *A Study of Billboards and Junkyards as Related to Some Aspects of the Aesthetics of the Highway Environment*. Joint Highway Research Project, Engineering Experiment Station, File No. 9-5-4, Project No. C-36-48D. Purdue University, 1969.
(26) Zimmer, M. R., and L. L. Golden. Impressions of Retail Stores: A Content Analysis of Consumer Images. *Journal of Retailing,* Vol. 64, 1988, pp. 265-293.
(27) Dodds, W. B., K. B. Monroe, and D. Grewal. The Effect of Price, Brand, and Store Information on Buyer's Product Evaluations. *Journal of Marketing Research,* Vol. 28, 1991, pp. 307-319.
(28) Nasar, J. L. *The Evaluative Image of the City*. Sage, Thousand Oaks, CA, 1998.
(29) Sheets, V. L. Affect, Cognition, and Urban Vegetation: Some Effects of Adding Trees Along City Streets. *Environment and Behavior,* Vol. 23, No. 3, 1991, pp. 285-304.
(30) Smardon, R. C. Perception and Aesthetics of the Urban Environment: Review of the Role of Vegetation. *Landscape and Urban Planning,* Vol. 15, 1988, pp. 85-106.
(31) Grewal, D., and J. Baker. Do Retail Store Environmental Factors Affect Consumers' Price Acceptability? An Empirical Evaluation. *International Journal of Marketing,* Vol. 1, 1994, pp. 107-115.
(32) O'Doherty, R. Using Contingent Valuation to Enhance Public Participation in Local Planning. *Regional Studies,* Vol. 30, No. 7, 1996, pp. 667-678.
(33) Mitchell, R. C., and R. T. Carson. *Using Surveys to Value Public Goods: The Contingent Valuation Method*. Resources for the Future, Washington D.C., 1989.
(34) Kaplan, R. The Analysis of Perception Via Preference: A Strategy for Studying How the Environment is Experienced. *Landscape and Urban Planning,* Vol. 12, 1985, pp. 161-176.
(35) Ulrich, R. S. Human Responses to Vegetation and Landscapes. *Landscape and Urban Planning,* Vol. 13, 1986, pp. 29-44.
(36) Kaplan, R. The Role of Nature in the Urban Context. In Altman, I., and J. F. Wohlwill (eds.). *Behavior and the Natural Environment*. Plenum, New York, 1983.

(37) Schroeder, H. W. Environment, Behavior and Design Research on Urban Forests. In Zube, E.H., and G. T. Moore (eds.). *Advances in Environment, Behavior and Design (Vol. 2)*. Plenum, New York, 1989.
(38) Brehm, S. S., S. M. Kassin, and S. Fein. *Social Psychology*. Houghton Mifflin, New York, 1999.
(39) Leyens, J. P., and S. T. Fiske. Impression Formation: From Recitals to Symphonie Fantastique. In P. G. Devine, D. L. Hamilton, and T. M. Ostrom (eds.). *Social Cognition: Impact on Social Psychology*. Academic Press, New York, 1994.
(40) Wyer, R. S., and A. J. Lambert. The Role of Trait Constructs in Person Perception: An Historical Perspective. In Devine, P. G., D. L. Hamilton, and T. M. Ostrom (eds.). *Social Cognition: Impact on Social Psychology*. Academic Press, New York, 1994.
(41) Sommer, R., H. Guenther, and P. A. Barker. Surveying Householder Response to Street Trees. *Landscape Journal*, Vol. 9, No. 2, 1990, pp. 79-85.
(42) Elmendorf, W. F., and A. E. Luloff. Using Qualitative Data Collection Methods When Planning for Community Forests. *Journal of Arboriculture*, Vol. 27, No. 3, 2001, pp. 139-151.
(43) Dillman, D. A. *Mail and Internet Surveys: The Tailored Design Method*. Wiley & Sons, New York, 2000.
(44) Sullivan, W. C. Perceptions of the Rural-Urban Fringe: Citizen Preferences for Natural and Developed Settings. *Landscape and Urban Planning*, Vol. 29, 1994, pp. 85-101.
(45) Stamps, A. E. Use of Photographs to Simulate Environments: A Meta-Analysis. *Perceptual and Motor Skills*, Vol. 71, 1990, pp. 907-913.