Appendix B: What the Visual Preference Literature Tells Us[2]

Visual preference surveys have become a popular tool among planning and urban design practitioners. By tapping visual media, such surveys help to illustrate physical design alternatives in ways that words, plans, and other media cannot. They have found applications in visioning projects, design charrettes, and other physical planning activities with heavy public involvement.

Such surveys have become a mainstay of the new urbanist and smart growth movements. Their surveys suggest that the public prefers traditional small town and village scenes to contemporary suburban scenes (Constantine 1992; Nelessen 1994; Malizia and Exline 2000). This fact has been used both to argue for and to effect changes in development practices. Smaller cities such as LaCrosse, Wisconsin and Metuchen, New Jersey have written design codes based on expressed preferences (Nelessen and Constantine 1993). The City of Iowa City (2004) considered the results of a citywide visual preference survey when revising its comprehensive plan and zoning ordinance. The City of Orlando (2003) used a visual preference survey to identify pleasing design concepts for almost every element of the built environment including apartments, houses, offices, street layouts, signs, and even transmission towers.

A national visual preference survey conducted by A. Nelessen Associates for the National Association of Realtors showed that the public supports smart growth principles such as rural and open space preservation and compact and clustered development (National Association of Realtors, 2001). Statewide planning exercises like the Livable Delaware Summit (2001) and What Michigan Wants (2004) have assessed the public's reaction to different development patterns using visual preference surveys. Envision Utah (2000) decided on future development patterns for the Greater Wasatch Area based in part on visual preference surveys.

Yet, visual preference surveys have their limitations. Without further analysis, it is never clear whether expressed preferences are significant in a statistical sense nor whether other variables confound results. Nor is it obvious which physical features of scenes are responsible for high or low ratings. Is it the narrow streets, small building setbacks, mature trees, vernacular architecture, or some combination of these and incidental

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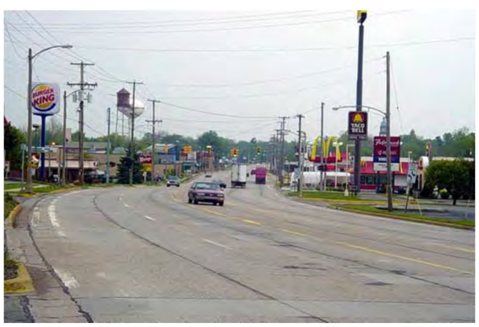
2 This appendix is taken from Ewing, R. (2000). Asking transit users about transit-oriented design. *Transportation Research Record,* 1735, pp. 19-24; Ewing, R., King, M., Raudenbush, S., & Clemente, O. (2005). Turning highways into main streets: Two innovations in planning methodology. *Journal of the American Planning Association*, 71, pp. 269-282; and Ewing, R., Handy, S., Brownson, R., Clemente, O., & Winston, E. (2006). Identifying and measuring urban design qualities related to walkability. *Journal of Physical Activity and Health*, 3, pp. s223-240.

features that contribute to overall preference for traditional urban scenes? More than one observer of this process has commented that when you show citizens stark images of new suburban subdivisions or strip centers versus beautified images from America's finest small towns, the outcome is predictable and largely meaningless (as in Figures B-1ab).

Figures B-1ab. Bias through Scene Selection ("What Michigan Wants Visual Preference Survey")

average score = 6



average score = -4

Visual Assessment Studies

Fields allied with planning use the term visual assessment study to describe activities related to but distinct from visual preference surveys.   Visual assessment methods have long been used as a research tool by forest managers, environmental psychologists, and architects and landscape architects.

The term visual assessment study implies more than a simple preference rating…it implies:

- critical analysis of scenes

- use of statistics to test the significance and strength of relationships
- control of confounding influences

The field of visual assessment took off in late 1970's. Researchers showed photographs of urban and rural scenes to groups of observers, who were asked to rate them according to personal preference, scenic value, or overall beauty. Some studies went a step further to explain what it was about scenes that caused them to be preferred (Carls 1974; Herzog, Kaplan, and Kaplan, 1976; Wohlwill 1980; Schroeder 1982; Anderson & Schroeder 1983; Buyhoff, Gauthier, & Wellman 1984; Schroeder 1988; Herzog 1992; Schroeder & Orland 1994).

In some studies, scenes were not rated for preference at all, but instead evaluated for mediating qualities that contribute to preference such as complexity, enclosure, naturalness, and safety. For example, several studies explored how the design of parking lots, urban parks, or landscapes could affect the perception of personal safety. Well maintained vegetation, visible buildings, and high tree density all contributed to the perception of safety (Appleton 1975; Herzog 1982; Nasar 1982; Shaffer & Anderson 1983; Schroeder & Anderson 1984; Kuo, Bacaicoa, & Sullivan 1998; Stamps 2005).

Places

There is general agreement that the complexity of a scene plays a part in determining preference (Nasar 1983; Stamps 1999; Heath et. al 2000). When provided with images of city blocks, people generally prefer those that have a high level of detail. At the same time, one study found people prefer homogenous blocks (Stamps 1994). Together, these findings indicate that people enjoy looking at streetscapes where there is a balance between a high level of visual interest and the viewer's ability to make sense of the scene, in other words, people like complexity with coherence and order.

Herzog et al. (1982) studied peoples' preference for unfamiliar urban scenes. Scenes were divided into five categories: contemporary life, alley/factory, urban nature, unusual architecture, and older buildings. Scenes were rated with respect to four perceptual qualities: complexity, coherence, identifiably, and mystery. The study found that the most preferred scene type was urban nature while the least preferred was alley/factory. Urban nature rated high on the quality of mystery, while the alley/factory scene had an undesirable combination of high complexity and low coherence.

Nasar (1984) studied major arterial roads through city centers. Preferred scenes were well-maintained, had natural elements, and weren't crowded with traffic. Visual preference was therefore determined to be a function of two factors: order (order, naturalness, and upkeep) and diversity (high contrast, diversity, and few vehicles).

Cervero and Bosselmann (1998) tested whether Americans would accept higher densities in transit villages if coupled with amenities such as open space and retail plazas. They created photo slide images to simulate walks through neighborhoods with different densities and amenity mixes. The conclusion: Americans will accept higher densities in transit villages in exchange for easy access to rail and the availability of amenities, in particular open space. The addition of more retail services such as bakeries and cafés was also well received by the respondents.

Buildings

Several visual assessment studies have focused on peoples' preferences for architectural design features. In one study, Stamps (1999a) examined the degree to which qualities of architectural facades (surface complexity, silhouette complexity, and façade articulation) affect preference when varied simultaneously. The study found that the most important factor for visual preference was surface complexity; this factor had a far greater preference effect than both silhouette complexity and façade articulation. In another study, Stamps (1999b) sought to relate preferences to the visual complexity of facades. Qualities of facades, specifically the percentage of a façade covered by design elements and the number of turns in the silhouette, proved to be better predictors of preference than did characteristics of the observers themselves.

Landscapes

Kaplan (1985) found that the most important factor influencing neighborhood satisfaction was not the amount of open space available but rather the type and arrangement of the space. Residents most valued the presence of trees, well-landscaped grounds, and places for taking walks. Similarly, Talbot et al. (1987) found that areas conducive to walking, including forests and ponds, were preferred by residents in multifamily neighborhoods.

Manicured and well maintained landscapes are preferred over wild, unmanaged nature (Schroeder 1982; Anderson and Schroeder 1983; Shaffer and Anderson 1983; Kaplan 1985; Talbot and Kaplan 1986; Kuo et al. 1998). Landscapes with trees are preferred over those without (Kaplan 1983). Lien and Buhyoff (1986) looked at the diameter of trees and found that peoples' preference for natural scenes increases with the average tree diameter. People also prefer landscapes with fewer, large trees that are set against smooth ground covers (such as manicured grass) rather than in dense forests with shrubs (Buhyoff et al. 1984; Kaplan 1985; Ulrich 1986; Talbot and Kaplan 1986; Schroeder 1988). A video-imaging study looked at clusters of trees and found that the highest preference ratings were assigned to landscapes with the most trees and largest cluster diameters (Schroeder & Orland 1994).

Along with trees, the presence of bodies of water is natural feature valued by residents of urban settings (Carls 1974; Schroeder 1982; Schroeder & Anderson 1984; Talbot et al. 1987).

Signage

Nasar (1987) examined peoples' preferences for signage along commercials strips. Shoppers and merchants viewed photographs of street scenes, which varied in complexity and coherence. The respondents then ranked the scenes separately on three different scales. Ratings were highest for moderate complexity and high coherence. In a later study, Nasar and Hong (1999) investigated the role of sign obtrusiveness (defined as low coherence) and complexity on peoples' preferences for urban signscapes. The study found that preference for signscapes is linked to reductions in sign obtrusiveness; people found less-obtrusive signscapes more legible and interesting.

We now go into some detail in describing three visual assessment studies that have followed best analytic practices. Their results are directly relevant to pedestrian- and transit-friendly design guidelines.

Main Street Design

The guidebook, *Flexible Design of New Jersey's Main Streets*, recommends that state highways designated as "main streets" conform to special design standards and policies (Ewing & King 2002; Ewing 2002). The New Jersey Department of Transportation (NJDOT) response to the guidebook has been positive. But there is continued uncertainty at NJDOT as to exactly which state highways should be accorded this special status. To help answer this question, main street stakeholders were asked to rate different urban highways in a visual assessment survey. This section describes the process and resulting scoring formula (for more details, see Ewing et al. 2005).

Viewers

The survey was conducted at the quarterly meeting of Main Street New Jersey/Downtown Revitalization Institute. At the meeting were representatives of urban, suburban, and rural communities throughout the state. Among them were directors of Main Street Programs and Special Improvement Districts, downtown advocates, downtown business owners, representatives of local governments, architects, engineers, and consultants. This group provided a broad cross section of people interested in promoting main streets in New Jersey.

This convenience sample of respondents was selected for their familiarity with main streets rather than their representation of the larger population. The purpose of the survey was to operationally define a good main street, not to assess public preferences for street characteristics. Given this purpose, main street stakeholders appeared well-suited as respondents.

The survey was administered as a PowerPoint presentation. It began with a short instructional session, including a sample of photographs of main streets from an earlier visual assessment survey of national experts. The idea was to show the range of possible streetscapes, so that participants would have a common basis for subsequent ratings.

Scenes

NJDOT assisted in scene selection by nominating 83 "main streets" for inclusion in the study. These were of four types:

- Classic main streets such as Nassau Street in Princeton and Washington Street in Hoboken.

- Urban streets recently reconstructed to be more main street-like, such as Springfield Avenue in Maplewood and Maple Avenue in Red Bank.

- State highways that local authorities would like to make more main street-like, such as Route 202 in Bernardsville and Ocean Boulevard in Long Branch.

- Controversial roadways that have pitted NJDOT against local interests, such as Brunswick Avenue in Lawrenceville and Broadway in Salem.

Of these, 50 were chosen for the visual preference survey. Two streets were chosen from each of New Jersey's 21 counties, with the balance coming from the more urbanized counties. Most lie on state or county routes. Selection was driven by the desire for diverse roadway cross sections and diverse roadway edge conditions. Streets currently undergoing construction, and those that offered no safe place along the centerline from which to take photographs, were excluded from the sample.

In the survey, each street was depicted by both a panoramic photograph of the streetscape and a video clip giving an impression of traffic volumes and pedestrian activity. Film was shot outside the rush hour, generally between 10 a.m. and 4 p.m., on clear days. This was done to keep traffic volumes low enough so edge conditions were visible from the centerline, and to control for weather as an extraneous influence on main street scores.

Variables

The photographs and video clips used in the survey were subsequently analyzed for content. Features of main streets and their immediate environments were measured for use as explanatory variables. Analysts worked together in an informal Delphi-like process to assign values to each variable, and discussed and debated until a consensus was reached. Twenty-three variables were measured from the panoramic photographs, and an additional two variables came from the video clips. The choice of variables was guided by an earlier survey of national experts and by the literatures on street and urban design.

From panoramic photographs, researchers determined:

- Average building height, in feet (10 ft per story)

- Average median width, in feet

- Average setback from curb to visible buildings, in feet

- Average shoulder width, in feet

- Average sidewalk width, in feet

- Average travel lane width, in feet
- Curb extensions visible, 1=yes, 0=no
- How well street pavement is maintained, subjective 1-5 scale
- Marked crosswalk visible, 1=yes 0=no
- Number of travel lanes
- Pedestrian-scaled streetlights, 1=yes, 0=no
- Posted speed limit, mph
- Proportion of street frontage with parking lots, vacant lots, and other dead spaces
- Proportion of street frontage with parked cars
- Proportion of street frontage with tree canopy
- Proportion of visible buildings that are commercial
- Proportion of visible buildings that are historic
- Ratio of building height to street width plus building setbacks
- Textured pavement visible, 1=yes, 0=no
- Total back-of-sidewalk to back-of-sidewalk width, in feet
- Total curb-to-curb width, in feet
- Underground utilities, 1=yes, 0=no
- Uniform building heights, subjective 1=yes, 0=no

From video clips, researchers determined:

- Number of moving vehicles visible
- Number of pedestrians visible

Results

Figures B-2 through B-4 show a high rated scene, an average scene, and a low rated scene. Scenes were rated on a scale of 1 to 7.

Figure B-2. Washington Street, Hoboken (average score = 5.6)

Figure B-3. East Avenue (Route 40), Woodstown (average score = 4.2)

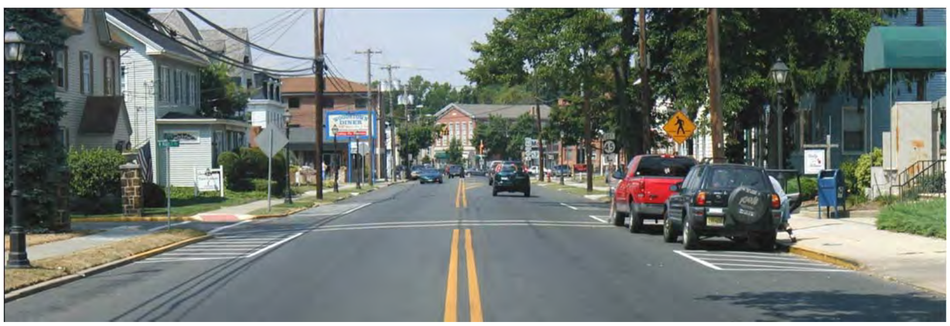


Figure B-4. Morris Avenue, Union Township (average score = 3.4)

Michael King

Many combinations of viewer and scene variables were tested to explain viewer ratings. The only available variables characterizing viewers—gender and affiliation (DOT or other)—proved to have no explanatory power. Apparently women and men, DOT employees and others, react similarly to street scenes. This is consistent with earlier visual assessment literature revealing common environmental preferences across demographic groups (Stamps 1999).

By contrast, many of the variables characterizing scenes proved significant individually and in combination with each other. This again is consistent with the visual assessment literature. Altogether, 90 percent of the variation across scenes, and 39 percent of the overall variation in slide scores (including variation across viewers and measurement errors), were explained by the significant scene variables.

The variables in the best-fit equation related to land use context, facility design, and aesthetics. Land use context variables most clearly distinguished main streets from other roadways; facility design variables were nearly as important and can be manipulated by DOTs at the margin to make highways more main street-like; and aesthetic variables were included in the analysis to control for purely aesthetic influences on main street scores.

The statistically significant variables were:

- proportion of street frontage with parked cars at curbside – Curbside parked cars serve as a buffer between the sidewalk and street, and they slow traffic by narrowing the traveled way and creating "side friction" as cars pull in and out. This variable has the strongest influence on main street scores of those tested. The higher the proportion of parked cars, the higher the main street score.

- proportion of street frontage covered by tree canopy – Street trees add color, a sense of enclosure, a degree of complexity, and other valued urban design features to streetscapes. Given the emphasis on canopy in the variable definition, mature shade trees will add more value than younger shade trees or mature trees of other types. The higher the proportion of street frontage with tree canopy, the higher the main street score.

- curb extensions visible – Curb extensions provide space for plantings and street furniture, shorten crossing distances for pedestrians, make pedestrians more visible as they wait to cross, and may calm traffic. Only two of the scenes in the visual assessment study featured curb extensions, perhaps because curb extensions anywhere other than at intersections reduce the amount of curbside parking, another valued main street characteristic. Controlling for other variables, the presence of curb extensions increases the main street score.

- proportion of buildings that house commercial uses – In many viewers' minds, only shopping streets qualify as main streets. These viewers gave streets serving residential uses relatively low scores. However, other viewers scored residential streets as highly as commercial streets. So, while the scoring formula gives priority to commercial streets, the proportion of commercial buildings is only one factor among many in the formula.

- average sidewalk width – A few of the roadways in the sample lacked sidewalks altogether, and many had sidewalks of minimum width. Wider sidewalks are associated with a more extensive public realm and heightened pedestrian activity, essential qualities of great streets. The wider the sidewalks, the higher the main street score.

- number of travel lanes – Addition of travel lanes beyond the basic two is associated with higher speeds, more traffic, longer crossing distances for pedestrians, and more asphalt (an unaesthetic element). The association between number of travel lanes and main street scores is negative but relatively weak.

- proportion of street frontage made up of dead spaces – Dead spaces detract from the liveliness, walkability, and aesthetics of main streets. Counted as dead spaces in the content analysis were vacant lots, public parking lots, private parking lots separating commercial buildings from the street, driveways interrupting the continuity of street frontage, and blank walls. The higher the proportion of dead space in our sample of street scenes, the lower the main street score.

The other significant variables, underground utilities and quality of pavement maintenance, were included to control for purely aesthetic effects.

Omitted Variables

After controlling for the preceding variables, the remaining variables proved insignificant. Many had the expected signs but fell below the conventional 0.05 significance level. These included (with partial correlation signs in parentheses):

- average median width (+),
- marked crosswalk visible (+),
- pedestrian-scaled street lights (+),
- proportion of visible buildings that are historic (+),
- textured pavement visible (+),
- total curb-to-curb width (-),
- uniform building heights (+),
- average shoulder width (-),
- average travel lane width (-),
- number of moving vehicles visible (-), and

- posted speed limit (-).

Certain context variables emphasized in the urban design literature did not perform as expected. For example, average building setback and ratio of building height to street width plus building setbacks are believed to affect the perception of streets as enclosed, positive spaces. The greater the building setback and the lower the height of buildings relative to the distance between them, the less well-defined street space becomes. Yet, average building setback and ratio of building height to street width plus building setbacks proved insignificant and actually had the "wrong" signs in various model runs, positive and negative signs, respectively. It is some consolation that one significant variable, the proportion of street frontage made up of dead spaces, accounts for parking in front of buildings and hence, to a degree, accounts for building setbacks.

Bus Stop Design

The precursor to this manual, a transit-oriented design (TOD) manual prepared for the Florida Department of Transportation (FDOT), is based in part on a visual assessment survey of transit users, nonusers, and (for the sake of comparison) transit professionals. This may have been the first-ever application of visual preference survey methodology to transit facilities (for more details, see Ewing 2000).

Viewers were shown a series of paired slides of bus stops (50 pairs in all); slides were paired randomly to avoid the possibility of survey bias. Viewers were asked to choose the stop from each pair at which they would prefer to wait; asked to rate each stop chosen as a place to wait; and for the first 25 pairs, asked to explain why they chose the stops they did.

Viewers

Survey participants were recruited by the Sarasota County (FL) Transportation Authority, Sarasota's local bus operator. Free transit passes were offered as an inducement to participate, and refreshments were provided as well. Two separate sessions were held to better accommodate participants' schedules.

Scenes

Slides of downtown transit centers, transfer facilities, and bus shelters from around the state were shown at the midpoint of each session, and ratings and comments were solicited. However, for purposes of quantitative analysis, the "core" visual assessment survey was limited to one type of facility (bus stops) from one part of the state (South Florida). The stops selected for the survey represent the widest range possible from those available in South Florida. They were selected from many hundreds of bus stops photographed for the TOD manual. Sample selection was designed to maximize variance in attributes across bus stops.

All stops were photographed from the same angle and distance, near the curb and about 40 feet in front of the stop. This vantage point takes in the stop itself plus: (a) one side of the street up close and the entire streetscape in the distance; (b) the sidewalk and any cross streets on the bus stop's side; (c) the land use immediately to the rear of the stop; and (d) the background land uses for some distance. All slides were taken on sunny days to minimize any effect of weather conditions.

Variables

Slides used in the survey were subsequently analyzed for content; features of the bus stops and their surroundings were measured/quantified for later use as explanatory variables. Three analysts worked together in an informal Delphi-like process. Each independently assigned a value to a feature. They then discussed values and rationales until a consensus was reached on assigned values. Nineteen variables were measured/quantified in this manner for each slide. The choice of variables was guided by the literatures on transit-oriented design, urban design, defensible space, and environmental preference. The variables tested were:

Bus Stop Variables

- ADS = 1 if advertisement is present on bench and/or shelter; 0 otherwise
- BENCH = 1 if the bus stop has a bench but no shelter; 0 otherwise
- CARS = 1 if cars are parked in front of the bus stop; 0 otherwise
- CURB = 1 if the street has a vertical curb at the stop; 0 otherwise
- FURNITURE = number of different types of street furniture (newspaper boxes, telephones, etc.)
- INTERSECTION = 1 if the bus stop is located at an intersection; 0 otherwise
- RIDERS = number of users waiting at the stop
- SETBACK = distance from the bus stop to the street edge (in feet)
- SHADE = percentage of the bus stop area which is shaded
- SHELTER = 1 if the bus stop has a shelter; 0 otherwise
- TURNOUT = 1 if the bus stop has a turnout; 0 otherwise
- WINDOWS = 1 if windows overlook the bus stop; 0 otherwise

Background Variables

- CROSSWALKS = total number of crosswalks visible in the background
- LANES = total number of traffic lanes of abutting street
- LIGHT = 3 if the background lighting is bright; 2 if it is average; 1 if it is dim
- PASSERSBY = number of people visible in the background
- SIDEWALK = 3 if the sidewalk leading to the bus stop is continuous; 2 if the sidewalk is intermittent; and 1 if there is no sidewalk
- TRAFFIC = number of cars clearly visible on the abutting street
- TREELINE = percentage of street frontage lined by trees
- MIXED = 1 if the background has mixed uses; 0 otherwise
- NEIGHBORHOOD = 1 if the background has houses fronting on the street; 0 otherwise
- OFFIND = 1 if the background has offices and/or industry; 0 otherwise
- PARKLIKE = 1 if the background is a park or park-like; 0 otherwise
- STOREFRONT = 1 if the background has stores fronting on the street; 0 otherwise
- STRIP = 1 if the background has stores fronting on a parking lot; 0 otherwise
- SUBDIVISION = 1 if the background has subdivisions backing up to the street; 0 otherwise

Viewer Variables

- PLACE = 1 if the viewer's place of residence is in the suburbs; 0 if it is in the city
- SEX = 1 if the viewer is a male; 0 if female

Results

Examples of stops chosen by most viewers, and given high ratings when chosen, are shown in Figures B-5ab. Stops selected by few viewers, and given low ratings by those few, are shown in Figures B-6ab. Scenes were rated on a scale of 1 to 5.

Figures B-5. Most Preferred Scene

Times Selected = 89%
Average Rating = 3.9

Figures B-6. Low Rated Scene

Times Selected = 27%
Average Rating = 1.6

For all viewers combined, the variables that most increase the likelihood of a bus stop being chosen are (in order of declining significance based on "asymptotic" t-statistics):

- a bus shelter
- a bus bench (without a shelter)
- trees or an overhang shading the stop
- a vertical curb at the stop
- trees along the street leading to the stop

All of these variables are significant and positive for each of the three viewer groups. One additional variable—the presence of advertising on the shelter or bench—is significant and negative for each of the groups.

A slightly different set of variables affect the ratings of chosen bus stops. In this case, the most significant variables are (again, in order of declining significance):

- a bus shelter
- trees along the street leading to the stop
- the setback of the stop from the street edge
- location of the stop at an intersection
- a vertical curb at the stop

As a final measure of significance, five variables significantly affect (at the 0.001 level) both the choices and ratings of all viewers combined.

- a bus shelter
- trees along the street leading to the stop
- a vertical curb at the stop
- the setback of the stop from the street edge
- a continuous sidewalk leading to the stop

Urban Design Qualities

The two preceding studies sought to explain viewer preferences in terms of physical features of scenes. A third study instead sought to explain viewer ratings on perceptual scales thought to affect walkability (see Chapter 2).

The methodology is described in detail elsewhere (Ewing et al. 2005b; Ewing et al. 2006; Ewing & Handy 2008). It is the basis for an illustrated field survey manual posted on the Active Living Research website (Clemente et al. 2005).

Viewers

An expert panel was recruited for this study. It consisted of 10 urban design and planning experts from professional practice and academia. The 10 panel members were recruited from different disciplines and have different orientations (for example, some new urbanist, others not). They are leaders in their respective fields, and have intimate knowledge of urban design concepts from their research, teaching, and/or practice.

The 10 were *Victor Dover*, urban designer, Dover, Kohl & Partners Town Planning; *Geoffrey Ferrell*, urban designer/code expert, Geoffrey Ferrell Associates; *Mark Francis*, landscape architect, University of California, Davis, CA; *Michael Kwartler*, architect/simulations expert, Environmental Simulation Center; *Rob Lane*, urban designer, Regional Plan Association; *Anne Vernez Moudon*, urban designer/planner, University of Washington; *Tony Nelessen*, urban designer, A. Nelessen Associates, Inc.; *John Peponis*, architect/space syntax expert, Georgia Institute of Technology, Atlanta, GA; *Michael Southworth*, urban designer, University of California, Berkeley, CA; and *Dan Stokols*, social ecologist, University of California, Irvine, CA

Scenes

To ensure that reactions to street scenes were not biased by different filming techniques, a consistent filming protocol was developed. A great deal of experimentation and dialogue among the investigators went into the development of a protocol that would mimic the experience of pedestrians. Pedestrians are usually in motion, sway a bit as they walk, have peripheral vision, and tend to scan their environments. The protocol specified the starting point on a street block, walking speed, and panning motions; the distance covered and time length of the clips varied somewhat depending on actual walking and panning speeds but averaged between 1 and 1 ¼ minutes.

Working off a shoot list, more than 200 clips were filmed in dozens of cities across the United States. Diversity of street scenes was ensured by the different regional locations of the investigators and the travels of the investigators on other business during the course of the study. The focus was on commercial streets in urban or "main street" settings – all places with sidewalks and other pedestrian amenities such as landscaping, pedestrian lighting, street furniture, and businesses or public spaces within view.

From the larger set, 48 clips were selected that best matched the combinations of high/low values in a fractional factorial design. Following the design as closely as possible resulted in the selection of clips that were distinctly different.

Variables

To measure physical features of streetscapes, all 48 video clips were analyzed for content. All told, more than 130 features were measured in this manner for each scene. The process typically required more than an hour for each video clip, and much more for the more complex scenes. Detailed operational rules for measuring each physical feature were developed to ensure consistency.

For most features, there was almost perfect agreement or substantial agreement among the team members. It is relatively easy to count objects and measure widths. Several features had low or even negative inter-rater reliability values. Of these, features such as the number of landscape elements could probably be rated more consistently with better operational definitions. Other features, such as landscape condition, involve a high degree of judgment and might require training and/or photographic examples to achieve reasonable inter-rater reliability.

Results

Figures B-7 through B-10 are static images from four of the video clips, illustrating variation in urban design qualities. Clips were rated by our expert panel on a scale that represented low to high levels of each quality (1 to 5).

Figure B-7. Scene Rated High on All Urban Design Qualities (Annapolis, MD)

Figure B-8. Scene Rated High on Imageability, Linkage, and Coherence (Washington, D.C.)

Figure B-9. Scene Rated High on Enclosure, Transparency, and Complexity (San Francisco, CA)

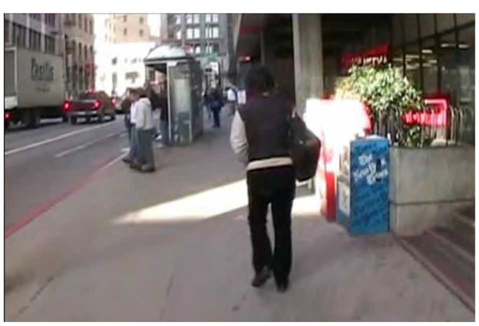


Figure B-10. Scene Rated Low on All Urban Design Qualities (Rockville, MD)

Expert panel ratings were used as dependent variables in the estimation of statistical models. The physical characteristics of the street environment were the independent variables. The models provided several important bits of information: which physical characteristics are statistically associated with each perceptual quality; the direction of the association, whether positive or negative; the share of variation in ratings of each perceptual quality across the scenes explained by the physical characteristics in the model; and the share of total variation in ratings (including variation across video clips, expert panelists, and measurement error) explained by the model.

The following discussion covers eight urban design qualities. Five of the eight urban design qualities were operationalized with a degree of validity and reliability deemed adequate for future research. The five are: imageability, enclosure, human scale, transparency, and complexity. Our operational definitions do not always comport with the qualitative definitions, and provide new insights into the nature of these urban design qualities.

Of more than 130 physical features tested, 38 proved significant in one or more models (including models of legibility, linkage, and coherence). Seven features were significant in two models: long sight lines, number of buildings with identifiers, proportion first floor façade with windows, proportion street wall, common tree spacing and type, and number of pieces of public art. Two features were significant in three models: number of people in a scene and presence of outdoor dining.

Imageability

Previous Attempts to Operationalize. Beyond Kevin Lynch's detailed qualitative characterizations, we could find no attempts to operationalize imageability either in visual assessment studies or design guidelines.

Operational Definition. An imageability model was derived from expert panel ratings and a content analysis of scenes, The final model differs slightly from that reported previously (Ewing et al. 2005b). Based on field experience, the number of people visible in a scene, including those standing and sitting, was substituted for the number of moving pedestrians. Features contributing significantly to the perception of imageability are (in order of significance):

- number of people (+)
- proportion of historic buildings (+)
- number of courtyards, plazas, and parks (+)
- presence of outdoor dining (+)
- number of buildings with non-rectangular silhouettes (+)
- noise level (-)
- number of major landscape features (+)
- number of buildings with identifiers (+)

The significance of the number of people and outdoor dining points to the importance of human activity in creating imageable places. The lack of significance of landmarks, memorable architecture, and public art forces us to rethink just what makes a place memorable. This model is strong with respect to validity and reliability (see Ewing et al. 2005b; Ewing et al. 2006).

Enclosure

Previous Attempts to Operationalize. The visual assessment literature suggests that enclosure is an important factor in human responses to environments, and that solid surfaces are the important variable in impressions of enclosure. Using photographs of Paris, Stamps and Smith (2002) found that the perception of enclosure is positively related to the proportion of a scene covered by walls, and negatively related to the proportion of a scene consisting of ground, the depth of view, and the number of sides open at the front. These results were confirmed in later visual simulations (Stamps 2005).

Enclosure is defined both qualitatively and quantitatively in many urban design guidelines and several land development codes. The qualitative definitions sometimes capture the multi-faceted nature of the concept, for example, Denver, CO's: "Building facades should closely align and create a continuous facade, punctuated by store entrances and windows. This produces a comfortable sense of enclosure for the pedestrian and a continuous storefront that attracts and encourages the pedestrian to continue along the street" (City of Denver 1993).

However, when it comes to operationalizing the concept of enclosure, urban design guidelines tend to limit themselves to one aspect of enclosure, the relationship between street width and abutting building heights. Guidelines from the Raleigh, NC, illustrate this limited approach:

> The condition of enclosure generated by the height-width ratio of the space is related to the physiology of the human eye. If the width of a public space is such that the cone of vision encompasses less street walls than the opening to the sky, then the degree of spatial enclosure is slight. A 1:6 height-to-width ratio is the minimum for appropriate urban spatial definition. An appropriate average ratio is 1:3. As a general rule, the tighter the ratio, the stronger the sense of place (City of Raleigh 2002).

Maximum setback limitations in certain zoning districts of progressive jurisdictions (for example, New York, Seattle, and San Francisco) seem aimed in part at creating a sense of street enclosure. Likewise, required building lines (build-to requirements) in the new form-based codes may have this purpose (Arlington, VA; Woodford County, VA; Pleasant Hill BART Station Property Code).

Operational Definition. Based on expert panel ratings and a content analysis of scenes, features contributing significantly to the perception of enclosure are (in order of significance):

- proportion street wall—same side of street (+)
- proportion street wall—opposite side of street (+)
- proportion sky—across street (-)
- number of long sight lines
- proportion sky—straight ahead (-)

The signs of the coefficients in the model are as expected, with long sight lines, proportion of the view ahead that is sky, and proportion of the view across the street that is sky detracting from the perception of enclosure. A more continuous "street wall" of building facades, on each side of the street, adds to the perception of enclosure. This model suggests that enclosure is influenced not just by the near side of the street but also by views ahead and across the street. Surprisingly, the average street width, average building setback, average building height, and relationship between the width of the street and building height were not significant. This model is strong with respect to validity and reliability (see Ewing et al. 2005b; Ewing et al. 2006).

Human Scale

Previous Attempts to Operationalize. Land development ordinances and urban design guidelines occasionally make reference to human scale as a desirable quality. Davis CA's define human scale in qualitative terms: "The size or proportion of a building element or space relative to the structural or functional dimensions of the human body.

Used generally to refer to building elements that are smaller in scale, more proportional to the human body, rather than monumental (or larger scale)" (City of Davis undated).

A few ordinances get more specific, for example, Placer County, CA's:

> The relationship of a building, or portions of a building, to a human being is called its relationship to "human scale". The spectrum of relationships to human scale ranges from intimate to monumental. Intimate usually refers to small spaces or detail which is very much in keeping with the human scale, usually areas around eight to ten feet in size. These spaces feel intimate because of the relationship of a human being to the space... The components of a building with an intimate scale are often small and include details which break those components into smaller units. At the other end of the spectrum, monumental scale is used to present a feeling of grandeur, security, timelessness, or spiritual well being. Building types which commonly use the monumental scale to express these feelings are banks, churches, and civic buildings. The components of this scale also reflect this grandness, with oversized double door entries, 18-foot glass storefronts, or two-story columns (Placer County 2003).

There has been only one previous attempt to operationalize human scale via a visual assessment survey, and this strictly with respect of architectural massing (Stamps 1998). The most important determinant was the cross sectional area of buildings, second was the amount of fenestration, and third was the amount of façade articulation and partitioning.

Operational Definition. The best-fit human scale model differs slightly from that reported previously (Ewing et al. 2005b). Based on our field experience, the number of pieces of street furniture and other miscellaneous items was substituted for a more limited set of street items. Features contributing significantly to human scale are (in order of significance):

- number of long sight lines (-)
- number of pieces of street furniture and other miscellaneous items (+)
- proportion first floor with windows (+)
- building height (-)
- number of small planters (+)

The signs of the coefficients are in the expected direction. Human scale is the only quality for which characteristics of viewers proved significant in our expert panel ratings: urban designers tended to rate scenes higher than did other panel members. This model is strong with respect to validity and reliability (see Ewing et al. 2005b; Ewing et al. 2006).

Transparency

Previous Attempts to Operationalize. Transparency is the urban design quality most frequently defined in urban design guidelines and land development codes. Some definitions of transparency are strictly qualitative. Others get quantitative. The concept is operationalized almost always in limited terms of windows as a percentage of ground floor façade. San Jose's operational definition is typical:

> Transparency: A street level development standard that defines a requirement for clear or lightly tinted glass in terms of a percentage of the façade area between an area falling within 2 feet and 20 feet above the adjacent sidewalk or walkway (City of San Jose 2004).

Operational Definition. The three contributors to perceptions of transparency (in order of significance) are:

- proportion first floor with windows (+)
- proportion street wall-same side of the street (+)
- proportion active uses (+)

The signs of the coefficients are in the expected direction. The model confirms but expands the standard approach to operationalizing transparency. It suggests that both being able to see into buildings and having human activity along the street contribute to the perception of transparency. Note that windows above ground-level do not increase the perception of transparency (after controlling for other variables). This model is strong with respect to validity and reliability (see Ewing et al. 2005b; Ewing et al. 2006).

Complexity

Previous Attempts to Operationalize. Complexity is one perceptual quality that has been measured extensively in visual assessment studies. It has been related to changes in texture, width, height, and setback of buildings (Elshestaway 1997). It has been related to building shapes, articulation, and ornamentation (Stamps 1999; Heath et al. 2000).

Operational Definition. In order of significance, contributors to complexity are:

- number of people (+)
- number of dominant building colors (+)
- number of buildings (+)
- presence of outdoor dining (+)
- number of accent colors (+)

- number of pieces of public art (+)

The signs of the coefficients are in the expected direction. The significance of pedestrians and outdoor dining suggests that human activity may contribute as much to the perception of complexity as do physical elements. The lack of significance of several other variables is notable: number of building materials, number of building projections, textured sidewalk surfaces, number of streets lights and other kinds of street furniture, among others. This model is strong with respect to validity and reliability (see Ewing et al. 2005b; Ewing et al. 2006).

Coherence

Previous Attempts to Operationalize. Achieving coherence (often termed compatibility) may be the overriding purpose of urban design guidelines and standards. As the City of Glendale, California, puts it: "The purpose of the design review process is to ensure compatibility and a level of design quality acceptable to the community."

In visual assessment studies, the coherence of scenes is frequently assessed by individual raters. The judgments tend to be very consistent/reliable across raters. Two studies have gone on to relate coherence to physical characteristics of scenes. Nasar and Stamps (2009) found that streets were rated as more coherent if infill houses had a style considered compatible with the surrounding styles (based on previous ratings of style compatibility). Streets were also rated as more coherent if the infill house was not more than roughly twice as large as other houses on the street. Previously, Nasar (1987) had found that viewers prefer street scenes with signage that is moderately complex and highly coherent. Coherent signage has a consistent vocabulary of heights, sizes, shapes, materials, colors, and lettering. If signs have enough characteristics in common, the street scene will appear orderly, logical, and predictable to pedestrians strolling by. If not, it will appear messy.

Operational Definition. In order of significance, contributors to coherence are:

- common window proportions (+)
- number of people (+)
- common tree spacing and type (+)
- number of pedestrian-scale street lights (+)

Two of the variables have strong conceptual connections to coherence: common window proportions and common tree spacing and type. Connections to the other two variables are less obvious. Pedestrian scale street lights are always of uniform style and size and unify scenes visually to a surprising degree. Pedestrians become a dominant and relatively uniform element as their numbers increase. Other conceptually important variables are missing from the model, including common architectural styles and common building masses.

Legibility

Previous Attempts to Operationalize. Only one visual assessment study has attempted to measure legibility, this in connection with natural rather than urban landscapes (Herzog and Leverich 2003). Legibility was highly correlated with another perceptual quality, coherence. The hypothesized relationship to landmarks proved to be weak.

Operational Definition. In order of significance, contributors to legibility are:

- terminated vista (+)
- number of buildings with identifiers (+)
- common tree spacing and type (+)
- memorable architecture (+)
- number of place/building/business signs (+)
- number of pieces of public art (+)

The number of buildings with identifiers and the number of signs have obvious conceptual connections to legibility; the significance of common tree spacing and memorable architecture is less easily explained but may be related to the ability to place the street in a larger spatial context. The set of variables in the model also has conceptual connections to imageability, suggesting that panelists may have had difficulty distinguishing between these two concepts.

Linkage

Previous Attempts to Operationalize. We could find no attempts to operationalize linkage in visual assessment studies or design guidelines (except those relating to sidewalk connections).

Operational Definition. In order of significance, contributors to linkage are:

- common building heights (+)
- number of visible doors (+)
- number of street connections (+)
- presence of outdoor dining (+)
- proportion recessed doors (+)

The significance of recessed doors, outdoor dining, and common building heights suggests the importance of psychological as well as physical connections between buildings, sidewalks, and streets.