Published in final edited form as:

Archit Sci Rev. 2007 September 1; 50(3): 234–245. doi:10.3763/asre.2007.5029.

Identifying Streetscape Features Significant to Well-Being

Arnold R. Spokane^{1,†}, Joanna L. Lombard^{2,4}, Frank Martinez^{2,4}, Craig A. Mason³, Deborah Gorman-Smith⁵, Elizabeth Plater-Zyberk², Scott C. Brown⁴, Tatiana Perrino⁴, and José Szapocznik^{4,2}

¹College of Education, Lehigh University, Bethlehem, Pennsylvania 18015, USA

²School of Architecture, University of Miami, Coral Gables, Florida, USA

³College of Education and Human Development, University of Maine, Orono, Maine, USA

⁴School of Medicine, University of Miami, Miami, Florida, USA

⁵College of Medicine, University of Illinois at Chicago, Chicago, Illinois, USA

Abstract

To determine effective relationships between the built environment and health and well-being, a transdisciplinary team of architectural, behavioral and health scientists developed a built environment coding system (UMBECS). They examined the relationship of resulting streetscape features to health and well-being at the block level. The research team conducted studies of the validity of UMBECS focusing on children through school conduct and grades, and on elders through a longitudinal cognitive functioning study. For children, contrary to popularly held views, commercial-residential mix was as effective as a high proportion of residential use in predicting children's school outcomes (i.e., better conduct, achievement, effort, and grades). For elders, modest but statistically significant relationships existed between block-level features, elders' neighboring behaviors, and social support, which in turn were significantly associated with cognitive and affective functioning. These findings suggest the utility of this built environment coding system for examining the relationship of built environment features to residents' health and well-being. UMBECS offers a useful tool for developing a viable transdisciplinary model of the role of the built environment in behavioral and health outcomes.

Keywords

Block-level analysis; Coding systems; Community design; Environmental health; Environmental measurement; Streetscapes; Urban planning; Well-being

Introduction

Basic human experience tells us that places in which we live and work exert an influence on our behavior (i.e., Gifford, 2007; Savitch, 2003). Theorists and researchers have identified aspects of the physical environment that affect individuals and communities (i.e., Jacobs, 1992; Leyden, 2003; Pikora, Bull, Jamrozik, Knuiman, Giles-Corti & Donovan, 2002; Srinivasan, O'Fallon & Dearth, 2003). Many empirical studies have found specific physical and psychosocial features of urban neighborhoods that affect residents, including the physical arrangement of buildings (Abu-Ghazze, 1999; Brown & Cropper, 2001), size of dwelling (Lawton, Brody & Turner-Massey, 1978), interactional space (Skjaeveland &

[†]Corresponding author: Tel: 1 610 758 3250; Fax: 1 610 758 3227; arsl@lehigh.edu.

Garling, 1997), and friendliness toward activity (Brownson, Chang, Eyler, Ainsworth, Kirtland, Saelens, & Sallis, 2004), as well as some general physical features (Evans, 2003; Northridge, Sclar & Biswas, 2004; Taylor, Shumaker & Gottfredson, 1985). Conclusions from this work reinforce the supposition that the design of neighborhoods affects individual residents (Corburn, 2004; Frumkin, Frank & Jackson, 2004). The precise mechanisms, however, by which the physical aspects of the built environment of neighborhoods sustain or diminish the health and well-being of their inhabitants are still largely unknown.

To advance understanding of the interactions between people and neighborhoods, it is important to build upon the foundation of the many significant, discipline-specific or element-specific studies that integrate physical, psychosocial and design processes. Whereas research in this area tends to rely on residents' perceptions or observational measures of the overall neighborhood such as block length and intersection density, the collaborative effort of this study sought to identify in an objective manner the specific features of the streetscape at the lot level that contribute to the social processes relevant to well-being. Refined measurement systems are crucial to progress in understanding the complex manner in which the built environment affects behavior, and subsequently, the health of residents.

By observing lots and blocks in a target neighborhood and attempting to identify all aspects of the built environment in these lots and blocks, our transdisciplinary team designed a streetscape coding system (University of Miami Built Environment Coding System [UMBECS]; Lombard, Martinez, Mason, Szapocznik, Gorman-Smith, Plater-Zyberk, & Spokane, 2006). The system relies on an assessment of a full array of streetscape features at the level of each individual property or lot, including aspects of the street, sidewalk, front yards and building facades. Aggregating the features of an individual lot into a single block face, and then further aggregating this information at the neighborhood level, these data reveal potential indicators and metrics that may be used to predict social behavior and health consequences for children, and elders, two vulnerable groups at potentially heightened risk for negative consequences of urban environments (Gorman-Smith, Tolan & Henry, 1999; Krause, 2003).

Several assumptions underlay the work described in this paper. The first assumption is drawn from the professional and clinical experience of our research team, believing that the combined perspective of practicing architects and urban designers with those of behavioral and health scientists and clinicians can form a new framework for investigation. Although our measurement approach was an empirical one, a second assumption was that two community-building theories – ecodevelopmental theory drawn from social psychology; and new urbanism theory, drawn from architecture and urban planning – provided the foundation for the development and validation of UMBECS. Ecodevelopmental theory maintains that the social and physical characteristics of neighborhoods have both direct as well as indirect effects on the behavior of inhabitants (Coatsworth, Pantin, McBride, Briones, Kurtines & Szapocznik, 2002; Coatsworth, Pantin & Szapocznik, 2002). In turn, social processes in neighborhoods are influenced by larger, macro-level influences such as culture and policy. Policy influences upon the neighborhood may include zoning, building codes, and regional plans.

New urbanism theory predicts that neighborhoods with diverse blocks and walkable streets and sidewalks will foster an extended network of connections among inhabitants (Duany & Plater-Zyberk, 1992; Leyden, 2003; Saelens, Sallis, Black & Chen, 2003), thereby increasing monitoring, social responsibility and support (Jacobs, 1992; Leccese & McCormick, 2000; Leyden, 2003). The integration of residential, retail, and civic uses promotes continuous activity in urban neighborhoods, over the course of a day and with increased contact hours, enhancing the likelihood of social connectedness among

inhabitants. This social connectedness can form a social net for children and families (Plas & Lewis, 1996) as well as create opportunities for socialization and activity among older adults (Hunt, 2001; Patterson & Chapman, 2004). Taken together these two theories reinforce the hypothesis that physical and social contexts create opportunities and demands that may affect behavior and health, particularly in urban environments (Cohen, Doyle, Turner, Alper & Skoner, 2003; Frumkin, Frank & Jackson, 2004).

Our observational measurement perspective required a novel approach to the unit of measurement of a neighborhood. In this research the unit is labeled, the “streetscape block,” (see Figure 2) – that is, the block that is formed by the street and its facing blocks which constitutes the daily life experience of the resident. The streetscape is thus composed of all of the elements that comprise these two facing blocks.

The aggregation of the data, therefore, is the result of a new statistical configuration of the “block.” Most current research uses a census or platted block (see Figure 1), which is comprised of abutting properties surrounded by streets, as the unit of analysis. In this study, which seeks to understand streetscape attributes that affect the experience of daily life, the social space created by the two facing sides of street – the “streetscape block” – became the unit of measurement.

As shown in Figure 1, the census or platted block aggregates rear-yard neighbors. The streetscape block, shown in Figure 2, aggregates front-door neighbors, collecting the features of the facing lots across a public right of way. In seeking predictive indicators, the team considered all of the features of the streetscape that define its faces, character, and use so that the assessment drew upon the full array of elements, including building facades, porches, stoops, sidewalks, street trees, and parking, without weighting toward any individual theory of the built environment. Figure 3 contains photographs of four typical blocks in East Little Havana in Miami, one with a single-family dwelling two with commercial buildings and one multiple family dwelling with front yard parking.

Two findings drawn from behavioral science literature informed the collaboration in the present study. First, strong social connections have been shown to predict health and well being (Adler & Matthews, 1994; House, Landis & Umberson, 1988). For example, Cohen *et al.*, (2003) showed that following direct exposure to a rhinovirus, increased sociability was associated with a linear decrease in the probability of developing a cold. This finding between social connectedness and disease has been repeatedly replicated (Adler & Matthews, 1994; House, *et al.*, 1988). Second, an extensive literature in psychology has documented the importance of adult monitoring of children for the prevention of problem behaviors, such as drug abuse and delinquency (Chilcoat, Dishion & Anthony, 1995; Dishion & McMahon, 1998; Parker & Benson, 2004). Parental monitoring provides opportunities to guide and teach children, as well as to limit children’s associations with deviant peers, a considerable source of risk (Gifford-Smith, Dodge, Dishion & McCord, 2005). Because problem behaviors often occur outside of the home, neighbors can play an important role in managing these behaviors through the monitoring of public space. Indeed, social connectedness among neighbors, together with a willingness to intervene for their common well being (also termed “collective efficacy”), has been associated with reduced neighborhood violence (Sampson, Raudenbush & Earls, 1997), as well as fewer mental health problems among children (Xue, Leventhal, Brooks-Gunn & Earls, 2005). This type of neighborhood monitoring is believed to provide informal social control, especially important in disadvantaged neighborhoods where risks for children are more pronounced. The present study also presumes that behavior occurs within an ecodevelopmental context, in which child development is nested within the family that in turn is nested within a neighborhood, community and larger society (Barker, 1968; Bronfenbrenner, 1979; Szapocznik &

Coatsworth, 1999). Measurement of the physical environment within ecodevelopmental theory is an understudied but critical component of the ecodevelopmental context.

An empirically supported system for coding essential elements of neighborhood built environments is an important next step in research that applies to urban problems the combined perspectives of architects and planners, social scientists, and health scientists. This paper describes the development of such a system and preliminary findings from three studies examining the application of UMBECS to real-world problems, including investigating the potential behavioral/health impacts of streetscape features. Several types of evidence are needed to conclude that an inventory or measure is tapping a domain intended by the developers (DeVellis, 2003). Measures that do not assess what is intended by the researcher may lead to erroneous conclusions. Therefore, it is important to determine whether an instrument predicts behavior relevant to the domain in question. Validation is a cumulative process by which the meaning of scores is “sharpened, refined, and enriched through the gradual accumulation” (Anastasi, 1986) of research findings and clinical experience. Thus, the present paper both describes the UMBECS system, and discusses three preliminary studies bearing on the measure’s validity.

Method

To identify potential physical markers in the streetscape, the team chose an urban neighborhood of 3,857 individual properties organized by well-defined streetscapes, clear block structure, and identifiable boundaries. This area is characteristic of many American, first-ring suburbs laid out in the 1910s, absorbed by the host city in the succeeding years, and now a poor community. Typically, a community of this socio-economic profile might not be thought of in terms of distinctive streetscapes. In fact, the clarity and variety of the streetscapes of the neighborhood make the study possible and the neighborhood is not mitigated by economic advantages that could shield or remove the resident from the influence of the neighborhood.

Description of the University of Miami Built Environment Coding System

The team developed a built environment coding system (Lombard *et al.*, 2006) to assess the streetscape block through an itemized survey of indicators or measured features of individual lots as described above. A collection of four rating forms was used to survey the physical characteristics of (1) built lots in the interior of a block, (2) built lots at the corners or intersection of two streets, (3) vacant lots and (4) parks. Data were entered using hand-held computers to increase the level of data quality and reduce the time required to collect data in the field. The HP Jornada permitted programming which employed touch screen technology with pull-down menus.

Description of the survey data—Once UMBECS was created, the team drew upon behavioral methodology to ensure the reliability and accuracy of the collected data. This involved six stages:

1. Developing a “Gold Standard” for training student raters
2. Training raters
3. Initial assessment of lots
4. Cleaning of data
5. Re-assessment of lots
6. Final data cleaning

The primary architect authors independently surveyed a pre-defined series of diverse lots using UMBECS and undertook the development of the “Gold Standard.” Any disagreements in ratings between the architects were discussed with the full team and clarified, then redesigned and retested. Final ratings were then recorded. This subset of lots and ratings were then used to assess the achievement of criterion for the student raters (e.g., inter-rater reliability of .80).

Architecture students ($n = 11$) were then trained with UMBECS and the manual. Following completion of the training and achievement of reliability, the student raters surveyed the lots. Each property or lot was assessed for each of the 72 indicators beginning with the distinction between “built lot” (a property with a building on it) and “vacant lot” (a property without a building on it). Each built lot was classified as occupied or unoccupied, along with specific features of the building, front yard, sidewalk and street edge. Occupied buildings also were rated for use.

To assist in training, each survey item was illustrated in the Manual with a photograph of a building in the study area that illustrated the indicator. An example that describes “porches” is contained in Figure 4:

Indicators generated by UMBECS—The UMBECS system is coded from twenty-seven touch screens with pull-down menus on the HP Jornada handheld computer. Seventy-two individual aspects are coded for each lot including vacant lots. A comprehensive description of the seventy-two features coded on UMBECS is contained in the UMBECS Manual (Lombard *et al.*, 2006). The following seven categories of features are coded on UMBECS and the features can be aggregated at the neighborhood and at the block level:

- *Walkability* – including street and sidewalk features such as street width, traffic direction, swale and sidewalk characteristics, trees, and parking
- *Visibility Interior* – including set back, grade, windows and sills
- *Visibility Exterior* – including balconies, porches, terrace and stoops, and doors
- *Character* – including balcony embellishment, window type, room type, and fence
- *Frontage* dimensions of each lot
- *Contiguous Diversity* – mix of building use/purpose, including residential, commercial, and institutional
- *Density* – number of occupied residential units per lot, as well as number of stories (low-rise, mid-rise, and high-rise buildings)

Validity Studies

Each of the 3,857 lots was assessed for 72 indicators on all 403 streetscape blocks of the neighborhood. Following data collection, the team conducted a series of three studies to determine whether indicators from UMBECS would relate in theoretically predicted ways to resident behavior and health.

We are concerned in our work with the criterion-related validity of UMBECS. Criterion-related validity requires an empirical association between the measure in question and outcomes that should be logically related to that measure (DeVellis, 2003). Three studies are summarized below which examined the relationship between the UMBECS coding and (a) neighborhood structure, (b) children’s school conduct grades, and (c) elders’ behavioral health, respectively. It is important to note that the preliminary work of this transdisciplinary

collaboration was conducted in an inner-ring Hispanic neighborhood and should be examined across other cultural contexts, as the validation process unfolds,

Measurement of Streetscape Features in a Single Neighborhood: Criterion-related Validity of UMBECS

Table 1 presents the means, standard deviations and ranges for each of the streetscape features coded in UMBECS across all 403 blocks in the East Little Havana neighborhood. As seen in Table 1, the average block was 63% residential, 24% commercial, and 7% institutional, reflecting the mix of use in this neighborhood. Streetscape features, such as porches and windows, that were hypothesized to facilitate monitoring behavior and pedestrian activity (cf., Evans, 2003; Jacobs, 1961/1992; Leccese & McCormick, 2000) were differentially present across the blocks in the neighborhood, including windows on the street ($\approx 79\%$), doors on the street ($\approx 56\%$), balconies ($\approx 14\%$), porches ($\approx 7\%$), and narrow streets ($\approx 11\%$). Streetscape blocks varied from completely residential blocks to blocks that were completely non-residential, from the absence of sidewalks to the presence of sidewalks greater than 1.5m (60in) and from blocks without any porches to blocks with many porches. This ensured a range of blocks that enabled the objective survey of streetscape features to supply data with precision and reliability. This initial study confirms that it is possible to survey built environment features at the lot level and then to aggregate features by streetscape blocks in a manner that reflects the differing character of the built environment within the neighborhood.

Relating Streetscape “Diversity of Use” to Children’s School Conduct Grades: Criterion-related Validity of UMBECS

The association between built environment features and social or health variables of inhabitants of a neighborhood is a critical test of the criterion validity of UMBECS. Using the UMBECS data, therefore, the team examined the relationship of children’s school conduct grades to one streetscape feature – diversity of use (Szapocznik *et al.*, 2006). School conduct grades were examined because studies show that conduct grades are key predictors of future health, behavior, and social outcomes that include school dropout, substance abuse, delinquency, and unsafe sexual behavior (Gruber & Machamer, 2000; Hopps, Davis & Lewin, 1999; Jimerson, Egeland, Sroufe & Carlson, 2000; Williams, Ayers, Abbott, Hawkins & Catalano, 1999). Diversity of use of the built environment refers to the extent to which the buildings within a block provide various services, commercial activity for example, in close proximity to residential buildings. In some cases, diversity of use may be found in buildings that offer various functions within one structure, such as first floor commercial use with office and/or residential units above. Blocks and streets with diversity of use enable easy access to work, shopping, and recreation (Duany *et al.*, 2000; Jacobs, 1961/1992; Leccese & McCormick, 2000). Recent findings on diversity of use include reports that neighborhoods characterized as high in diversity of use are associated with more walking (Saelens *et al.*, 2003) and greater social capital or cohesion among neighbors (Leyden, 2003) than neighborhoods low in diversity of use. Ecodevelopmental theory posits that social and physical environmental contexts are critical in understanding an individual’s behavior and development (Bronfenbrenner, 1979; Barker, 1968). The theory predicts that increased supervision of children by adults in the neighborhood should lead to increased social capital (Frumkin *et al.*, 2004; Leyden, 2003) and hence result in fewer child conduct problems (cf., Sampson *et al.*, 1997; Szapocznik *et al.*, 2006). Based on this work, we hypothesized that higher diversity of use would be associated with greater pedestrian traffic and interactions among neighbors, greater social capital (Leyden, 2003; Saelens *et al.*, 2003), and, therefore, higher conduct grades.

For this study, data from all 2,857 public school children in all 403 blocks of the neighborhood was obtained (Szapocznik *et al.*, 2006). The initial analyses examined the relationship of children's grades to the diversity of use on the "streetscape blocks" on which they resided. The first step in the analysis was to identify the clusters or combinations of residential, commercial, and institutional use, that typically occur at the block level in this neighborhood. A cluster analysis (i.e., statistical method for grouping objects of a similar kind into respective categories) revealed that three block-types typically occurred in the neighborhood and corresponded to *Residential*, *Commercial*, and *Mixed-Use* blocks, respectively. As shown in Figure 5, *Residential* blocks were an average of 90% residential, whereas *Commercial* blocks were approximately 70% commercial, and *Mixed-Use* blocks were characterized by a mix of residential, commercial, and institutional uses.

Although it is commonly held that residential-only blocks are best for children and families, the conduct grades in Figure 6 can be seen to be better in mixed-use blocks than in the residential-only blocks, particularly for males ($X^2(2) = -6.097$, $p < .05$ (Szapocznik *et al.*, 2006), who are at higher risk for conduct problems than females (e.g., Fergusson & Horwood, 2002). For males, the overall effect of block type was significant, with mixed-use blocks associated with conduct grades 0.13 points higher than residential blocks. For females, neither the overall effect of block type nor the mixed-use or commercial coefficients were significantly different from residential. This finding suggests that in an inner-city neighborhood with an intact physical block structure, the presence of commercial use, often found at the block corners, can provide a beneficial effect on the behavior of children. This study does not assess or compare results with outer-ring suburban settings, although that comparison would be an interesting next step.

Looking more closely at these results, the team examined children's conduct grades with respect to the specific proportions of residential, institutional, or commercial use on the blocks on which they resided. In this previously unpublished analysis, participants were nested within blocks (i.e., multiple children resided in each block) using a Hierarchical Linear Modeling (HLM) which is a multi-level analytic procedure (Raudenbush & Bryk, 2002). This HLM analysis predicted children's conduct grades as a function of the children's individual characteristics (i.e., gender and year in school, which were modeled as Level 1 effects) and the characteristics of the block that the children lived on (i.e., proportion residential and institutional use, which were Level 2 effects).

The resulting final model for conduct grades indicated disproportionately large changes in grades at extreme values of institutional use, and interactions between residential and institutional use. Moreover, these effects also were found to predict the Level 1 gender and year in school coefficients, suggesting that the effect of these block diversity variables differs for males and females and varies by year in school.

These effects, while rather complex, are illustrated in Figure 7, which graphs the final models for conduct grades by gender, and by year in school. For males, once the proportion of residential frontage on a block exceeded 40%, observed grades were good, regardless of the composition of the remaining frontage. When the proportion of residential block frontage fell below 40%, the variation in grades increased (as the area of the graph in Figure 7 darkens, grades go down).

The lowest grades were observed when the proportion of institutional frontage was high, and the proportion of residential frontage was low (upper left). In this situation, relatively large improvements in grades were observed in association with either an increase in the degree to which the remaining frontage was residential, or a decrease in the proportion of frontage that was institutional, and hence an increase in the proportion of frontage that was commercial.

Among females, conduct grades were generally higher, but much less related to diversity of use.

Similar findings were observed when comparing elementary versus middle-school students: The general pattern for middle-school students was that the worst grades were observed in high-institutional/low-residential blocks, and this pattern – with much smaller differences – was observed for elementary-school students.

These results suggest that, contrary to popular lore, mixed-use (commercial and residential) blocks can have beneficial effects for children. Of great interest in this study is that blocks that were low in both residential and institutional use had excellent outcomes. That conduct was related less to the neighborhood environment for girls than for boys is consistent with prior research (Kroneman, Loeber & Hipwell, 2004). In addition, although solely residential blocks were associated with positive academic and behavioral outcomes for children in this urban, poor community, two types of mixed-use blocks were associated with equally positive outcomes: (1) blocks with high residential/ low institutional use; and (2) at least for boys, blocks with a low proportion of both residential and institutional use and a high proportion of commercial use.

The main findings from this second study lead to the following three conclusions:

1. Contrary to popularly held views, a commercial-residential mix was as effective as a high proportion of residential use in predicting children's school conduct grades.
2. Second, the beneficial effect of commercial blocks for children's outcomes was more apparent for boys than for girls. Although these data do not explain this difference, this finding may be related to local cultural morés that permit adolescent boys more freedom in the neighborhood, and restrict girls more exclusively to the home.
3. Blocks with high institutional use but little residential use, were associated with lower school grades. Jane Jacobs described the deleterious effect of large institutional uses on neighborhood blocks, decrying the lack of activity in "off-hours" ([1961] 1992, p.169). Institutional uses also tend to produce large stretches of facade without windows or doors, often with just a single point of entry which diminishes the "eyes on the street," and the potential for positive monitoring.

The results of this initial study of the data base offers a method and resource for further study, while preliminary findings suggest that judicious planning of the built environment, with a locally appropriate mix of commercial, residential and institutional use, may enhance child behavioral health among Hispanic urban youth.

Relating Streetscape "Eyes on the Street" to Elders' Behavioral Health: Criterion Validity of UMBECS

A third, unpublished study (Szapocznik *et al.*, 2007) used UMBECS to examine the hypothesis that the relationship of streetscape features that were theorized to support visual and social contact between residents and passersby (i.e., porches; balconies) – termed "eyes on the street" (Jacobs, 1961/1992) – would enhance elderly residents' cognitive functioning (functional status; memory) and reduce psychological distress (anxiety and depression). The study also tests the hypothesis that these effects are mediated by self-reports of the elder's social and neighboring behavior (Szapocznik *et al.*, 2007).

There were two steps in the design of this third study: Enumeration and Longitudinal Study. First, the 16,000 households in all 403 blocks of the neighborhood were enumerated to identify all elders, 70 years or older (the neighborhood was 95% Hispanic). In each of the

273 blocks with any elders living in them, all eligible elders were placed on a list in random order. Following enumeration, the elder first selected was approached, and if s/he refused to participate, the second elder selected was approached for consent to screen, and so on, until one elder in each of the blocks with elders had been consented. A trained bilingual assessor collected data in the elder's home. The assessment protocol, which consisted of the social behavior and neighboring measures, the cognitive measures (tracking speed, functional status) and the psychological well-being measures (anxiety and depression), was part of a comprehensive battery completed by each elder over a four-hour period. A complete description of this method is contained in Szapocznik *et al.* (2007).

Elders were assessed at Baseline, and at 12, 24, and 36-months post-baseline on measures of neighborhood social behaviors, social support, cognitive functioning, and psychological distress. This study used the UMBECS database of all 3,857 lots in 403 blocks of East Little Havana described above. (For purposes of this study, two UMBECS categories were used – visibility from interior, and visibility from exterior – based on the view that both sets of features should enhance opportunities for visual and social contact between the person in the home and passersby on the street.) A total of 273 Hispanic elders, 70–100 years old, were assessed in their own homes. Figure 8 shows a structural equation model (SEM), a statistical analysis that combines path analysis with multiple regression procedures, of the baseline relationship between built environment features that were hypothesized to influence psychological distress and cognitive functioning mediated by neighboring behavior and social support (24-month data were recently completed).

The positive UMBECS streetscape features in this model, balconies, terraces, stoops, porches, low sill-height, above-grade, and doors facing streets, suggest opportunities to make eye contact between individuals inside buildings and individuals in the street. This SEM model revealed modest but significant relationships between most of these block-level features and the elder's neighboring behaviors and social support, which in turn were significantly associated with the elder's cognitive and affective functioning.

To our knowledge, this is the first study that has shown a relationship between streetscape block features and older adults' social behaviors and mental health. Features such as the presence of a balcony or terrace, which permit broader observation of the surrounding area, improve neighborhood climate (i.e., a positive and socially stimulating neighborhood environment). This in turn appears to enhance cognitive functioning, whereas porches, stoops, door on the street, and first floors below 1 m above grade appear to provide opportunities for person-to-person contact. This facilitates interaction that may facilitate direct social interactions leading to higher perceived levels of support. Thus, UMBECS can be a powerful tool for studying the relationship between built environment features, behavior and subsequent health across social groups.

One observed relationship appears counter to the hypothesized direction. Low sill height, which could increase visibility from the interior of the home to the street, turned out to associate with *less* social support. A return visit to the neighborhood indicates that on these blocks, low sill height is often combined with "slab-on-grade" construction, which does not provide adequate privacy, and thus the windows are curtained, but this relationship merits further study. This finding, however, suggests that architectural features that achieve the proper balance between needs for privacy and social connectedness may be experienced as beneficial for residents.

Discussion

This first of three studies using the UMBECS data demonstrate the potential of combining the understandings and theoretical assumptions of architects and urban designers with the clinical experience, measurement techniques, and behavioral investigation methods of the social sciences. This transdisciplinary system for assessing the built environment through streetscape measurements of neighborhoods appears to be a valid and potentially useful tool in the investigation of educational, health and well-being outcomes in the neighborhood, both for children and for elders (Brown *et al.*, 2007; Szapocznik *et al.*, 2005, 2006, 2007).

The streetscape blocks of the study neighborhood typically aggregate as many as 22 facing properties, a potential 44 lots for a single streetscape block. In most blocks in East Little Havana, the full length of the block hosts a significant array of diverse building types and conditions. The magnitude of effort required to code individually 3857 lots made comparison with another neighborhood impractical. As Rapoport (1990) cautioned, the meaning of specific features of the built environment may vary from culture to culture. In particular, the meaning of the “front region” or facing aspect of a lot may have cultural significance (p. 132; see also, i.e., Szapocznik *et al.*, 2005). As the studies reveal the most significant indicators, future surveys can be whittled down to those features, thus enabling more expedient studies of other neighborhoods and cultures.

Capturing place and people at a single point in time is useful as a snapshot of a neighborhood and residents who are in transition. When studying a stable population, such as the elders, in a rapidly evolving neighborhood, however, construction of new buildings, changes to buildings, infill, and alterations of neighborhood structures occur on an ongoing basis. For longitudinal studies, updated surveys are periodically needed and must be incorporated into research investigations after an initial database of the built environment is compiled. A refined focus on the most significant features will make this work easier to accomplish.

Regarding the unit of measurement, the team initially determined that block level analyses should be conducted in the form of the streetscape block. Further investigation that aggregates this information in order to understand better the physical realm of the resident can be examined through the study of the “effective neighborhood,” the blocks that are part of a resident’s daily walks. We are also aware that the mere presence of an architectural feature does not ensure that the feature will have a specific effect upon residents (i.e., a window may be present, but the line of sight through the window may not be effective in making a social connection with the street). Consideration of these relationships may yield other indicators, and further findings. Other configurations such as adjacent, or “rook” blocks (as the rook in chess moves), as well as perceived neighborhood elements are being studied (Brown *et al.*, 2007; Szapocznik *et al.*, 2005, 2006, 2007) and may clarify how the built environment affects behavior and health. As the units expand, the use of GPS technology can enhance the analyses and representation of these data.

Although social and behavioral scientists acknowledge an increased and substantial interest in architectural and physical aspects of the built environment (Gifford, 2007; Sundstrom, Bell, Busby & Asmus, 1996), most observe with dismay that a comprehensive theory of the built environment will be difficult to derive (Sundstrom *et al.*, 1996). Such a theory is more likely to evolve when architectural scientists, architects and planners, social scientists, health and biological scientists and clinicians collaborate in transdisciplinary research that amalgamates the knowledge base and theoretical perspectives of each discipline. The work of this investigative team suggests that a viable model can be developed to account for the complex interaction among physical features, social processes and individual behaviors in

studying the relationships among the built environment, behavior and health. The potential of a theoretically derived and empirically validated system for assessing the streetscapes of neighborhoods to assess their impact on health and well-being offers promise for future research and theory building that can inform policy and design.

Acknowledgments

This work was supported by Robert Wood Johnson Foundation Grant No 037377 (José Szapocznik, PI), National Institute of Mental Health/National Institute on Environmental Health Sciences Grant No MH 063709 (José Szapocznik, PI; Arnold R. Spokane, Co-PI), National Institute on Aging Grant No AG 027527 (José Szapocznik, PI; Scott C. Brown, Co-PI), and funding from the John S. and James L. Knight Foundation. The authors are indebted to the editor and two anonymous reviewers for comments and feedback on an earlier version of this manuscript.

References

- Abu-Ghazze TM. Housing layout, social interaction, and the place of contact in Abu-Nusier, Jordan. *Journal of Environmental Psychology*. 1999; 19:41–73.
- Adler N, Matthews K. Health psychology: Why do some people get sick and some stay well? *Annual Review of Psychology*. 1994; 45:229–259.
- Anastasi A. Emerging concepts of test validation. *Annual Review of Psychology*. 1986; 37:1–15.
- Barker, RG. *Ecological psychology*. Stanford, CA: Stanford University Press; 1968.
- Bronfenbrenner U. Contexts of child rearing: Problems and prospects. *American Psychologist*. 1979; 34(10):844–850.
- Brown, SC.; Mason, CA.; Perrino, T.; Lombard, J.; Martinez, F.; Spokane, AR.; Szapocznik, J. Built Environment and Elders' Physical Functioning: The Role of Eyes on the Street. Miami, FL: University of Miami; 2007. Unpublished manuscript
- Brown BB, Cropper VL. New urban and standard subdivisions: Evaluating psychological and social goals. *Journal of the American Planning Association*. 2001; 67:402–419.
- E., Brown SC, Spokane A. The impact of the built environment on children's school conduct grades: The role of diversity of use in a Hispanic neighborhood. *American Journal of Community Psychology*. 2006; 38:299–331. [PubMed: 16967342]
- Brownson RC, Chang JJ, Eyler AA, Ainsworth BE, Kirtland KA, Saelens BE, Sallis JF. Measuring the environment for friendliness toward physical activity: A comparison of the reliability of three questionnaires. *American Journal of Public Health*. 2004; 94(3):473–483. [PubMed: 14998817]
- Chilcoat HD, Dishion TJ, Anthony JC. Parent monitoring and the incidence of drug sampling in urban elementary school children. *American Journal of Epidemiology*. 1995; 141:25–31. [PubMed: 7801962]
- Coatsworth JD, Pantin H, McBride C, Briones E, Kurtines WK, Szapocznik J. Ecodevelopmental correlates of behavior problems in young Hispanic females. *Applied Developmental Science*. 2002; 6(3):126–143.
- Coatsworth JD, Pantin H, Szapocznik J. Familias Unidas: A family-centered ecodevelopmental intervention to reduce risk for problem behavior among Hispanic adolescents. *Clinical Child and Family Psychology Review*. 2002; 5(2):113–132. [PubMed: 12093012]
- Cohen S, Doyle WJ, Turner R, Alper CM, Skoner DP. Sociability and susceptibility to the common cold. *Psychological Science*. 2003; 14:389–395. [PubMed: 12930466]
- Corburn J. Confronting the challenges in reconnecting urban planning and public health. *American Journal of Public Health*. 2004; 94:541–546. [PubMed: 15053998]
- DeVellis, RF. *Scale development: Theory and applications* (2nd ed.). Thousand Oaks, CA: Sage; 2003.
- Dishion TJ, McMahon RJ. Parental monitoring and the prevention of child and adolescent problem behavior: A conceptual and empirical formulation. *Clinical Child & Family Psychology Review*. 1998; 1(1):61–75. [PubMed: 11324078]
- Duany A, Plater-Zyberk E. The second coming of the American small town. *Wilson Quarterly*. 1992; 16:19–48.

- Evans GW. The built environment and mental health. *Journal of Urban Health*. 2003; 80(4):536–555. [PubMed: 14709704]
- Fergusson DM, Horwood LJ. Male and female offending trajectories. *Developmental Psychopathology*. 2002; 14(1):159–177.
- Frumkin, H.; Frank, L.; Jackson, R. *Urban Sprawl and Public Health: Designing, Planning, and Building for Healthy Communities*. Washington, DC: Island Press; 2004.
- Gifford R. The consequences of living in high-rise buildings. *Architectural Science Review*. 2007; 50(1):2–17.
- Gifford-Smith M, Dodge KA, McCord J. Peer influence in children and adolescents: Crossing the bridge from developmental to intervention science. *Journal of Abnormal Child Psychology*. 2005; 33(3):255–265. [PubMed: 15957555]
- Gorman-Smith, D.; Tolan, PH.; Henry, D. The relation of community and family to risk among urban-poor adolescents. In: Cohen, P.; Slomkowski, C.; Robins, LN., editors. *Historical and Geographical Influences on Psychopathology*. Mahwah, NJ: Erlbaum; 1999.
- Gruber E, Machamer AM. Risk of school failure as an early indicator of other health risk behaviour in American high school students. *Health, Risk & Society*. 2000; 2:59–68.
- Hopps H, Davis B, Lewin LM. The development of alcohol and other substance use: A gender study of family and peer context. *Journal of Studies on Alcohol*. 1999; 13(Supp.):22–31.
- House JS, Landis KR, Umberson D. Social relationships and health. *Science*. 1988; 241:540–545. [PubMed: 3399889]
- Hunt M. Settings conducive to the provision of long-term care. *Journal of Architectural and Planning Research*. 2001; 18(3):223–233.
- Jacobs, J. *The Death and Life of Great American Cities*. New York: Vintage Books; 1992. (Original work published in 1961).
- Jimerson S, Egeland B, Sroufe LA, Carlson B. A prospective longitudinal study of high school dropouts examining multiple predictors across development. *Journal of School Psychology*. 2000; 38:525–549.
- Krause, N. Neighborhoods, health, and well-being. In: Wahl, H-W.; Scheidt, RJ.; Windley, PG., editors. *Annual Review of Gerontology and Geriatrics*, Vol. 23. *Aging in Context: Sociophysical Environments*. New York: Springer; 2003. p. 223-249.
- Kroneman L, Loeber R, Hipwell AE. Is neighborhood context differently related to externalizing problems for girls compared with boys? *Clinical Child and Family Psychology Review*. 2004; 7(2):109–122. [PubMed: 15255175]
- Lawton MP, Brody EM, Turner-Massey P. The relationships of environmental factors to changes in wellbeing. *The Gerontologist*. 1978; 18(2):133–137. [PubMed: 640453]
- Leccese, M.; McCormick, K. *Charter of the new urbanism*. New York: McGraw Hill; 2000.
- Leyden KM. Social capital and the built environment: The importance of walkable neighborhoods. *American Journal of Public Health*. 2003; 93(9):1546–1551. [PubMed: 12948978]
- Lombard, J.; Martinez, F.; Mason, C.; Szapocznik, J.; Gorman-Smith, D.; Plater-Zyberk, E.; Spokane, AR. *University of Miami Built Environment Coding System (UMBECS)*. Miami, FL: University of Miami; 2006. Unpublished manual
- Northridge ME, Sclar ED, Biswas P. Sorting out the connections between the built environment and health: A conceptual framework for navigating pathways and planning healthy cities. *Journal of Urban Health*. 2003; 80(4):556–568. [PubMed: 14709705]
- Parker MJ, Benson MJ. Parent-adolescent relations and adolescent functioning: Self-esteem, substance abuse, and delinquency. *Adolescence*. 2004; 39:519–530. [PubMed: 15673227]
- Patterson PK, Chapman NJ. Urban form and older residents' service use, walking, driving, quality of life, and neighborhood satisfaction. *American Journal of Health Promotion*. 2004; 19(1):45–52. [PubMed: 15460101]
- Pikora TJ, Bull FCL, Jamrozik K, Knuiam M, Giles-Corti B, Donovan RJ. Developing a reliable audit instrument to measure the physical environment for physical activity. *American Journal of Preventive Medicine*. 2002; 23(3):187–194. [PubMed: 12350451]

- Plas JM, Lewis SE. Environmental factors and sense of community in a planned town. *American Journal of Community Psychology*. 1996; 24(1):109–143.
- Rapoport, A. *The meaning of the built environment: A nonverbal communication approach*. Tucson, AZ: University of Arizona Press; 1990.
- Raudenbush, SW.; Bryk, AS. *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Thousand Oaks, CA: Sage; 2002.
- Saelens BE, Sallis JF, Black JB, Chen D. Neighborhood-based differences in physical activity: An environment scale evaluation. *American Journal of Public Health*. 2003; 93(9):1552–1558. [PubMed: 12948979]
- Sampson RJ, Raudenbush SW, Earls F. Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science*. 1997; 277(5328):918–924. [PubMed: 9252316]
- Savitch H. How suburban sprawl shapes human well-being. *Journal of Urban Health*. 2003; 80(4):590–607. [PubMed: 14709707]
- Skjaeveland O, Garling T. Effects of interactional space on neighboring. *Journal of Environmental Psychology*. 1997; 17:181–198.
- Srinivasan S, O’Fallon LR, Dearry A. Creating healthy communities, healthy homes, healthy people: Initiating a research agenda on the built environment and public health. *American Journal of Public Health*. 2003; 93:1446–1450. [PubMed: 12948961]
- Sundstrom E, Bell PA, Busby PL, Asmus C. Environmental psychology: 1989–1994. *Annual Review of Psychology*. 1996; 47:485–512.
- Szapocznik, J.; Coatsworth, JD. An ecodevelopmental framework for organizing the influences on drug abuse: A developmental model of risk and protection. In: Glantz, M.; Hartel, CR., editors. *Drug abuse: Origins and interventions*. Washington, DC: American Psychological Association; 1999. p. 331–366.
- Szapocznik J, Lombard J, Martinez F, Mason CA, Gorman-Smith D, Plater-Zyberk.
- Szapocznik, J.; Mason, CA.; Brown, SC.; Lombard, JL.; Martinez, F.; Newman, FL.; Spokane, AR. *American Journal of Community Psychology*. Miami, FL: University of Miami; 2007. The relationship of built environment to social behaviors and mental health in Hispanic elders: The role of “eyes on the street”. submitted to
- Szapocznik, J.; Spokane, AR.; Lombard, J.; Martinez, F.; Mason, C.; Brown, SC.; Cruza-Guet, MC.; Brandt Greenfeld, R. *Designing healthy communities: The culture-centered science of built environment, behavior and health*. In: Quraeshi, S., editor. *Reimaging West Coconut Grove*. Washington, DC: Spacemaker; 2005. p. 164–175.
- Taylor RB, Shumaker SA, Gottfredson SD. Neighborhood-level links between physical features and local sentiments: Deterioration, fear of crime, and confidence. *Journal of Architectural and Planning Research*. 1985; 2(4):261–275.
- Williams JH, Ayers CD, Abbott RD, Hawkins JD, Catalano RF. Racial differences in risk factors for delinquency and substance use among adolescents. *Social Work Research*. 1999; 23:241–256.
- Xue Y, Leventhal J, Brooks-Gunn J, Earls FJ. Neighborhood residence and mental health problems of 5- to 11-year-olds. *Archives of General Psychiatry*. 2005; 62(5):554–63. [PubMed: 15867109]

Figure 1.
Platted block.

Figure 2.
Streetscape block.

Figure 3.
Photographs of two streetscape blocks in East Little Havana, Miami.

Screened porch

Porch with bars

Open-air porch

Figure 4.
Training manual illustrations on porches.

Figure 5.
Built environment diversity of use by block-type (adapted from Szapocznik et al., 2006).

Note: Whiskers indicate $\pm$ one standard deviation for conduct grades based on gender and block type.

Figure 6.

Youth conduct grades, by built-environment use block-type and gender (from Szapocznik et al., 2006).

Legend: Bottom left dotted enclosed section indicates more than 30% commercial in block

Figure 7.

Conduct grades by proportion commercial residential frontage, gender, and by year in school.

Figure 8. Conceptual model of the relationship of the built environment to elders' neighborhood climate, social support, cognitive problems, and psychological distress (adapted from Szapocznik et al., 2007).

Table 1

Ranges, Means, and Standard Deviations of Architectural Features in Lots on 403 Residential Blocks in a Single Urban Neighborhood¹

Architectural Indicator	Min	Max	Mean	SD	Notes
Presence of building above grade	0.000	1.000	0.402	0.271	
Percentage of building facing street /windows	0.000	0.771	0.136	0.082	
Presence of a low sill height (<= 1 m)	0.000	1.000	0.443	0.252	
Setback distance (0 to 6+ m)	0.000	6.098	4.252	1.374	NOTE: Transposed into meters, up to 6.1 m per lot
Presence of windows	0.000	15.000	9.100	3.069	NOTE: In percent, up to 15% per lot
Presence of a balcony	0.000	1.000	0.154	0.180	
Presence of a porch	0.000	0.833	0.079	0.116	
Presence of a terrace	0.000	1.000	0.073	0.121	
Presence of a stoop	0.000	1.000	0.261	0.231	
Presence of a front door on street	0.000	1.000	0.559	0.253	
Sidewalk 0.0 m wide present (no sidewalk)	0.000	0.947	0.095	0.158	
Sidewalk less than 1 m present	0.000	1.000	0.016	0.097	
Sidewalk 1–1.5 m present	0.000	1.000	0.729	0.340	
Sidewalk wider than 1.5 m present	0.000	1.000	0.173	0.303	
On street parallel parking	0.000	1.000	0.764	0.294	
Narrow street width	0.000	1.000	0.109	0.312	NOTE: A given block is 0 or 1, indicating whether it was a narrow street
Bi-directional traffic	0.000	1.000	0.432	0.496	NOTE: A given block is 0 or 1, indicating whether it had bi-directional traffic
Building on sidewalk edge	0.000	1.000	0.133	0.211	
Tree in front yard	0.000	1.000	0.449	0.254	
Front yard parking	0.000	1.000	0.271	0.208	
Front yard hardscape	0.000	1.000	0.162	0.188	
Front yard landscape	0.000	1.000	0.471	0.289	
Parking on ground floor without lobby	0.000	0.326	0.007	0.036	
Parking on ground floor with lobby	0.000	0.500	0.011	0.053	
Porch open air	0.000	0.544	0.062	0.097	
Porch enclosed by screen	0.000	0.333	0.005	0.026	
Porch enclosed by metal bars	0.000	0.333	0.010	0.035	
Porch enclosed by screen and metal bars	0.000	0.182	0.002	0.014	

Architectural Indicator	Min	Max	Mean	SD	Notes
Balcony embellishments	0.000	0.500	0.033	0.076	
Fence - chain link	0.000	0.924	0.282	0.240	
Fence - wood	0.000	0.692	0.009	0.052	
Fence - open metal	0.000	0.154	0.005	0.022	
Fence - closed metal	0.000	1.000	0.061	0.125	
Fence - masonry	0.000	1.000	0.111	0.187	
Fence - barbed wire	0.000	0.667	0.023	0.091	
Roof - hip	0.000	1.000	0.180	0.204	
Roof - hip with dormer	0.000	0.000	0.000	0.000	
Roof - hip with ridge parallel to street	0.000	0.000	0.000	0.000	
Roof - hip with ridge perpendicular to street	0.000	0.000	0.000	0.000	
Roof - flat	0.000	1.000	0.483	0.275	
Roof - gable with dormer	0.000	0.049	0.001	0.002	
Roof - gable with ridge parallel to street	0.000	0.667	0.072	0.108	
Roof - gable with ridge perpendicular to street	0.000	0.648	0.107	0.125	
Roof - complex	0.000	0.667	0.041	0.093	
Proportion fixed window area	0.000	0.985	0.163	0.243	
Proportion awning window area	0.000	1.000	0.337	0.231	
Proportion casement window area	0.000	0.632	0.041	0.084	
Proportion sash window area	0.000	1.000	0.243	0.196	
Proportion jalousie window area	0.000	1.000	0.107	0.143	
Proportion unknown window style area	0.000	0.265	0.008	0.033	
Proportion vertical window area	0.000	1.000	0.667	0.211	
Proportion horizontal window area	0.000	0.700	0.122	0.124	
Proportion equal axis window area	0.000	0.556	0.110	0.115	
Proportion unknown window axis area	0.000	0.000	0.000	0.000	
Maintenance (scale of 0 to 1)	0.000	1.000	0.508	0.148	
Presence of graffiti	0.000	0.385	0.007	0.035	
Balcony open air	0.000	1.000	0.145	0.171	
Balcony enclosed by screen	0.000	0.093	0.000	0.006	

NOTE: Value is the mean "Maintenance" score for a block, weighted by lot frontage

Architectural Indicator	Min	Max	Mean	SD	Notes
Balcony enclosed by metal bars	0.000	0.179	0.002	0.015	
Balcony enclosed by screen and metal bars	0.000	0.273	0.001	0.014	
Occupied	0.000	1.000	0.880	0.180	
Percentage of block that is residential	0.000	1.000	0.629	0.354	
Percentage of block that is commercial	0.000	1.000	0.241	0.319	
Percentage of block that is institutional	0.000	1.000	0.069	0.158	
Percentage of block that is vacant	0.000	0.670	0.080	0.132	
Total	0.256	0.672	0.519	0.069	

/ Entries in Table 1 represent UMBECS coded values for individual lots aggregated by streetscape block and across the 403-streetscape blocks in East Little Havana, Miami. Unless otherwise noted, value is proportion of total frontage of all lots with the given feature on a residential block.