Measuring the Reliability of a Senior Walking Environmental Assessment Tool

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CERTIFICATE OF APPROVAL

This is to certify that the MPH thesis of

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Abstract

Background: Research documenting built environment effects on physical activity often excludes certain segments of the population. The senior population, one segment perhaps most influenced by the physical features of an environment, has been understudied. Developing reliable environmental measurements is an important component for increasing our knowledge of environmental effects on physical activity among seniors.

Specific Aims: The specific aims of this thesis include to assess the inter-rater and intra-rater reliability of the items on SWEAT; to reduce the variables of SWEAT into summary concepts that describe the most important environmental factors impacting walking among seniors via principal components analysis; and to compare information gathered from SWEAT with qualitative observations collected simultaneously to determine if SWEAT was a complete instrument with which to assess the built environment.

Methods: An extensive review of urban planning and health literature has helped identify important concepts and theories used in the development of the Senior Walking Environmental Assessment Tool (SWEAT). Thirty-six neighborhood segments were assessed for inter-rater reliability and eighteen segments were analyzed for intra-rater reliability. Variables in SWEAT were reduced into summary concepts that were considered to be important factors impacting walking among seniors via principal components analysis. A subjective comparison between data collected with SWEAT and qualitative observations collected at the same time were performed to determine whether SWEAT was a complete instrument to assess the built environment.

Results: Sixty-eight percent of items on SWEAT exhibited adequate reliability (k>0.6 and not significant paired t-tests). Intra-rater reliability was lower than expected; only 35% of the items on SWEAT exhibited adequate reliability within raters. SWEAT was reduced to four summary concepts via principal components analysis: *Sidewalks, Safety, Streetlife* and *Density*. Overall, qualitative observations did not provide unique assessments of environmental features and thus validated SWEAT as a comprehensive tool.

Discussion: Raters exhibited good-excellent agreement when using SWEAT, however reliability within raters was lower than expected. Principal components analysis isolated key environmental factors consistent with other studies as well as with the conceptual framework of this thesis. Qualitative observations collected simultaneously with SWEAT confirmed SWEAT was a comprehensive tool for assessing the built environment. With revisions and further investigation into intra-rater reliability results, SWEAT has the potential to be a valuable tool for this field of research.

Introduction

History

Epidemiology and public health have a rich history examining environmental and geographic determinants of health that dates back to the fifth century BC. Concerned with epidemics of disease, the Greeks observed that the environment in the Mediterranean Basin was directly related to variations in disease (Adams 1981). In the mid-1700's, Percival Pott determined the environmental causes of scrotal cancer among chimney sweeps. Later in 1854, Dr. John Snow mapped the rates of cholera in London to determine that contaminated water from a single pump was the cause of the cholera epidemic (Brody et al. 1999). The microbial revolution of the 18th and 19th centuries shifted medicine's focus from environmental to microbial determinants in health. As a result, epidemiology and public health shifted from broader, environmental determinants of disease to microbial, individual determinants of disease (Susser and Susser 1996). Susser and Susser (1996) discussed the need to shift to an eco-epidemiology paradigm that includes different levels: individual, social and environmental. Since the early 1990's, researchers have again focused on the role of place effects on community and individual health (Macintyre et al. 2002). The 'new public health' has attempted to redirect the attention of public health researchers and practitioners back towards environmental influences on health and health behavior (Macintyre et al. 2002).

Recently, epidemiologists and public health practitioners have emphasized the role of neighborhood environments and the built environment on individual and community health. Broadly, the built environment encompasses all spaces and products that are created or modified by people (CDC Accessibility & the Environment, Accessed

January 25, 2005). According to urban planners, the term 'built environment' is an umbrella term that addresses three integral urban planning concepts: urban design (e.g., the design of a city and its physical elements), land use (e.g., distribution of activities) and transportation systems (e.g., the physical infrastructure of roads, sidewalks, bike paths, railroad tracks and bridges) (Handy et al. 2002).

Neighborhoods offer a unique way to examine the effects of the built environment on health because people have the most interaction with their environments at this level. In fact, the social and physical aspects of neighborhoods jointly impact individual health. In a study of several neighborhoods in SW Philadelphia (Greenberg et al. 1994), Greenberg and colleagues noted how neighborhood quality impacted quality of life. In their research, they discovered residents' perceptions of neighborhood quality played a role in how they viewed their own quality of life. Moreover, infectious disease rates, infant mortality and asthma trends are also associated with neighborhoods. Fullilove explains how the spread of HIV, syphilis, gonorrhea and tuberculosis have been directly impacted by the social and socio-economic structure of neighborhoods (In Kawachi I and Berkman L(eds), 2003, pg. 211). For instance, geographic segregation often confining African Americans to disadvantaged neighborhoods with poor access to health facilities plays an important role in high rates of infant deaths in this population (Collins JW et al., In Kawachi I and Berkman L (eds), 2003, pg. 223).

Of particular interest for this thesis however, is the way neighborhood environments affect physical activity. Indeed, neighborhoods are a good place to study the environment-physical activity relationship because neighborhood design may actually determine the levels of functioning and activity in residents of all ages. (Glass and

Balfour, In Kawachi I and Berkman L (eds), 2003, pg. 303). In the case of physical activity, health researchers recognize different models of health behavior are needed to explain environmentally cued or influenced behavior, such as walking (Owen et al. 2004). Ecological models emphasizing the effect of physical environment on behavior may be more likely to explain the physical activity-environment relationship than models considering individual choice as the primary determinant of behavior (Owen et al. 2004). In recent years, epidemiologists and public health professionals have specifically considered the role of the physical or built environment of the neighborhood (Owen et al. 2004) on regular physical activity.

Significance

The field of research concerning the effects of the built environment on physical activity is limited and often excludes certain segments of the population. The senior population, one segment perhaps most influenced by the physical features of an environment, has been understudied (Saelens et al. 2003). Communities designed to meet universal design criteria – guidelines for creating environments that can be accessed by people of all abilities – are essential for ensuring adequate use by all residents (CDC Accessibility and Environment, Accessed January 25, 2005). Mobility and perhaps independence can be limited by a poorly designed community, especially among people with compromised function (Shipp et al. 1999, Lawton et al. 1982). As a mode of transportation and a form of exercise, walking in particular can be dramatically influenced by the environment (McCormack et al. 2004). For seniors, walking provides a low cost, low impact way to stay healthy and mobile. Despite this, only 31% of individuals aged 65 to 74 reported participating in 20 minutes of moderate physical activity three or more days per week in 2000 (US HHS 2000).

Ecological models of physical activity behavior identify various influencing factors including interpersonal, intrapersonal, social, and specifically, physical environmental factors (Stokols 1996). Such models may be useful for explaining walking patterns among seniors. Health researchers and practitioners, as well as policy makers and planners, are also recognizing the potential impact of the built environment on public health. In fact, public health strategies to increase participation in physical activity designed since 2000 focus explicitly on supportive factors in the physical environment (Humpel et al. 2002, Baker et al. 2000, Bauman et al. *in press*).

Considering the rapid growth of the senior population in the United States (Merck Institute on Health & Aging and CDC 2004), it is important to understand factors that may influence their ability to remain active in their community and 'age in place' (remain living in the community as they age). To accurately assess the impact of the built environment on walking behavior among seniors, it is essential to have reliable and valid methods for measuring its effect. The purpose of this thesis was to test the reliability of an observational instrument that assessed the built environment in studies examining the relationship between the physical environment and walking among seniors. Given the limited understanding of the effect of the physical environment on physical activity among seniors, a reliable, senior-specific instrument that measures the built environment would significantly contribute to current research.

Review of Relevant Literature

Only a few published health studies have tested the reliability of observational instruments assessing features of the physical environment. In fact, the vast majority of instruments developed to assess the built environment rely on self-reports of residents and measure perceived environmental features. The accuracy of self-reported data versus objective data is not well understood, although several studies have noted low agreement between perceived (self-reports) and objective (trained observations) data (Kirtland et al. 2003 and St. John 1987). Relying on resident reports of both walking and built environment features may introduce information bias and skew results. For instance, individuals who are more active may over-report or exaggerate the number of environmental obstacles than those who are not as active. Instruments that require trained researchers to observe and quantify specific features of the built environment attempt to provide more objective data than those that rely on self-reports of neighborhood residents only. Therefore, the use of trained observers to assess neighborhood environments may reduce the risk of bias and result in more accurate data. A brief discussion of studies that assess the reliability of observational instruments follows. Studies that assessed reliability of instruments utilizing self-reported data or perceived aspects of the built environment (Humpel et al. 2004, Saelens et al. 2003, Kirtland et al. 2003) were not included. In addition, studies that did not focus exclusively on the built environment (Greenberg et al. 1994, Sampson et al. 1997) were also excluded. Appendix A includes a summary of strengths and limitations of existing observational built environment instruments.

Pikora et al. (2002) developed an instrument to evaluate environmental factors that may influence walking and cycling in Perth, Australia neighborhoods. Feedback and advice from experts in a variety of fields were solicited and systematic reviews of the literature were conducted to create the Systematic Pedestrian and Cycling Environmental Scan (SPACES). This 67-item instrument was designed to assess ten dimensions of the built environment: walking/cycling surface (e.g., presence of path, path material, continuity and slope), streets (e.g., parking, width of street and curbs), traffic (e.g., volume, speed and traffic control devices), permeability (e.g., street design and distance between intersections), personal safety (e.g., lighting and path obstructions), traffic safety (e.g., presence of crossings, presence of buffer zone and marked traffic lanes), streetscape (e.g., trees, gardens and cleanliness), views (e.g., commercial sights, water and nature), facilities (e.g., presence of parks, schools, parks, etc.), and subjective assessments (e.g., attractiveness of segment or difficulty of walking/cycling).

Data were collected by sixteen observers with prior data collection experience and who completed a 3-day training program. Inter-rater and intra-rater agreement was assessed for each element in a sample of segments (sections of road between consecutive intersections) taken from the highest and lowest quintiles of social disadvantage as defined by the Australian Bureau of Statistics. One-hundred eight observations were assessed for reliability. Inter and intra-rater agreement was generally excellent ($\kappa > 0.75$), except for items in the subjective assessment category that exhibited good agreement ($\kappa = 0.4$-0.75).

Caughy et al. (2001) developed a brief observational instrument as part of a larger study examining the impact of urban neighborhood conditions on parenting and child development. This instrument included 45 physical features such as type and condition of buildings, condition of ground and undeveloped spaces, type of street, presence of graffiti/litter and neighborhood resources. The tool was divided into several scales: physical incivilities (e.g., graffiti, litter, condition of buildings, etc.), territoriality (e.g., residences with borders, residences with security bars and sign denoting neighborhood crime), and play resources (e.g., yards, busy streets and children playing). Fifty-seven neighborhoods in Baltimore, MD were selected for study.

Raters completed 30 hours of training over six days and observed a total of 1,135 blocks. Percent agreement between raters was calculated for 25% of the blocks and averaged 87%. Methods developed by Sampson et al. (1999) to calculate neighborhood-level reliability ("between neighborhood reliability") and street-level reliability ("within neighborhood reliability") were used in this study. Reliability between neighborhoods was very high (r= 0.96, 0.93, and 0.94 for the physical incivilities, territoriality, and play scales, respectively). Reliability within neighborhoods was generally lower. Correlation coefficients for the physical incivilities scale was 0.74 but territoriality and play resources scales were 0.33 and 0.42 respectively.

Emery et al. (2003) created an observational tool to assess the built environment and generate an overall walking suitability score for each road segment. Eleven environmental variables from 31 road segments were assessed including traffic volume, traffic speed, lanes of traffic, sidewalks (e.g., presence, material, surface condition and width), buffer width, curb ramps, lighting and isolated problem spots (e.g., no crosswalks). Intra-class correlation coefficients were calculated to assess reliability between two raters. The inter-rater reliability was acceptable for the overall walking suitability score (r=0.79) but reliability of certain items was lower than expected. Low intra-class correlations were noted for sidewalk presence, sidewalk material, buffer width, number of through lanes, sidewalk condition, sidewalk width and presence of curb ramps. Despite some disappointing findings, this assessment tool is useful because it results in a fairly reliable walking suitability score for each segment.

Weich et al. (2001) evaluated aspects of the built environment in several London wards. The Built Environment Site Survey Checklist (BESSC) assessed height and age of housing, number of dwellings and type of access, provision of gardens, use of public space, amount of derelict land, security and accessibility of local shops and amenities. Twenty-five of the twenty-seven items in the BESSC had fixed categorical responses. The two remaining items required the researcher to rank the features of the built environment. Eleven housing areas were assessed independently by two researchers. The authors did not define how many blocks comprised a 'housing area' making it difficult to fully assess their methods. Every third area in the ward was selected for inter-rater reliability testing. Investigators calculated kappa to measure inter-rater reliability only and found fifteen out of twenty-five (60%) of the items had moderate-to-good agreement ($\kappa \geq 0.50$). Kappa coefficients were less adequate when researchers were asked to subjectively rank environmental features.

Numerous urban planning instruments have been developed to assess the built environment (Moudon and Lee 2003). These instruments may be useful for health researchers assessing the environment-activity relationship but some limitations exist. Many instruments have not been empirically tested, are often too complex and require knowledge of urban planning concepts that may be challenging for health researchers.

Limitations of Current Research

There are several limitations with the current research. Because only a few, specific environmental aspects were assessed in Caughy et al. (2001) and Emery et al. (2003), it limits the examination of the environment-activity relationship. Several studies were limited by small sample sizes or limited variation in segments (Weich et al. 2001, Emery et al. 2003, Pikora et al. 2002). This may have limited the ability to accurately assess reliability of some or all aspects of the environment. Several existing instruments were developed and tested in the UK or Australian neighborhoods and may not be directly applicable to neighborhoods in the United States (Pikora et al. 2002 and Weich et al. 2001). Such instruments may need to be re-tested before use in the U.S. Though potentially informative, the scoring system in Emery et al. (2003) was not empirically based and assessments were made from a distance in a car. It is unclear how the investigator determined how responses equated to scores. Also, such 'windshield assessments' may not be as accurate as those made by foot on the segment itself. Moreover, it is also not clear if any of the current tools consulted universal design criteria. Of the current observational tools, none focus specifically on the unique environmental needs of seniors. Therefore, this is an opportunity for future research.

Research Question & Specific Aims

The Senior Walking Environmental Assessment Tool (SWEAT) was developed by Grazia Cunningham and Yvonne L Michael as part of the Neighborhood, Built Environment and Health among Urban Seniors study (funded by National Institutes of Health/National Institute of Aging [R03AG022240] and the Borchard Center Foundation for Law and Aging) which examined the effects of the physical environment on walking behavior among the senior population. This thesis assessed whether SWEAT was a reliable observational instrument to measure the unique environmental needs of seniors. The specific aims of this thesis include to:

1. Assess the inter-rater and intra-rater reliability of the items on SWEAT.
2. Reduce the variables of SWEAT into summary concepts that describe the most important environmental factors impacting walking among seniors via principal components analysis.
3. Compare information gathered from SWEAT with qualitative observations collected simultaneously to determine if SWEAT was a complete instrument with which to assess the built environment.

Materials and Methods

Background on Parent Study

Analyses described in this thesis were performed on data collected during the Neighborhood, Built Environment and Health among Urban Seniors study (Michael YL, Principal Investigator). The investigator hypothesized that the built environment either hindered or promoted walking among seniors, ultimately impacting their health and ability to age in place. Major goals of the parent study included developing instruments for data collection and observing environment features. These are described below.

Development of Conceptual Framework

Prior to the development of the Senior Walking Environmental Assessment Tool (SWEAT), a conceptual framework was developed from which to create specific questions. This framework was developed in several ways. An extensive review of the literature focusing on the environment and physical activity was conducted to understand important theories and concepts involved in the environment-walking relationship. Details of this review are published elsewhere (Cunningham and Michael 2004).

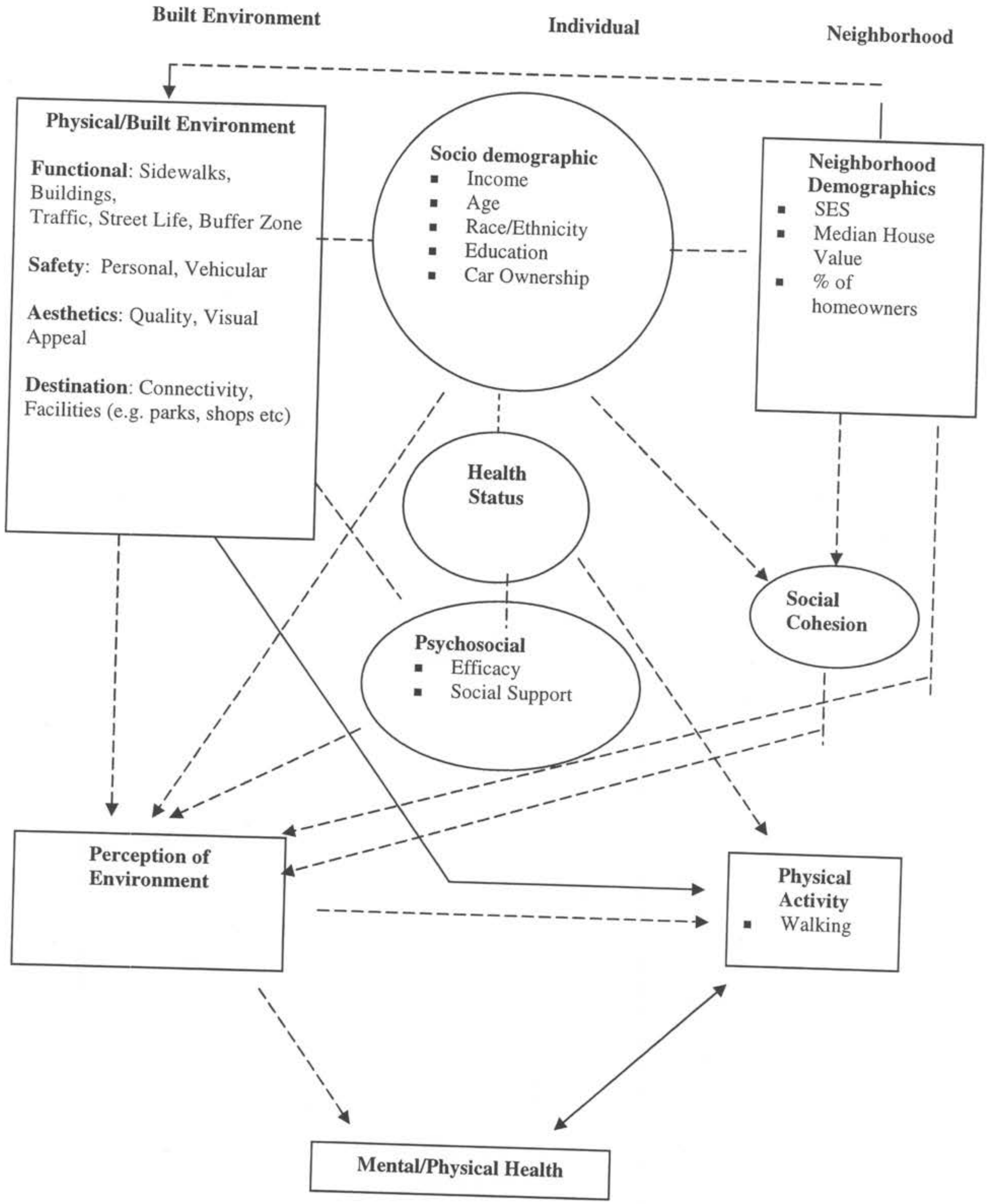
The review revealed only six studies that assessed the impact of the physical environment on seniors (Chapman et al. 1981, Booth et al. 2000, Hovell et al. 1989, King et al. 2000, Wilcox et al. 2000, Balfour et al. 2002). Among these studies, several themes were evident. Three of the six studies focused on accessibility to facilities (Chapman et al. 1981, Booth et al. 2000, Hovell et al. 1989). One study assessed facilities more generally yet did not report significant results (Chapman et al. 1981). The remaining three studies measured specific urban design (e.g., sidewalks) and aesthetic elements (King et al. 2000, Wilcox et al. 2000, Balfour et al. 2002).

Aesthetic elements were associated with physical activity in two studies (King et al. 2000 and Wilcox et al. 2000). Two of the three studies reported that indicators of low safety (e.g., unattended dogs and inadequate lighting) were related to a decrease in physical activity (Booth et al. 2000, King et al. 2000, Balfour et al. 2002). Safety, aesthetics, convenience or access to facilities (e.g., exercise or general services) and micro-scale urban design (e.g., sidewalks present) were included in four of the six studies (Chapman et al. 1981, Wilcox et al. 2000, Booth et al. 2000, Hovell et al. 1989). Generally, research of seniors has supported the importance of proximity to services, topography, safety (e.g., unattended dogs, heavy traffic or lighting), enjoyable scenery and visually pleasing environments for promoting physical activity, specifically walking. These environmental features were included in SWEAT.

Two published conceptual frameworks (Pikora et al. 2002 and Saelens et al. 2003) were used as templates for SWEAT's conceptual framework. Health and urban planning research indicated that a wide variety of factors influence walking including perceptions, individual factors, socio-demographic and environmental factors. Figure 1 illustrates the influencing factors in a senior's choice to walk (adapted from Saelens et al. 2003 and Pikora et al. 2002). Physical environment features impact perceptions of environmental obstacles and the ability to be physically active. Senior-specific environmental features include items such as presence and quality of sidewalks, enjoyable scenery, traffic safety, personal safety, and proximity to facilities. The ability to be physically active in one's community ultimately affects health.

Factors other than the physical environment are important, but were not examined in this thesis (denoted by dashed lines in figure). Psychosocial correlates of physical activity such as self-efficacy and perceived benefits of exercise have been extensively studied by others (Caspersen et al. 1985 and Sallis et al. 1998) and will not be discussed here. Socio-demographic variables such as age, income, race/ethnicity, education and car ownership influence individual perceptions of social support and social cohesion. This shapes the perception of the neighborhood environment and in turn influences walking and health. Neighborhood demographics impact the level of social cohesion in a community as well as the perception of environmental obstacles that effect health and walking behavior. Several neighborhood aspects (e.g., income and race) were considered in the selection of neighborhoods assessed in this thesis.

Figure 1: Conceptual framework used to develop SWEAT



Adapted from Saelens et al. (2003) and Pikora et al. (2002)

As seen in Figure 1, four built environment concepts are important factors influencing seniors and thus were used to frame questions to be included on SWEAT. *Functional* features consisted of physical items of the street, sidewalks and buildings that reflect structural aspects of the environment. The *safety* category consisted of both personal safety (e.g., presence of adequate lighting and tree height) and traffic safety (e.g., presence of crossing areas or traffic control devices) items. Because individuals are more likely to walk in visually interesting and complex environments (Frank and Engelke 2001), features in the *aesthetics* concept reflect the quality and visual appeal of the surroundings. Finally, items in the *destinations* category relate to the availability of community and commercial services in the neighborhood.

Development of SWEAT

One structured observational tool, SPACES (Pikora et al. 2002), was used as a template for SWEAT because it was comprehensive, theory-based and observational. Senior-specific items were added to assess various environmental features that according to previous studies, predicted walking among seniors. Experts in urban planning, exercise science and gerontology were consulted during the developmental process and provided feedback on SWEAT. The investigator and project director pilot-tested the revised instrument on one segment and made additional changes before training observers. The final 35-question observational instrument (SWEAT) assessed features such as the presence and quality of sidewalks, enjoyable scenery, traffic, safety or crime and destinations or facilities.

An extensive training manual was developed and distributed to research assistants as a reference (see Appendix C). Four observers were trained to use the tool in two 4-

hour sessions during the first phase of data collection (Oct-Dec 2002). During these sessions, the training manual was reviewed and observers practiced using SWEAT on several neighborhood streets. This formal training contrasts with that used in other studies where observers were trained for longer periods of time. Caughy et al. (2001) trained observers during 30 hours of training over six days while observers in Pikora et al. (2002) were trained over a 3-day period. Although formal training of SWEAT was limited, informal training (i.e. feedback with investigator) and modifications to SWEAT (e.g., revisions of question order) were ongoing throughout the study. Additional observers were trained in the same manner during the second phase of data collection (Jan-Aug 2003). A total of nine observers were trained to use SWEAT. Overall, observers rated SWEAT moderately easy to use (2.5, scale: 1 [easiest] to 5 [most difficult]).

Face Validity of SWEAT

Face validity, the subjective assessment of the appropriateness of SWEAT in assessing the built environment, was assessed via expert feedback. Experts in urban planning, gerontology and exercise science reviewed concepts measured in the tool, reviewed each question for appropriateness and suggested new questions where necessary. All consulted experts agreed that relevant concepts were incorporated in SWEAT. The questions were considered to be very detailed and appropriate for a pilot study with a main goal of determining and measuring important neighborhood features that influence walking in the neighborhood. Some minor design changes were suggested (e.g., omitting section headings) and were incorporated into the final version of SWEAT.

Development of Qualitative Assessment Form

A qualitative assessment form was also created to capture details that could have been missed by SWEAT and determine the completeness of SWEAT. At the same time that SWEAT was being completed on a street segment, a second observer described the street in words, counted pedestrian traffic and assessed the overall pleasantness for walking. Observers were provided information on how to conduct qualitative research prior to pilot testing the form and practiced collecting qualitative data on several neighborhood segments.

Neighborhood Observations

Data collection was conducted in several Portland, OR neighborhoods. Neighborhoods were selected from neighborhoods in the Senior Health and Physical Exercise (SHAPE) study; a randomized control trial that promoted a walking program in 583 healthy but inactive seniors from 56 Portland metro area neighborhoods (Fisher et al. 2002). A sample of ten neighborhoods in Portland was randomly selected from the control group of SHAPE. Neighborhoods were stratified according to the change in proportion of seniors from 2000 and 1996 and according to median property value (high, medium and low). Over-sampling of high and low property value categories was performed to capture extreme SES categories in neighborhoods. Table 1 illustrates the matrix used to select neighborhoods.

Geographic Information Systems (GIS) software (Arcview 3.3) and Regional Land Information System (RLIS) were used to identify all segments (defined as the section of road between consecutive intersections) in each of the ten neighborhoods. Roads that traversed a park, roads in heavily industrial areas and highways were excluded. A ten percent sample of segments in each neighborhood was randomly selected for observation. Due to limited financial resources, one selected neighborhood (Brentwood-Darlington) was excluded.

Table 1: Matrix used to select neighborhoods by median property value and proportion of seniors

Median Property Value	Declining % of Seniors†	Stable % of Seniors†
High (>$158,575)	Downtown, NW, Bridlemile, *Sullivan's Gulch,* HAND, *Buckman*	Laurelhurst, Mt. Tabor, *Ardenwald, Richmond*
Med ($125,150 – 158,070)	Center, South Tabor, Mill Park, *Montavilla,* Brooklyn, Eliot, University Park	Sunnyside, Powellhurst-Gilbert, *Creston-Kenilworth,* Roseway
Low (<$120,600)	King, *St. Johns, Cathedral Park,* Portsmouth, Sumner	Kenton, Parkrose, *Woodlawn, Brentwood-Darlington*

†Based on 1996 American Community Survey data and 2000 US Census data (www.portlandmaps.com)

Data collection occurred in two phases: Oct-Dec 2002 and Jan-Aug 2003. Data were collected on both sides of the street because variation can exist from side to side. For this purpose, north or west sides of the segment were labeled side one and south or east sides were labeled side two. Five two-person teams of trained observers assessed segments. One person served as the primary observer and completed SWEAT while the second person served as the secondary observer and noted the qualitative features of the segment. Individuals were not assigned to complete either instrument. Rather, observers chose what instrument to use prior to observations.

A ten percent sample of segments selected for observation from each neighborhood was randomly selected for re-assessment. Four observers conducted re-assessments for reliability analyses. During phase one of data collection, inter-rater reliability (consistency between observers) segments were originally assessed at two different days/times by two observers. Time between assessments ranged from one day to one month for phase one. To maximize efficiency, observers assessed segments at the same day/time during phase two of data collection. For intra-rater reliability (test-retest) data collection, the same observer returned to a segment after the initial assessment for re-assessment. Re-assessments occurred one month after the initial assessment. Data for intra-rater analysis were not collected from Jan-Aug 2003 due to limited staff.

A review of the neighborhoods demonstrated that the selected neighborhoods had homogenous race distributions (predominantly White). Neighborhoods tended to have middle to upper class SES with median property values ranging from $107,430 to $224,780. Individual SES was substantially lower in those neighborhoods with a higher percentage of renters (e.g. Sullivan's Gulch). Interestingly, personal income directly contrasted with median property values. Median property value as a proxy for SES may have limitations such as the inability to account for apartment buildings which may have high property but whose residents may have lower income. In this study however, property value was chosen as a proxy for neighborhood SES because personal income may not have been an adequate indication of wealth among people 65+ who generally do not have income. On average, 52.2% of residents in selected neighborhoods are homeowners.

Table 2 summarizes characteristics for the selected neighborhoods. Selected neighborhoods had similar demographic characteristics as Portland neighborhoods, in general. According to 2000 Census data, 79.2% of people living in Portland were White and median property value was $157,900. A slightly higher percentage of overall Portland residents owned their own home (56.9%) than those living in neighborhoods selected for observation.

Table 2: Summary of neighborhoods by density, race, median property value, household income, proportion of homeowners, description of land use, change in proportion of seniors

Neighborhood/pop†	Pop Density † (persons/acre)	Race†	Median Property Value†	Household Income ‡	% Homeowners†	Description of land use †	Stable/Declining % of seniors*
Sullivan's Gulch (NE)/3043	14	77.5% white	224,780	49% low; 40% middle	26.0%	Fair mix of commercial and employment uses. Some residential (single-family and multi-family) units. Very limited open space	Declining
Buckman/7923	10	83.1% white	181,475	55% low; 28% middle	16.0%	Fair mix of land uses from employment to open spaces to retail/commercial to residential.	Declining
Ardenwald (SE uplift)/294	2	96.6% white	167,050	14% low; 48% middle	79.0%	Mostly single family dwellings and open space Some industrial space	Stable
Richmond/11320	13	84.0% white	158,575	34% low; 54% middle	60.0%	Majority is residential with some commercial space.	Stable

Table 2 (continuation): Summary of neighborhoods by density, race, median property value, household income, proportion of homeowners, description of land use, change in proportion of seniors

Neighborhood/pop†	Pop Density † (persons/acre)	Race†	Median Property Value†	Household Income ‡	% Homeowners†	Description of land use †	Stable/Declining % of seniors*
Creston-Kenilworth/ 8234	16	75.8% white	139,150	44% low; 37% middle	38.0%	Residential and commercial area along 26. Some open spaces	Stable
Montavilla/15987	11	73.4% white	125,150	39% low; 55% middle	61.0%	Residential. Limited open spaces	Declining
Cathedral Park/3033	4	75.0% white	120,600	50% low; 36% middle	52.0%	Residential and employment zoning. Commercial zone is a stand-alone area.	Declining

Table 2 (continuation): Summary of neighborhoods by density, race, median property value, household income, proportion of homeowners, description of land use, change in proportion of seniors

Neighborhood/pop†	Pop Density † (persons/acre)	Race†	Median Property Value†	Household Income ‡	% Homeowners†	Description of land use †	Stable/Declining % of seniors*
Woodlawn/ 4889	10	36.2% white	112,000	47% low; 34.0% middle	66.0%	Residential. Industrial area is rather large – second to SF zoning. One open space.	Stable
St. John's/11346	1	61.8% white	109,525	47% low; 33% middle	56.0%	Majority is industrial, with some areas of open space and a concentrated area of single-family dwelling zoning	Declining
Brentwood-Darlington/ 11456	10	76.0% white	107,430	46% low; 33% middle	68.0%	Residential.. Some employment and open spaces interspersed.	Stable

†Information in columns extracted from 2000 Census and www.portlandmaps.com
‡ Information from 1996 Census - <$15K-24K (low); %25-74K (medium); $>75K (high)
* Information from 2000 Census data and 1996 American Community Survey data; change = greater than half a standard deviation of difference

Table 3: Number of segments observed in each neighborhood (reliability not included)

Neighborhood	Number of segments
Ardenwald	4
*Brentwood-Darlington**	--
Buckman	42
Cathedral Park	24
Creston-Kenilworth	34
St Johns	58
Montavilla	86
Richmond	60
Woodlawn	33
Sullivan's Gulch	14
Total	355

* *Not observed*

The numbers of segments and neighborhoods observed are shown in Table 3. Most data were collected in July, August and November. Roughly the same number of segments was observed in the morning as in the afternoon. Table 4 summarizes neighborhood observations.

Table 4: Summary of neighborhood observations by observer, month and time of observation

		Frequency	Percent
Observer	1	168	36.8
	2	30	6.6
	3	169	37.0
	4	61	13.3
	5	3	.7
	6	1	.2
	7	9	2.0
	8	13	2.8
	9	2	.4
By Month	October 2002	25	5.5
	November 2002	80	17.5
	December 2002	52	11.4
	January 2003	11	2.4
	February 2003	1	.2
	April 2003	10	2.2
	May 2003	57	12.5
	June 2003	61	13.3
	July 2003	75	16.4
	August 2003	83	18.2
Time of Day	Morning	222	48.6
	Afternoon	229	50.8

On average, it took seventeen minutes for observers to complete SWEAT. The average temperature was 63 degrees and it was not raining when 97% of the observations were completed. Observers considered most segments to be easy (45.3%) to moderate (44.2%) to assess (scale: 1 [easiest] – 5 [most difficult]).

Inter-rater and Intra-rater Reliability Studies

Two datasets were created for reliability analysis. The inter-rater dataset was limited to observations from two observers because they re-assessed the majority of segments (n=36 segments). The intra-rater dataset included observations from all four raters due to the small number of segments observed (n=18 segments). Prior to reliability analyses, data cleaning was performed which included re-categorizing variables, handling missing values and running univariate analyses (descriptive statistics, frequencies and means) on all variables to check for out-of-range values. Variables with missing values that were found to be data entry errors were corrected (n=10). Several variables were recoded from 1 (yes) or 2 (no) to 0 (no) or 1 (yes) in order to apply the Central Limit Theorem (binomial distributions approximate normal distribution as sample size increases). In addition, it was noted that skip patterns were ignored on 12 out of 72 completed SWEAT forms in the inter-rater dataset and 13 out of 36 completed SWEAT forms in the intra-rater dataset (see Appendix D for SWEAT). Data were recoded such that if sidewalks were not present (per question 16), then questions 17-21 would be coded as 98 or not applicable (NA). Finally, the length of crosswalk was converted from paces to inches based on measured paces for each observer. In general, when no observations were noted, items were coded as not applicable (98) and set to missing in subsequent analyses.

Descriptive variables serving as identifiers for administrative purposes (e.g., *date, time and weather*) were not included in the reliability analyses because they did not have direct relevance to whether the tool was reliable. Also, some questions required observers to manually total individual counts of certain features. These *total counts* were omitted because they reflected the observer's ability to add correctly rather than the reliability of the tool. In several instances, observers were asked to describe items falling into *other* categories (e.g., *other sidewalk material*). These qualitative descriptions were not included in the quantitative analysis. Data were analyzed separately for each side of the street.

Reliability of items was assessed in several ways. For categorical variables, the proportion of occasions where raters agreed on scores (agreement) was calculated (Portney and Watkins 1993). This does not take into account the level of agreement that could have occurred by chance, however. Thus, the observed agreement was further supported by the kappa statistic (κ), a measurement of reproducibility, which compares observed agreement to agreement expected to occur by chance (Armitage and Colton (eds) 1998). When the observed agreement exceeds agreement expected to occur by chance alone, then kappa is positive. When the observed agreement is less than agreement expected to occur by chance alone, kappa is negative. Kappa equals zero when observed agreement equals agreement expected to occur by chance, if the raters were independent. Kappa equals one when there is perfect agreement. Levels of kappa correspond to varying degrees of agreement: κ <0.4=Poor, 0.4-0.59=Fair, 0.60-0.75=Good, >0.75=Excellent (Streiner and Norman 1994). For continuous variables, paired t-tests assessed agreement by testing differences between means of counts or measurements (level of significance set at 0.05 for all t-tests). S-Plus (2002) was used to calculate agreement, calculate kappa for categorical variables and perform paired t-tests on continuous variables. In some instances, kappa and/or t-tests could not be calculated due to lack of variability or lack of observations for items.

Principal Components Analysis

Principal components analysis was performed to reduce variables in SWEAT and classify them into key built environment dimensions. A factor analysis, applying principal components with varimax rotation, was carried out on items with non-zero variance and acceptable reliability ($\kappa > 0.6$) using SPSS (2003). Varimax rotation is a linear transformation of the data that results in uncorrelated components and solutions which are more easily interpreted. Prior to input, all variables were recoded. Categorical variables were re-coded to binary variables in order to meet the assumption that all variables included in principal components analysis follow a normal distribution. Binary variables follow a binomial distribution that will approximate normal with a large enough sample size. Continuous data were recalculated as proportions. All variables were input in a positive direction with walking to facilitate interpretation of the solution.

Solutions with 3, 4, 5, and 6 factors were compared to determine the most appropriate solution. Several criteria were used to determine the most appropriate solution. A cut-off criterion for factor loadings (correlations between components and observed variable) of at least 0.35 was used in interpreting key factors. Only those factors with eigenvalues (amount of variance accounted for by factor) greater than 1.0 were retained. Also, the scree plot was reviewed to determine the natural 'break' between components (Hatcher 1994). The cumulative percent of variance accounted for by the solution was also considered. Finally, the solution was examined to ensure a substantive set of components that could best summarize environmental features important for senior walking (Hatcher L 1994). Once a solution was determined, each factor was assigned a name based on the common theme that grouped items together.

Comparison of SWEAT and qualitative data

Quantitative data collected via SWEAT and qualitative data collected at the same time were subjectively compared to determine whether SWEAT was a comprehensive instrument or if qualitative observations were necessary to supplement information collected by SWEAT. Neighborhoods included in the comparison were selected based on several criteria. First, neighborhoods from high and low property value categories were selected. In addition, neighborhoods with stable and declining proportions of seniors were sampled. Ultimately, these were chosen because they were the most diverse neighborhoods and could provide an interesting portrayal of various neighborhood qualities.

Descriptive statistics (proportions) were calculated for 13 variables (e.g., presence of sidewalks, slope, width of sidewalk, good sidewalk condition, yard maintenance, building condition, visual interest, trees greater than 15 feet, services, obstructed sidewalks, traffic, overall feeling of safety [e.g., bars on windows] and crosswalks) from observations of 175 segments and compared with responses from corresponding 160 qualitative assessments. Atlast.ti (2004) was used to organize qualitative data, facilitate coding and identify themes in the qualitative data. In some instances, themes were coded using the words from the forms (in vivo) or labeled using other descriptive words (open coding). Recurring themes were compared to descriptive statistics and subjectively evaluated for uniqueness or similarities.

Results

Specific Aim #1: Assess inter-rater and intra-rater reliability of the items on SWEAT

The number and neighborhoods included in the reliability studies are shown in Table 5. Although all neighborhoods were sampled for re-assessment, not all neighborhoods were re-assessed due to limited manpower and time. This explains the difference between segments sampled for reliability and segments actually re- assessed.

Table 5: Number of segments included in inter-rater and intra-rater reliability analyses by neighborhood

Neighborhood	Number of segments for Inter-Rater Reliability	Number of segments for Intra-Rater Reliability
Buckman	4	--
Cathedral Park	2	2
Creston-Kenilworth	4	--
Montavilla	13	13
Richmond	7	2
St. John's	2	--
Sullivan's Gulch	--	1
Woodlawn	4	--
Total	36	18

Inter-Rater Reliability

Generally, most items in SWEAT had adequate reliability between raters. In fact, raters had acceptable agreement (good to excellent) for 67.7% of the responses. There tended to be no significant differences between means of numbers of buildings, sidewalk widths or curb heights. In several instances, mean differences were statistically significant, but these differences were not meaningful. Table 6 summarizes the results of the inter-rater reliability according to the four broad concepts included in the conceptual framework. Tables in Appendix E provide the reliability for each item in SWEAT.

Table 6: Inter-rater reliability of SWEAT items by concept in conceptual framework

Concept	No of responses on tool (includes side 1 and side 2)	Range - % Total Agreement	# (%) with kappa >0.6* or equal means
Functional			
Buildings[1]	22	--	9 (40.9)
Sidewalks[2]	47	61-94	37 (78.7)
Streetlife[3]	54	42-100	45 (83.3)
Aesthetics[4]	17	72-100	8 (47.0)
Safety			
Personal[5]	27	67-100	19 (70.4)
Traffic[6]	7	89-97	6 (85.7)
Destination			
Connectivity[7]	14	86-100	4 (28.6)
Facilities[8]	1	100	NA
Total	*189*		

*κ =0.6-0.75: good; >0.75: excellent (Streiner & Norman 1994)

1.Single family homes, Apts/Condos, Row/Town homes, Duplexes, Institutions, Retail, Commercial, Public, Religious, Mixed use, Total Buildings

2.Presence of sidewalks, Sidewalk width, Continuous sidewalk, Slope, Sidewalk material, Sidewalk obstructions

3 Presence of Buffer Zone, Items in Buffer Zone, Front porches, Benches, Other resting areas, Signs, Condition of signs

4. No. of stories, Bars on windows, Yard presence, Yard condition, Building condition, Litter, Bench Condition, Tree height

5. Trees greater than 15 ft, Trees less than 15 ft, Lights at crossing areas, Lights at other areas, Street lights at transit stops, Presence of intersections with traffic signals, Pedestrian controlled traffic devices, Crossing areas, Curb cuts, Width of Buffer zone, Signal time, Signal type, Length of crosswalk

6. Car count, Lanes of traffic, Traffic calming device, Speed limit, Bike lanes

7. Curbside parking, Parking behind buildings, Parking between buildings, Parking lots, No commercial/retail, Segment end, Transit stops

8. Restrooms

Most quantitative items in the *Functional* category such as *counts of single-family homes* and *maximum sidewalk width* were not significantly different between observers. The mean differences between raters' assessments of the number of single-family homes for side one and two was 0.14 (p=0.06) and -0.06 (p=0.16) homes, respectively. Assessments of sidewalk widths were significantly different for the minimum width of side one only (mean difference=6.3 inches, p=0.01). Variables assessing aesthetic characteristics of the street were less reliable, however. For example, raters were in fair agreement when assessing *sidewalk condition* (κ=0.4) and *yard condition* (κ=0.45). The majority of items in the *Functional* concept had good to excellent inter-rater reliability (κ=0.6 and above). Several variables had low reliability including *no obstructions side two, presence of sign, and condition of signs.*

Questions that assessed the types of obstructions in sidewalks ranged from fair to excellent agreement. Overall, items pertaining to *Streetlife* demonstrated good-excellent agreement. In some instances, kappa approached zero (e.g., *condition of signs*) when agreement between the two raters was equal to the level of agreement that would be expected to occur by chance. Most of the quantitative variables, such as *count of other resting places* and *count of buildings with porches* in the *Streetlife* category, were not significantly different between observers. The average number of other resting places differed by .06 (side one, p=0.66) and .42 (side two, p=0.19). Raters' assessments of buildings with front porches differed, on average, by 0.39 buildings for side one (p=.07) and 0.14 for side two (p=.43).

Again, most items within the *Aesthetic* category had less adequate inter-rater reliability. This was not always true however, as raters were in good agreement assessing the *presence of litter.* Observers significantly differed with respect to *counts of one story buildings* on side two. In fact, one observer counted an average of 0.11 more one-story buildings (p=0.04) than the second observer.

Categorical items in the *Safety* concept illustrated variation between sides of segments. There was generally high agreement between observers when assessing the *presence of intersections* (κ=0.87) and *pedestrian controlled devices* on side one (κ=0.76), for example. There was also high agreement between observers' assessments of *Signal type* (e.g., green or walk signal). However, intersections with traffic signals were observed only 11% of the time. When present, observers agreed on whether signals were Walk or Green signals. Observers were in high agreement on the traffic safety features of the tool (κ range=0.60-0.88). Measurements of *curb heights* were marginally significantly different for side one. On average, raters' measurements differed by 0.41 inches (p=0.05).

Items within the *Connectivity* concept varied broadly. For example, most parking was curbside parking. Observers had perfect agreement (κ=1) for both sides of the street of *curbside parking*. Other types of parking (e.g., *behind buildings, between the street and the building,* and *independent lots*) were not common. When they did exist, agreement was lower than expected or equal to what was expected by random chance (κ= -0.3 to 0). There was perfect agreement in the assessment of *how a segment ended* and the *presence of transit stops* (κ=1.00).

<u>Intra-Rater Reliability</u>

Intra-rater agreement was lower than expected. Overall agreement within raters tended to be poor; only 34.9% of responses demonstrated adequate agreement ($\kappa \geq 0.6$). Like inter-rater agreement, there were generally no significant differences within raters for count measurements of items. Also, more subjective questions had lower reliability. Table 7 summarizes the results of the intra-rater reliability for each item according to concept in the conceptual framework. Tables in Appendix E provide reliability for each item by concept and lists items for which reliability could not be evaluated due to lack of variation.

Table 7: Intra-rater reliability of SWEAT items by concept in conceptual framework

Concept	No of responses on tool (includes side 1 and side 2)	Range - Agreement	# (%) with κ > 0.6 or equal means
Functional			
Buildings[1]	22	--	7(31.8)
Sidewalks[2]	47	50-83	16 (34.0)
Streetlife[3]	54	50-100	19 (35.2)
Aesthetics[4]	17	67-100	5 (29.4)
Safety			
Personal[5]	27	44-100	14 (51.2)
Traffic[6]	7	83-100	3 (42.3)
Destination			
Connectivity[7]	14	83-100	2 (14.3)
Facilities[8]	1	100	NA
Total	*189*		

*κ = 0.6-0.75: good; >0.75: excellent (Streiner & Norman 1994)
1.Single family homes, Apts/Condos, Row/Town homes, Duplexes, Institutions, Retail, Commercial, Public, Religious, Mixed use, Total Buildings
2.Presence of sidewalks, Sidewalk width, Continuous sidewalk, Slope, Sidewalk material, Sidewalk obstructions
3 Presence of Buffer Zone, Items in Buffer Zone, Front porches, Benches, Other resting areas, Signs, Condition of signs
4. No. of stories, Bars on windows, Yard presence, Yard condition, Building condition, Litter, Bench Condition, Tree height
5. Trees greater than 15 ft, Trees less than 15 ft, Lights at crossing areas, Lights at other areas, Street lights at transit stops, Presence of intersections with traffic signals, Pedestrian controlled traffic devices, Crossing areas, Curb cuts, Width of Buffer zone, Signal time, Signal type, Length of crosswalk
6. Car count, Lanes of traffic, Traffic calming device, Speed limit, Bike lanes
7. Curbside parking, Parking behind buildings, Parking between buildings, Parking lots, No commercial/retail, Segment end, Transit stops
8. Restrooms

Most items in the *Functional* category had fair (κ = 0.4 to 0.59) to good (κ=0.60 to 0.75) agreement. Most sidewalk items exhibited fair to good agreement. Sidewalk condition, a more subjective question, resulted in poor agreement. Generally, items assessing sidewalk obstructions such as *bumps/cracks* and *weeds/leaves* had fair agreement. Most of the *Streetlife* items resulted in good agreement (mean κ for side one =0.70; mean for side two=0.63).

Intra-rater reliability of *Aesthetic* questions was poor to fair. Observers had low agreement in re-assessing the *presence of litter* (κ=0.24) and *yard condition* (κ=0.25). There were no significant differences between building counts of one-two story buildings. Mean differences of assessments of one-two story buildings between time one and time two ranged from 0.11 (p=0.50) to 0.39 (p=0.05). On average, raters would count .39 more two-story buildings and .11 fewer one-story buildings at time two.

The majority of items within the *Safety* concept exhibited poor intra-rater agreement, though agreement was relatively better than other concepts. Most of the t-tests showed that there were no significant differences in assessment of personal safety items between time one and time two. Generally, there were no significant differences between time one and time two of traffic safety items, except for *car counts in direction two*. On average, raters counted .89 more cars at time 2 (p=0.04).

Several items within the *Connectivity* concept resulted in perfect agreement within observers. *Curbside parking side one* and *parking between the street and building side one* had perfect agreement. For the rest of the items in the parking question, reliability was very low or could not be calculated.

Specific Aim #2: Reduce the variables of SWEAT into summary concepts that describe the most important environmental factors impacting walking among seniors

Twenty-six recoded SWEAT items were included in a principal components analysis. Table 8 summarizes the variables included in the analysis. As shown in Table

9 and Figure 2, a four-factor solution to the principal components analysis was supported. Generally, items included in each component had factor loadings (correlations between the component and observed variable) above the cut-off of 0.35. From the scree plot (Figure 2), it is evident that a natural break in the components occurred after the fourth component. The remaining components leveled off after that point and items in those components tended to repeat the same items; overall constructs enumerated by the first four components. The resulting four-factor solution accounted for 40% of the variance in the original data.

The first factor consisted of items pertaining to the sidewalk (e.g., *presence of continuous sidewalks*) and thus was labeled *Sidewalk.* The second factor included items such as *presence of curb cuts* or *two+ lanes of traffic* and was therefore labeled *Safety.* The third factor consisted of items that help create a complex street life for pedestrians (e.g., *percent of trees greater than 15 ft* and *the presence of* signs) and was named *Streetlife.* Finally, the fourth factor consisted of items like *proportion of apartments, condos and town homes* or *proportion of buildings with 3+ stories* and was thus, termed *Density.* These components mirrored important concepts in the literature and the conceptual framework for SWEAT.

Table 8: Variables included in principal components analysis and coding scheme used for input

Variable	Coded In PCA
% apts/condos/duplexes/rowhouses	Continuous (exclude 98)
% buildings with 3+ stories	Continuous (exclude 98)
% buildings with front porches	Continuous (exclude 98)
% residential buildings with bars on windows	Continuous (exclude 98)
Well maintained yards	>50% = 1; <50% =0
% trees over 15ft	Continuous
% other resting areas	Continuous (exclude 98)
No litter	None or almost none=1; else=0
Streetlights at crossing	Yes=1+, no=0/98
Streetlights at other areas	Yes=1+, no=0/98
Transit stops present	yes=1 (1,0); no=0 (98)
Total sides of street with curbside parking	0,1,2
Total sides with sidewalks	0,1,2
Total sides with continuous sidewalks	0,1,2,
Flat/gentle slope	0=no,1=yes
Total sides with asphalt/concrete sidewalks	0,1,2
Good sidewalk condition	0=no,1=yes
Total sides with no obstructions	0,1,2
Presence of bufferzone	0=none; 1=yes
Clear and large signs	1=clear and large; 0=else
Through segment	0=dead-end or cul-de-sac; 1=through street
Less than or equal to 2 lanes of traffic	0=3+ LOT; 1=1-2 LOT
Traffic calming devices	0=no; 1=yes
Curb cuts	0=none or at some; 1=yes at all
Curb height	Average
Cars per minute	Cars/4 for two way street; cars/2 for one way street

Figure 2: Scree plot of components included in principal components analysis

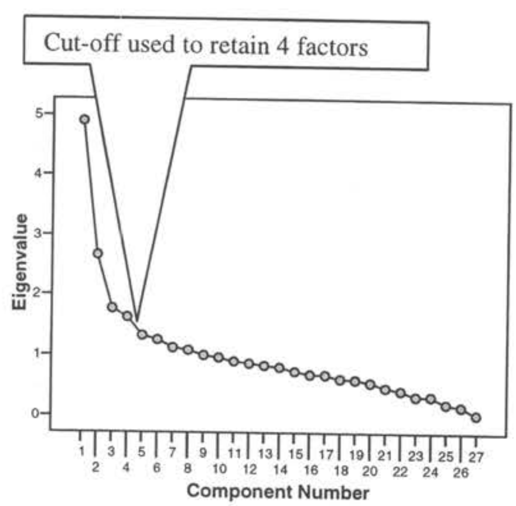


Table 9: Factor loadings of items for total sample, percentage of variance explained and eigenvalues

Factor	Loading	% Variance explained	Eigenvalue
Factor 1 (Sidewalks-Functionality)		18.2%	4.9
Sidewalks are present	0.93		
Sidewalks are made of concrete material	0.94		
There are no sidewalk obstructions	0.49		
Sidewalks are continuous	0.85		
Bufferzone is present	0.81		
Sidewalk in good condition	0.86		
Slope of sidewalk is flat	0.60		
Factor 2 (Safety)		9.9%	2.6
Curb cuts are present	0.55		
% front porches	0.43		
Streetlight count at other locations on street	0.35		
Curb parking is present	0.57		
Average curb height is zero	0.46		
1 or 2 or more lanes of traffic	0.64		
Presence of litter (proxy for crime)	0.47		
Number of cars per minute	0.70		
Factor 3 (Streetlife-Functionality)		6.6%	1.7
% trees greater than 15 ft	0.64		
% resting spots	0.78		
Presence of signs	0.39		
Other resting areas	0.60		
Factor 4 (Density-Functionality)		6.0%	1.6
Proportion of apartments/condos/town homes	0.76		
Proportion of buildings 3+ stories	0.74		

Specific Aim #3: Compare information gathered from SWEAT with qualitative observations collected simultaneously to determine if SWEAT was a complete instrument with which to assess the built environment.

Quantitative and qualitative observations from the following neighborhoods were compared: Ardenwald, Buckman, Cathedral Park, St. John's, Sullivan's Gulch, and Woodlawn. Neighborhood observations contained in the qualitative assessment forms were similar to observations derived from SWEAT. Therefore, most of the qualitative descriptions assessed environmental features already measured by SWEAT. For example, observers discussed features of the sidewalk (e.g., *condition of sidewalks),* personal and traffic safety items (e.g., *traffic)* and streetlife (e.g., *percent of trees greater than 15ft*). Table 10 summarizes the findings according to factors specified by principal components analysis. In some instances, observers described the *visual interest* of segments in the qualitative assessments. In this case, SWEAT did not specifically capture this feature quantitatively. In several instances (visual interest and density), there were no observations either on SWEAT or on the qualitative assessment form.

Table 10: Comparison between SWEAT and qualitative observations by principal components factors.

	SWEAT	Example Statements from Qualitative Assessments
Factor 1 (Sidewalks-Functionality)		
Presence of sidewalks	Average of 85.1% of segments had sidewalks	Sidewalks are present and in good condition…easy to walk
Flat/gentle slope	73.6% of segments had flat/gentle slopes	Sidewalks are clear & flat ….gently sloping sidewalk made this a nice place to walk
Sidewalk width	76.6% of sidewalks did not meet ADA requirements (6 ft wide) Mean min sidewalk width was 4.2 feet	Sidewalks are clear and wide enough for 2+ walkers with a gentle slope
Good sidewalk condition	69.7% of segments had both sidewalks in good condition	Sidewalks are … in good condition Sidewalks are a bit worn
Factor 2 (Safety)		
Obstructed sidewalks	17.9 % of segments had obstructions on both sides; 32.3% had obstructions on one side	S1 sidewalks have heavy debris from street trees, a guy doing lawn equipment maintenance and 2 sawhorses blocking the pathway. S2 is clear and passable.

Table 10 (continuation): Comparison between SWEAT and qualitative observations by principal components factors.

	SWEAT	Example Statements from Qualitative Assessments
Traffic	On average, 2 cars/minute	…busy 2 lane through street….Feels very busy and mostly car-oriented
Overall feeling of safety	An average of two homes per segment was observed to have bars on windows	Screen/barred doors make it seem that it is still coming out, or currently in, a rough time re: security/crime.
Crosswalks	On average, 1 second/ft	Crosswalks at intersection with NE 30th are well protected (crosswalks, ped-controlled signals), but still intimidating due to the fast traffic.
Factor 3 (Streetlife-Functionality)		
Yard maintenance	74.1% well maintained	Yards are well maintained but mostly grass.
Building condition	78.1% in good condition	Buildings are in good condition
Visual interest	NA	The street is curved so it feels more interesting than the standard grid
Trees >15 ft (%)	151 segments with street trees 65.8% of trees greater than 15 ft	…trees on both sides (in buffer zones) and on lawns are a nice way to keep the sidewalk shaded…
Services	12% of buildings were commercial or retail	Residential and religious/public
Factor 4 (Density-Functionality)	31.1% of segments had buildings with apartments/condos or town homes; 24.4% of the buildings observed had 3+ stories	NA

Discussion

Overall, these pilot data suggest that SWEAT has the potential to become a reliable senior-specific measurement instrument to assess built environments in Pacific Northwest neighborhoods. These data provide direction for improvement. In general, raters were in good to excellent agreement on most items. Intra-rater agreement however, was lower than expected. Overall, intra-rater reliability was poorer than reliability between raters. Areas of lowest agreement in both inter-rater and intra-rater reliability included questions regarding types of buildings, connectivity and those that required more subjective assessment (e.g., *yard condition* and *building condition).* In other instances, kappa equaled zero (e.g., *condition of signs)* when agreement between raters was no better than what would be expected by random chance. On average, mean differences of item counts or measurements between raters or assessments were not statistically different or meaningful from a practical perspective.

It is possible that lower agreement may have resulted from insufficient training or misunderstandings of specific questions. Formal training on SWEAT was not as extensive as training reported by Pikora et al. (2002) or Caughy et al. (2001) and could have impacted both inter and intra rater reliability. Training could be extended to address all issues prior to actual assessments in future studies. Observers could also have had different understandings of senior needs related to being able to travel on a sidewalk without significant obstruction. For instance, sidewalk cracks that may appear benign to mobile individuals may be hazardous for individuals over 55 with a physical challenge. According to observer feedback, some had difficulty understanding the types of signs to assess. In fact, one observer noted that this question was not applicable (NA) a total of 16 times while observer two only noted it as NA two times. Low intra-rater reliability, likewise, could possibly be explained by insufficient training or understanding of questions on the tool. Examination of marginal distributions for the question *condition of signs,* for example, illustrated that raters had different understandings of what signs to assess. In fact, one observer noted no signs 14 times, another noted no signs three times and the others noted that signs were always present. Examinations of marginal distributions could provide insight into possible training issues and increased training on specific questions may improve overall reliability.

Some items which were not frequently observed exhibited less adequate reliability than other items. Environmental change could have also resulted in lower reliability. Intra-rater assessments may be more vulnerable to time effects particularly since re-assessments occurred only at different points in time, unlike inter-rater assessments. Moreover, effects of time and environmental change could have influenced intra-rater reliability given the average the length of time between reassessments was one month. Yards in poor condition at time one, for instance, may have been cleaned up by time two. If true, then low intra-reliability could be an artifact of change - not an accurate representation of reproducibility. Several items in the *types of sidewalk obstructions* question scored low-moderate. Wet leaves on walks will more likely lead to falls among pedestrians than dry leaves. One way to control for seasonal or weather influences is to observe in the same season. There was a significant difference in the number of cars. This was not surprising since traffic volume fluctuates between days and times of day.

Despite these areas of lower reliability, it is noteworthy to mention that not all questions involving subjective assessment exhibited low reliability. For example, observers were asked to measure the maximum and minimum sidewalk widths. To a degree, this process involved subjectivity since observers chose areas of maximum and minimum widths on their own. Overall, mean differences (to the nearest $1/8^{th}$ of an inch) were not significantly different between raters or within raters for this variable. In addition, raters had perfect agreement when assessing the *condition of benches* and *presence of litter* on a segment. It is difficult to pinpoint why certain subjective questions demonstrated lower reliability, however.

The results of this study are consistent with reliability studies of other observational tools (Emery et al. 2003, Weich et al. 2001, Pikora et al. 2002). Similar to the reliability findings of SWEAT, Pikora et al. (2003) found that items in SPACES that required more subjective assessment demonstrated less adequate kappa scores for inter-rater reliability. These questions included assessing level of attractiveness and difficulty of segment for physical activity. Unlike SWEAT, SPACES was reported to have high inter-rater and intra-rater reliability. However, it is important to note that Pikora et al. (2002) used less stringent kappa ranges to signify good agreement (κ= 0.4-0.75), thus items with lower kappas were categorized as having good agreement. In this thesis, more stringent values for kappa were used for a more conservative assessment of SWEAT's reliability.

Reliability of instrument scales between neighborhoods in Caughy et al. (2001) was very high as well. Although intra-class correlation coefficients were used to assess reliability instead of kappa, high reliability of Caughy's scales may be due to the fact that raters were allowed to reach a consensus before entering data. Certainly, this would have inflated the level of agreement between raters. Both Weich et al. (2001) and Emery et al. (2003) reported less than desirable reliability findings for their tools. Emery et al. (2003) noted the importance of observing each side of the street separately as variability between sides limited raters' ability to rate the 'overall' street. Similar to this thesis, both of those tools were limited by small sample sizes and few observers as well.

SWEAT items were reduced to four key factors via principal components analysis. These included: *Sidewalks, Safety, Streetlife and Density*. Even though the cumulative percent of variance accounted for by these four components (40%) was lower than recommended (70%), the addition of more concepts did not add value or support unique concepts (Hatcher 1994). Overall, items within these categories exhibited factor loadings greater than 0.35. Three of the four concepts were consistent with the concepts within the conceptual framework for this thesis and with findings in the literature. Also, these were consistent with the specific environmental features deemed important by seniors in organized focus groups.

One feature, *Aesthetics*, reported to be important by seniors, was not isolated by principal components analysis. It is possible that this did not fall out as an important factor because there were fewer questions dealing with aesthetics compared to the other factors. In fact, it is often the case in principal components analyses that concepts with the most questions are often chosen as important factors (Hatcher 1994). Perhaps creating a more equitable balance of questions between important concepts would have allowed this important category to emerge as a key environmental factor. Although not found to be an important factor, aesthetics are perceived to be important determinants of walking by seniors (McCormack et al. 2004) and should be included in future tools. Other questions which were not isolated by principal components analysis should be re-evaluated and possibly removed from future versions of SWEAT. This would result in an instrument that accurately reflects important environmental features for senior walking.

The use of a qualitative tool confirmed that SWEAT was a comprehensive instrument for assessing the built environment. In general, the qualitative assessments did not provide unique assessments of segments. Pikora et al. (2002) found similar results. There were several exceptions. Density items were obtained from SWEAT data but were not specifically described in the qualitative assessments. Also, observers remarked on the *visual interest* of a segment on the qualitative form but these characteristics (e.g. complexity of a street) were not directly measured by SWEAT. Considered to be important to pedestrians (Frank and Engelke 2001), *visual interest* items may need better incorporation in future versions of SWEAT.

Strengths & Limitations

This study has several strengths. First, this is first to assess reliability of a senior specific tool. Also, SWEAT is the first tool to consult universal design criteria that specifies design specifications for pedestrians of all ages and abilities. For instance, sidewalks greater than six feet are considered safe for senior pedestrians. These guidelines were consulted when SWEAT was created and upon completion of principal components analysis. Remaining physically active and connected to the community are important ingredients for successful aging. Older adults face the same dangers as younger pedestrians but are less agile to cope with those dangers. For instance, seniors may have difficulty stepping off a curb so curb cuts are helpful. Third, SWEAT focuses specifically on factors important for walking. Moreover, the development of SWEAT was a multi-disciplinary effort. With revisions, SWEAT has the potential to be a reliable way to assess the built environment for senior walkers. Finally, results from the principal components analysis are consistent with self-reports of senior pedestrians and also with concepts identified by others in the literature.

In addition to these strengths, there are several limitations to this study. Small sample sizes limited the ability to observe certain features and thoroughly assess inter-rater and intra-rater reliability. On several items, kappa could not be calculated due to lack of variability despite very high agreement (e.g. *presence of benches).* Similarly, t-tests could not be calculated when certain items did not exist (e.g. no institutional buildings counted). Small sample sizes also impacted the ability to observe variation within an item. When there was little variation within an item or an item was rare, kappa was low. This occurred with the presence of yard item, for instance. There was only one instance when raters disagreed with one another on the presence of a yard.

Larger sample sizes may provide a more diverse representation of Portland neighborhoods and also greater variety of item responses. Because of the sample sizes, it was difficult to thoroughly test some of the items. It is therefore difficult to make conclusions about the reliability of this tool. Ultimately, SWEAT should be re-tested prior to future use to confirm reproducibility of items found in this thesis, since a slight change in cell distributions may affect kappa when sample sizes are small (Lantz and Nebenzahl 1996).

Moreover, it is possible that some rare events were not observed due to the selection criteria for the segments. For example, observers were asked about the presence of pedestrian controlled traffic signals at intersections. However, selected segments tended to be in residential areas where a segment flanked by two intersections with traffic signals was rare. Broader selection criteria could be created to capture such rare events or rare events could be eliminated from future versions of SWEAT. The study had limited resources as well and a limited number of full-time observers. Not all observers were able to conduct reliability assessments and some observed only a small number of segments. A greater number of trained observers who consistently remained on the project would have increased the number of observations included in the reliability studies. Training was also limited as compared to other studies (Caughy et al. 2001 and Pikora et al. 2002) and could have impacted agreement for certain questions. Limited resources impacted data collection of inter- and inter rater reliability as well.

Another potential issue with this study was the methods used in the design of SWEAT. Not all possible analyses were considered when the tool was developed and were therefore not possible at the time of analysis. For example, Sampson et al.'s (1999) hierarchical reliability analysis would have facilitated comparisons between and within neighborhoods but this analysis was not possible because of the type of data collected by SWEAT. Inconsistent methods of collecting reliability data between phases of data collection may have introduced a new source of variation – time – and affected the overall sample size of both inter- and intra- rater reliability datasets. It is recommended that future studies have consistent methods of collecting reliability data. Finally, further refinements based upon the principal components analysis are necessary to shorten the length of the tool and facilitate ease of use.

Future Studies

Future reliability studies should include a greater number of segments to observe a greater variety of environmental features and to confirm results of this thesis so SWEAT can be used as a reliable measure of the built environment in Pacific Northwest urban neighborhoods. Future studies could also evaluate reliability (or agreement) with a sample of segments prior to a complete rollout of SWEAT. Results may suggest areas for improved training or question revisions. Results of this thesis support further refinement of SWEAT in order to be used widely in the Pacific Northwest. For example, unreliable questions should be eliminated from SWEAT and streamlined to correspond with key factors summarized by principal components analysis.

To further examine the possibility that inadequate training led to poor intra-rater reliability, marginal distributions for each item should be analyzed by observer. Lack of marginal homogeneity might be symptomatic of rater bias, a need for additional training or changes in environmental conditions. To examine the effects of time on intra-rater reliability, re-assessments should be conducted within a week of the first assessment. Reliability results could then be compared with results of this thesis to better examine the effect of time on intra-rater reliability.

The results from the principal components analysis may also be used to generate an overall 'walkability' score for each neighborhood. In turn, this score – and ultimately SWEAT – should be validated using a secondary dataset such as the Senior Health and Physical Exercise (SHAPE) walking data which measured the prevalence of walking among seniors per neighborhood. Validation studies should also include an examination of concurrent validity to evaluate the degree to which walking, measured at the same point in time as the built environment, can be predicted by SWEAT. Overall, SWEAT has the potential to be a reliable senior-specific environmental assessment tool of urban neighborhoods in the Pacific Northwest.

Implications for Public Health

The development of a reliable, senior specific environmental assessment tool has the potential to profoundly impact research in this fast growing field. Promoting higher levels of participation in regular, moderate exercise by adults has been declared a public health priority by the U.S. Dept of Health & Human Services. It is increasingly important to consider the health concerns of seniors as the population rapidly ages. It is clear that the environment can have a profound impact on successful aging (Lawton 1982) but the relationship between the physical environment and activity in seniors has been under-studied.

Understanding how the environment creates obstacles for older adults in communities is important for planning livable communities and increasing the quality of life for seniors (Hans-Werner et al. 2003). Reliable measures of the environment therefore, are required to advance this field of research and to engage communities in considering simple environmental changes. SWEAT can be utilized by health researchers, urban planners and community policy makers to advocate and create environments in the Pacific Northwest that are senior and walking friendly. SWEAT also has the potential for adaptation in other geographic regions as well.

Ultimately, seniors may be more likely to participate in physical activity in their own communities and possibly prevent the devastating effects of such chronic conditions as obesity and heart disease, allowing them to remain in their communities. The creation of environments that support seniors' walking needs may help foster their sense of connection to community as well as their sense of independence. The role of the environment significantly contributes to the health of the population. With reliable instruments to measure the built environment based on specific needs of seniors, health researchers and urban planners have the potential to work together to create and maintain environments that support healthy aging.

Summary & Conclusions

A senior-specific observational instrument to assess the built environment is important to understand the effects of the physical features of the environment on walking or physical activity among this segment of the population. The Senior Walking Environmental Assessment Tool (SWEAT) is a 35-question instrument that measures key environmental features that may predict walking among seniors living in urban areas of the Pacific Northwest. Inter-rater reliability was good to excellent and intra-rater reliability tended to be poor to good. Small sample sizes hindered the ability to thoroughly assess reliability of some items and future reliability studies should be conducted in larger samples to confirm results. SWEAT should also be revised to exclude unreliable questions and to reflect the four factors (*Sidewalks, Safety, Streetlife, and Density*) that emerged from principal components analysis. Qualitative assessments in this thesis confirmed the completeness of SWEAT as an adequate measure of important built environment features.

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Appendix A: Review of Public Health Studies Assessing Reliability of Observational Instruments Measuring Features of Built Environment

Tool (Author, Year)	Strength(s)	Limitation(s)	Variables assessed	Type of instrument
Caughy MO et al. (2001)	- Use of existing literature to define important neighborhood features; - Observational instrument - Trained observers	- Use of only one 'built environment' feature –; - Social-environment scale - Not specific to seniors	- Physical incivilities (litter, graffiti etc) - Safety/Crime - Play resources (yards, children playing)	Subjective, observational
Walking Suitability Assessment (Emery J et al., 2003)	- Short instrument – limits observer burden - Observational measure of built environment - A 'suitability' score is calculated based on responses to items - Criterion validity assessed by using the opinions of three experts who independently assessed the same road segments	- No information on how road segments were selected - Observers assessed segments from their cars except to measure sidewalk width and feel grade of hill. - Not specific to seniors needs - Scores do not seem to be empirically based – no mention as to how scores were reached	- Traffic volume, speed, sidewalk and buffer width, surface quality, supportive amenities such as curb cuts and street lighting.	Subjective, observational
SPACES (Pikora TJ et al., 2002)	- Well-defined geographic area; - Use of objective data sources for neighborhood segments; - Use of trained observers; - Objective	- Only 27 of 12,925 segments re-audited for reliability; - Generalizability - Not specific to seniors	- Walking/cycling surface, Streets, Intersections, Lighting, Path obstructions, Traffic crossings, Crossing aids, Lanes of traffic, Trees, Garden maintenance,	Objective/subjective, observational

	- measure of buil environment		Cleanliness, Pollution, Parks, Views, Facilities (parks, shops etc).	
BESSC (Weich S et al., 2001)	- Standardized list of items on tool; - Well-defined variables; - Use of trained observers; - Objective measure of built environment	- No clear definition of 'housing area' (e.g. size, block or street?); - 11 segments were used to assess reliability; - Generalizability - Not specific to seniors	- Height and age of housing, number of dwellings and type of access, provision of gardens, use of public space, amount of derelict land, security and accessibility of local shops and amenities	Subjective, Observational

Appendix B: Training Manual

TRAINING MANUAL

The Impact of the Neighborhood Built Environment on Health of Seniors in Portland

Yvonne Michael
Grazia Cunningham
Mandy Green
Hannah Kellogg

Introduction

Who am I working for?

In conjunction with Portland State University and Oregon Research Institute (ORI), Dr. Yvonne Michael of Oregon Health & Science University (OHSU) is conducting a pilot-study of the impact of neighborhood built environment on the health of seniors in Portland, OR. The observational component will utilize a structured tool from which expert researchers will collect data on randomly sampled segments (sections of road between consecutive intersections) within selected Portland city neighborhoods. The goal of this project is to develop and test a reliable and valid instrument for future studies.

B. *Description of Research Project*

We propose to identify the community-level factors that enhance health and independent living for older persons. While the desire of older adults to "age in place" is recognized as an important objective in the design and implementation of in-home support services for the elderly, very little work has been done to understand the elements of neighborhood context and urban form that allow successful aging in place. There is significant information available to planners about how to meet the needs of older people with regards to building requirements, site access, and transportation. However, research used to inform policy has focused on single elements of the built environment (e.g., transportation, housing), excluding the importance of neighborhood social environment, and rarely considering how neighborhood factors and the built environment work in concert to encourage seniors' adaptation to changing physical demands. Additionally, research on environment and aging is rarely multi-disciplinary, including planners and public health researchers. Thus policy makers and program planners have little information about the influence of specific aspects of the neighborhood environment on physical health of seniors. Finally, the constructive involvement of older adults, especially those over 75, to inform community planners and policy makers about the specific concerns and needs of this population is rare. We will conduct an assessment of various neighborhoods in Portland, Oregon, utilizing the input of older adults living in those neighborhoods, to examine the relationship between health, neighborhood, and the built environment.

Study protocol

All observations should be conducted during daylight hours, 8:30 AM to 5:30 PM, in teams of two researchers

Prior to conducting observations, researchers will participate in an 8-hour training program that will include auditing practice and feedback.

Observations will always be conducted by pairs of researchers. After completion of training exercises, observer pairs will receive maps along with printed lists of street names and lengths of segments to be observed. Observers will return completed audit forms to study staff weekly and at that time will collect next package of lists and forms. For each neighborhood segment observed, the pairs of observers should designate a lead observer and a secondary observer and this will be indicated on the audit sheet.

Observer teams may interact and share information, questions during the data collection. In case of disagreement between team members on the correct response to an audit item, agreement should be reached if possible. If not possible to reach agreement, the opinion of the primary observer should be recorded in the audit and a note describing the disagreement should recorded by the primary observer in the notes section.

Safety

If in your best judgment there is reason to be concerned about personal safety during an observation, discontinue observation immediately. Also, in the event of any incident involving researchers, discontinue observation immediately, and seek appropriate help. In the event an observation is discontinued, please call Yvonne as soon as possible to notify her and describe incident fully in the qualitative observations for that segment.

Transportation

Pairs of observers will be responsible for transporting themselves to the selected neighborhood segments. Reimbursement will be provided for gas to and from OHSU study office for travel to observation points. If preferred, researchers will be provided Tri-Met bus tickets.

Appearance and behavior

Please dress appropriately for the season/climate. You will be expected to walk around your observation block, so please wear comfortable clothes and shoes and bring hats, umbrellas etc. Please try to be as unthreatening as possible. If approached, please state that you are collecting information for a research study being conducted at OHSU. Please do not approach human subjects or invite feedback/comments from human subjects at this time. Obey all posted signage with regards to entering buildings, etc.

Contact information

If you are sick or have an emergency, please call Yvonne at 503.494.9071.

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The Observational Tool

In this section, we will provide further detail about some questions on the tool, so as to assist your observations.

A. Instructions:

Please fill out the ID number for the neighborhood you are observing, along with the segment ID and ID number of primary and secondary observers. Also record the date, start and end times and temperature/climate of the day you are observing. Temperature should be ascertained by calling (503) 225-5555, then enter 1000 for Portland.

What you need to bring with you:

- Clip board
- Audit instrument
- Secondary observer form
- Tape measure
- Stopwatch
- Pencil

B. Some important Rules:

- **Maps: Map will include the segment street name and address range for this segment on the right and left sides of the street. This map will also include the neighborhood ID #, the segment ID #, and the segment length. Two views of the segment are provided: overall map with streets and other major features of the neighborhood that is being observed and a close-in view of the segment in relation to neighboring segments.**

- Determining side 1: Side 1 will always be the side in the **South or East** compass direction. Compass direction is included in the overall neighborhood map and can also be ascertained from the compass in the stopwatch.

- Determining side 2: Side 2 is the other side (North or West).

- IGNORE vacant lots and building sites, i.e., do not record on audit form. Note in secondary observation form.

- IGNORE buildings that do not face the observation street. In other words, properties that do not have their official address on the street that is being observed should not be counted for any of the questions except retaining walls; do not record building type, porch, or yard condition.

- Each segment should be able to be completed in one shift. If you are unable to complete a segment in one shift, mark your stopping point on the map and start in that place when the primary observer is next in the field.

Recording answers

- Always use pencil when recording answers. If you make changes, please erase completely.

- Tick boxes clearly to avoid misunderstanding later.

- If a question is to be skipped, draw a line through the question through to indicate that you have missed the question deliberately.

- If you make tick marks to count number of buildings, for example, please tally your tick marks and write in the numerical answer. Circle the numerical answer so that it is clear.

Important Points

- At the end of each segment, ensure that all questions on the audit form have been answered and your responses are clear and legible.

- At the end of each day, please go through each audit form to make sure that everything is complete and it is clear and legible.

- Please place the completed audit forms in segment number order (numerical order) in box in OHSU office and record your observer number and the date on the check off list.

E. Detailed explanations of survey questions:

Qualitative Data Collection

While primary observer is completing the audit, the secondary observer should write a brief qualitative description of the segment being observed. Written observations should provide words to describe the overall appearance of the segment and describe any anomalies (elements of the built environment outside the norm) that are observed on the block. Describe the segment type, the walking conditions for pedestrians, particularly seniors, and the level and type of noise you hear. Notice pedestrian traffic on the segment during your observation and circle the appropriate category on the form.

Q 1-2:

Count the number of buildings & building stories that face the front of the street (the front of the building should be facing the street you are walking). Buildings with mixed uses (e.g. retail stores with apartments above store) should be counted separately and described under the 'mixed use' option. Do not include basements in the story count, but do count attics if it appears the attic is or could be used as living space. Count buildings other than residential (Categories: Retail, Commercial, Public, Religious, Mixed Use) by separate addresses, even if the addresses are in the same physical building. For example, one large retail building with three business addresses should be indicated as "3" under Retail. If one business clearly occupies more than one address in a building, only count the business once. Skip these questions if there are no buildings (draw line through question). Record names of all non-residential buildings (e.g., businesses/offices) in Notes section.

Definitions of each item follow (from City of Portland, Bureau of Planning and censusfacts.gov):

Single-family homes: Designed for individual households. This is a 1-unit structure detached from any other house; that is, with open space on all four sides. Such structures are considered detached even if they have an adjoining shed or garage. A one-family house that contains a business is considered detached as long as the building has open space on all four sides. Mobile homes or trailers to which one or more permanent rooms have been added or built also are included.

Apts/Condos – multiple (more than 2) units in one building. Building may also be a single-family house that has been sub-divided into multiple units. Individual units should be indicated by separate letters or numbers. Do not count the number of units. Indicate the number of complexes.

Row houses/Town houses - This is a type of single-family dwelling structure that has one or more walls extending from ground to roof separating it from adjoining structures. In row houses (sometimes called townhouses), double houses, or houses attached to nonresidential structures, each house is a separate, attached structure if the dividing or common wall goes from ground to roof. Count and record each unit with its own address (so 5 connected townhouses would be recorded as "5").

Duplexes- A single family dwelling that has been split into two dwelling areas. These will be evidenced by two mailboxes. Record each duplex as "1" in the blank, and it will be understood that a duplex includes two addresses.

Institutional – Residential buildings such as Assisted Living facilities, Independent Living Facilities.

Retail - These include any building in which goods or services are sold to the average consumer. Examples: large or small grocery stores, cafes, clothing stores, movie theaters, insurance sales offices.

Commercial - Such buildings are used for industrial (e.g. warehouses or port hangers), employment purposes (large corporations) or any other business-business commerce.

Public – These include buildings for general public use, e.g. schools, post offices, libraries, government buildings, such as city hall, courthouses etc..

Religious – These include churches, temples or other religious gathering spot.

Mixed Use –Please describe the mixed use building in detail and identify it as one of the following types. Mixed use refers to the combining of retail/commercial and/or service uses with residential or office use in the same building or on the same site in one (1) of the following ways:

A. Vertical Mixed Use. A single structure with the above floors used for residential or office use and a portion of the ground floor for retail/commercial or service uses.

B. Horizontal Mixed Use – Attached. A single structure which provides retail/commercial or service use in the portion fronting the public or private street with attached residential or office uses behind.

C. Horizontal Mixed Use – Detached. Two (2) or more structures on one (1) site which provide retail/commercial or service uses in the structure(s) fronting the public or private street, and residential or office uses in separate structure(s) behind or to the side.

Q3: Please count the number of features such as porches, balconies, or stoops that provide a place where residents can overlook and interact with pedestrians. Porch should be wide enough to comfortably place a chair and still open the door. Skip question if there are no buildings (cross question out). Count each porch that belongs to a separate address (5 townhouses with a porch each should be indicated as "5" and 20 apartments with porches in one complex should be indicated as "1").

Q4: Indicate if there are any visible bars over windows or doors on any of the buildings in your segment. Skip question if there are no buildings (draw line through question). Count as for porches above.

Q5: Estimate the aesthetic maintenance of the yards on this block. If all or most have well trimmed and debris-free yards, record 75%. If some are well-maintained, then record 50-74%, and so on. Failure to water during dry months resulting in brown or yellow grass, etc. should not be considered poorly maintained. If there are no yards, draw a line through question.

Q6: Estimate the quality/upkeep of the buildings in your observation block based on evidence of broken windows, graffiti on the buildings, other damage, or need for repair/maintenance. Percentages should represent your best estimation. If there are no buildings, draw a line through question.

Q7: Provide a count for the number of trees in the buffer zone within the following height categories using your best estimate of height: <= 15 ft and > 15 ft.

Q8: Record (yes or no) if benches exist. If yes, count only publicly accessible benches, not including benches in private yard or other inaccessible place (e.g., locked park).

Q9: Indicate 'clean and not damaged' if all or most (75%) benches on the street are in good condition. If there is some damage or soilage, but it would not interfere with sitting on the bench count as good condition. Indicate 'poor condition' if all or most (75%) of the benches have damage or soilage that would interfere with sitting. If 25%-75% of the benches have problems that would interfere with sitting indicate 'some are not clean and are damaged'. If there are no benches, draw line through the question.

Q10: Indicate yes if there are any places, such as ledges or other flat places for sitting and/or resting. The resting place must be a height of 15 inches or more in order to be a possible resting spot for pedestrians. Also, resting place must be flush with the property line and not set back if it is on a residential/private property. Only count one retaining wall/ledge per property. If yes, please list these items on the survey. Include retaining walls for properties **not** on the segment if the wall itself **is** on the observed segment and could be used by pedestrians on the observed segment.

Q11: Record the quality of the cleanliness of your block as a whole (includes streets, sidewalks, properties, buildings). Note: if there is one piece of paper or piece of trash on the street, do not record this as 'dominant'.

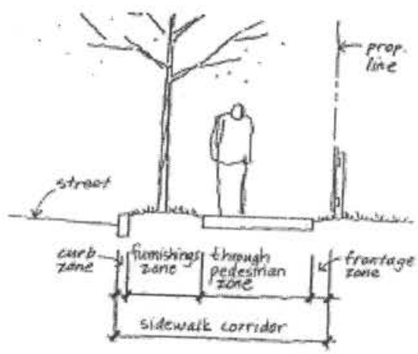
Q12: Indicate (Yes or No) if there are public restrooms or access to public restrooms (e.g. in libraries, municipal buildings, cafes, grocery stores). If possible, go into the building to confirm that there is a publicly accessible restroom.

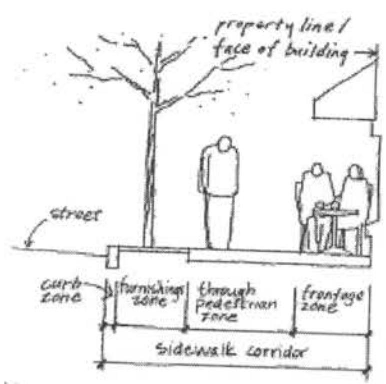
Q13-14: Provide a count of city streetlights that are visible at the crossing areas (intersections and any other designated crossing area) and along the street at non-designated crossing areas. Provide a count for both sides of the street. Do not count lights that are on private property/have been privately installed. If there are no streetlights, draw line through Q13 and Q14 . If there are streetlights, indicate whether any are positioned at transit stops.

Q15: Note if parking for retail stores exists, whether or not cars are currently parked there. If there is curbside parking (on street, in front of the commercial/retail building) indicate 'curbside parking'. If there is parking behind the commercial/retail building or underground, indicate 'Behind building or underground'. If there is a parking lot between the building front and the street, indicate 'Between building front and street'. If there is a parking lot that is not behind or in front of a commercial/retail building, indicate 'Parking lot independent of building'. Often these parking lots will take up a single lot or more and may or may not be marked for parking for one of the businesses or public buildings on the block. If there are no commercial/retail buildings, indicate 'No commercial/retail'. If there is no parking available on the block, draw a line through the question.

Definitions for Q16 & 17: questions on sidewalks and buffer (furnishings) zone:
This information was provided by the City of Portland Transportation Office (source: www.pdxtrans.org - Pedestrian Guide, accessed 10/22/2002).

The Sidewalk Corridor is typically located within the public right-of-way between the curb or roadway edge and the property line. The Sidewalk Corridor contains four distinct zones: the ***Curb Zone***, the ***Furnishings Zone (Buffer Zone)***, the ***Through Pedestrian Zone (sidewalk)***, and the ***Frontage Zone.*** See examples below:





The Furnishings Zone (Buffer zone) buffers pedestrians from the adjacent roadway, and is also the area where elements such as street trees, signal poles, utility poles, street lights, controller boxes, hydrants, signs, parking meters, driveway aprons, grates, hatch covers, and street furniture are properly located. This is the area where people alight from parked cars. Wherever it is wide enough, the Furnishings Zone should include street trees. In commercial areas, this zone may be paved, with tree wells and planting pockets for trees, flowers and shrubs. In other areas, this zone generally is not paved except for access walkways, but is landscaped with some combination of street trees, shrubs, ground cover, lawn, or other landscaping treatments. Separating pedestrians from travel lanes greatly increases their comfort as they use the Sidewalk Corridor.

Q16: For the purposes of this study, the sidewalk is operationalized as the area that is designed as the paved pedestrian throughway. Aging friendly sidewalks should be continuous without abrupt changes in level or interruption of steps. Discontinuous sidewalks are those that are partially paved and the rest is another material. If there is no sidewalk at all in your segment mark "No sidewalk" for Q16.

Q17: This question asks you to assess the slope of the sidewalk area. If there is no sidewalk, check the box for not applicable. Flat/gentle slope would include a slope that is equal to or less than 5%. Steep slope would include a slope that is greater than 5%.

Q18 & 19: Suitable surface material includes concrete, asphalt, level brick or tile. Mark the box of all surface materials that are used in this segment. Only include the sidewalk area (not the buffer zone or parking strip). If you choose 'Other', please describe the material of the sidewalk. Repeat for the second side of the street. If a sidewalk is discontinuous, please mark all the materials that make up that sidewalk, noting if any part of the sidewalk corridor is a private lawn. **By definition, any non-continuous sidewalk should not be considered "excellent" condition.**

Q20: When assessing the condition of the sidewalk, anything that deviates from the American Planning Association guideline stating that sidewalks should be non-slip and non-glare with no gratings in the walk should be noted. Obstructions that would not hinder walking (based on APA guidelines) and would allow a pedestrian using a walker to continue walking on the sidewalk should ***not*** be counted. Things in the sidewalk that are not obstructions (like grates, benches that are passable, etc.) should be noted in the notes on the secondary observer form. If you choose 'Other', please describe the obstructions you see.

Q21: This question requires you to indicate the presence of specific permanent items in the buffer zone or parking strip. Place a mark in the box by any item that is present in the buffer zone. If you mark 'other', please describe what you see. If there is no buffer zone at all, draw a line through the question.

Q22: This question requires you to assess the signs on the sidewalk that are associated with commercial or retail stores or providing pedestrian-related information. Include street name signs. Do not include home addresses or other signs that pertain to residential buildings (e.g. apartment names). Clear signs include signs with bold and simple typeface such as **Helvetica** or **Futura** with font size that is readable for person of average vision from a distance of 5 feet. Contrasting colors with light images on dark backgrounds are preferred, as well as raised lettering or Braille. The standard Tri-Met bus stop signs should be considered examples of signs that ***are not*** clear and large. If most (> 50%) or all of the signs meet these minimum standards indicate 'All or most signs are clear & large'. If few (<10%) or none of signs meet these standards indicate 'No or few signs are clear and large'. Indicate 'Some of signs are clear & large' if 10-50% of signs meet these standards. If there are no signs on this segment, draw a line through the question.

Q23: This question seeks to understand if this block connects with other streets and allows for easy pedestrian passage to other parts of the neighborhood. Streets that are cul-de-sacs limit pedestrian movement and promote auto activity. Dead end streets, without pedestrian throughways, also impede pedestrian activity. Some dead end streets have pedestrian throughways (e.g. trails); please investigate the dead end to check for pedestrian throughways.

Q24-25: Count the maximum number of lanes that are designated for motorized traffic, including those that are designated for traffic at specific times. If any lane is designated for a use other than traffic (for example, street parking is prohibited at certain times so that the lane can be used for travel), describe this in the space provided. For Q33, indicate whether there is a bike lane. A bike lane may be designated by a lane on the street (e.g. marked bike lane) or signs visible from the segment (sign for bike route).

Q26: Record the posted speed limit. If no posted speed, enter 98.

Q27: Indicate 'Yes' if there is a traffic circle, roundabout, "zebra stripes" at cross walks with no signal, or other traffic calming devices (e.g. speed bumps, planters, signs, crosswalk markings, jogging streets etc) within the observed segment. Include traffic circles in the intersections between the observed segment and the next street over. Indicate 'No' if none of these traffic calming devices are present.

Q28: Indicate existence of pedestrian signals at intersections or crosswalks that can be triggered by pedestrians by pushing a button or some other mechanism. If there are no pedestrian signals, indicate 'No pedestrian signals'. If there is a pedestrian signal, but no mechanism for pedestrian control, indicate 'Pedestrian signal but not controllable'. If there is a pedestrian signal and mechanism for pedestrian control, indicate 'Pedestrian signal and controllable'. Repeat this process in boxes under 'Int 2' if there is a second intersection with a signal. If there aren't signals, draw a line through the question.

Q29: Time the length of the **WALK**, if a pedestrian signal is present, or **GREEN** signal to the nearest 100th of a second. Using a stopwatch, start the watch as the Walk (or green) signal starts and stop the watch as the light indicates solid (no longer flashing) stop or red. Record the time in seconds with an accuracy of a hundredth of a second. Repeat this process if there is a second intersection with a signal and record time under 'Int 2'. Please circle either Walk or Green on your form to indicate which signal you observed. If there are no traffic signals, draw a line through the question.

Q30: Measure the length of the cross walk in normal paces. Count the number of normal paces that you are required to take in order to cross from one sidewalk to the other. Begin counting paces with your first step off the sidewalk and count until your first foot lands on the other curb. Record the number of paces required. Repeat this process if there is a second intersection with a signal and record number of paces required under 'Int 2'. If there are no traffic signals, draw a line through the question.

Q31: Measurement of the paved sidewalk should be taken of unobstructed sidewalk using tape measure provided. ***Measurement should be taken at least 30 feet from the intersection.*** If the width of the sidewalk varies within segment of observation, provide two measures based on your estimate of the place with maximum width and the place with the minimum width. If the width of the sidewalk is consistent within segment, only one measure should be taken and the value should be entered as both the maximum and the minimum. Measurement should begin at place of contact between the sidewalk and the curb (or buffer zone) if present and extend to the frontage zone or property line. If there are items *on the edge* of the sidewalk that functionally limit the width of the sidewalk (e.g., benches, bushes, etc.) this may be the minimum sidewalk width and the measurement of sidewalk at this point should not include the area blocked by this item. If the item is in the middle of the sidewalk, the item should be marked as an obstruction in Q20 and measurement should be taken in an area free of obstruction. Value should be reported in inches, with an accuracy to one-eighth of an inch. Draw a line through the question if there is no sidewalk.

Q32: Indicate the presence of ramps or curb cuts with less than 1-inch clearance between roadway and sidewalk at crossing areas (intersection or other designated crossing area). Don't count the middle of a block with no intersecting street, alley, or roadway as a crossing area.

Q33: Using the provided tape measure, measure the height of the curbs from the street to the top of the curb to the nearest 1/8 of an inch. You should do this for curbs where ***no curb cuts or ramps exist***. Take up to three measurements on each side of the curbs without curb cuts or ramps. If there are no curbs that need to be measured (all have curb cuts), draw a line through the question. Do not measure a curb if it is not attached to a sidewalk.

Q34: For the purposes of this study, the buffer zone is operationalized as the area in the sidewalk corridor that is between the street and the pedestrian throughway that contains at least one item (for example, street trees, signal poles, utility poles, street lights, controller boxes, hydrants, signs, parking meters, driveway aprons, grates, hatch covers, and street furniture). To measure this zone, use the tape measure provided to measure from the edge of the object that is the furthest from the street to the inside of the curb (e.g. in picture above, measure from the top of the phone booth to the inside of the curb). Only the maximum width of the buffer zone should be measured. Value should be reported in inches, to one-eighth of an inch. If no buffer zone exists or is not clearly evident, draw a line through the question. Do not measure the shoulder of a road as part of the buffer zone.

Q35: Count the number of vehicles that pass in one direction. Do this for 2 minutes. The secondary observer may assist by timing the passage of 2 minutes using the provided stopwatch. Repeat for the cars going in the other direction.

Record your end time and note the difficulty level for this segment on a scale of 1(easiest) – 5 (most difficult). Please describe any specific difficulties you had in assessing this street in the NOTES section.

The secondary observer should check through the primary form to verify that all items have been completed. It is not necessary for the secondary observer to check the accuracy of the observations on the primary form, only to make sure no items have been left blank.

Appendix C: Senior Walking Environmental Assessment Tool and Qualitative Assessment Form

SWEAT

Neighborhood ID ________
Segment ID ________
Primary observer ID ________
Secondary observer ID ________

Date ________
Start time ________
Temp in Fahrenheit ________
Is it raining? Yes _____ **No** _____

Please provide street and cross streets of block you are observing
Street: ____________________
Cross1: ____________________
Cross2: ____________________

1. Count buildings **(count number, 0 or greater)**

	Side 1	Side 2
Single Family		
Apts/Condos		
Row/town homes		
Duplexes		
Institutional		
Retail		
Commercial		
Public		
Religious		
Mixed Use		
Total		

Describe mixed use:

2. Record number of buildings with the following stories: (count number, 0 or greater)

	Side 1	Side 2	Total
1			
2			
3			
4			
5+			

3. Number of buildings on the block with front porches or areas where residents can overlook the street and/or interact with other pedestrians or street users. *(Count number, 0 or greater)*

Side 1	Side 2	Total

4. Count residential or commercial buildings that have noticeable bars. *Count number, 0 or greater*

Side 1	Side 2	Total

__________ __________ ______

5. Yard maintenance: (well-maintained = looks trim & clean)

>75% well maintained	☐ 1
50-74% well maintained	☐ 2
<50% well maintained	☐ 3

6. Condition of the buildings: (can you see broken windows, graffiti, litter or other signs of damage)

5% or less have damaged/need repair	☐ 1
5-25% have damage/need repair	☐ 2
>25% have damage/need repair	☐ 3

7. Height of trees- *(count number, 0 or greater, with the following heights)*:

	Side 1	Side 2	Total
≤15ft	______	______	______
>15ft	______	______	______

8. Are there benches for individuals to rest on, if necessary, along the street of this block?

	Side 1	Side 2
No	☐ 0	☐ 0
Yes	☐ 1	☐ 1
If yes, count (1 or greater):	______	______

9. Conditions of benches:

Clean and not damaged	☐ 1
Some are dirty & damaged	☐ 2
All in poor condition	☐ 3

10. Are there other places (e.g. ledges or retaining walls) for pedestrians to rest on or gather around?

	Side 1	Side 2
No	☐ 0	☐ 0
Yes	☐ 1	☐ 1
If yes, count	______	______

Describe: ____

____

11. Can you see any litter, graffiti, broken glass, etc.?

None or almost none	☐ 0
Yes, but not dominant feature	☐ 1
Yes, dominant feature	☐ 2

12. Are there publicly accessible restrooms on this block?

No	☐ 0
Yes	☐ 1

13. Count streetlights *(0 or greater)*:

	Side 1	Side 2
At crossing areas	______	______
Other locations on street	______	______

14. Are public streetlights positioned at transit stops? *(if transit stops are present)*

No	☐ 0
Yes	☐ 1

No transit stops ☐ 98

15. Commercial parking (check all that apply):

	Side 1	Side 2
Curbside parking	☐ 1	☐ 1
Behind buildings or underground	☐ 2	☐ 2
Between building front and street	☐ 3	☐ 3
Parking Lot independent of building	☐ 4	☐ 4
No commercial/retail	☐ 98	☐ 98

16. Are sidewalks continuous?

	Side 1	Side 2
No	☐ 0	☐ 0
Yes	☐ 1	☐ 1
No sidewalks	☐ 98	☐ 98

17. Slope:

	Side 1	Side 2
Flat/gentle	☐ 1	☐ 1
Steep slope	☐ 2	☐ 2

18. Sidewalk material *(check all that are present)*:

	Side 1	Side 2
Asphalt	☐ 1	☐ 1
Concrete	☐ 2	☐ 2
Bricks/Tile	☐ 3	☐ 3
Gravel	☐ 4	☐ 4
Dirt	☐ 5	☐ 5
Grass	☐ 6	☐ 6
Under repair	☐ 7	☐ 7
Private lawn	☐ 8	☐ 8
Other	☐ 9	☐ 9

List ______________________

19. Sidewalk condition & smoothness:

	Side 1	Side 2
Good (<10%has bumps, cracks, holes, weeds)	☐ 1	☐ 1
Moderate (10-50% has bumps, cracks, holes, weeds)	☐ 2	☐ 2
Poor (>50% has bumps, cracks, grates, holes, weeds)	☐ 3	☐ 3
Under repair	☐ 4	☐ 4

20. Sidewalk obstructions(mark all that create considerable obstruction/danger to pedestrian traffic):

	Side 1	Side 2
None	☐ 0	☐ 0

Bump/crack/hole	☐ 1	☐ 1
Weeds/leaves	☐ 2	☐ 2
Standing water/ice	☐ 3	☐ 3
Poles/signs	☐ 4	☐ 4
Tables/Chairs	☐ 5	☐ 5
Trees/shrubs	☐ 6	☐ 6
Parked Cars	☐ 7	☐ 7
Other	☐ 8	☐ 8

*Describe:*______________________________

21. Permanent items in the buffer zone (mark all that are present).

	Side 1	Side 2
None	☐ 0	☐ 0
Bike Racks	☐ 1	☐ 1
Controller boxes	☐ 2	☐ 2
Fire hydrants	☐ 3	☐ 3
Grate/hatch cover	☐ 4	☐ 4
Mailboxes	☐ 5	☐ 5
Newspaper boxes	☐ 6	☐ 6
Parking meter	☐ 7	☐ 7
Planter or flowers	☐ 8	☐ 8
Public Garbage Cans	☐ 9	☐ 9
Signal poles	☐ 10	☐ 10
Signs	☐ 11	☐ 11
Street light	☐ 12	☐ 12
Street furniture	☐ 13	☐ 13
Telephone booth	☐ 14	☐ 14
Trees or Shrubs	☐ 15	☐ 15
Utility poles	☐ 16	☐ 16
Wall	☐ 17	☐ 17
Water fountains	☐ 18	☐ 18
Other	☐ 19	☐ 19

Please describe______________________________

22. Are signs (including directional signs for pedestrians and signs in front of retail, commercial stores) on this street clear and large?

>50% are clear & large	☐ 1
10-50%are clear & large	☐ 2
<10% are clear & large	☐ 3

23. Does this segment end in a cul-de-sac or dead end?

No	☐ 0
Dead end w/o pedestrian thruway	☐ 1
Dead end with pedestrian thruway	☐ 2

Cul-de-sac ☐ 3

24. How many lanes of traffic are there in this block?

1 ☐ 2 ☐ 3 ☐ 4+ ☐

*If any lane(s) is/are designated for other purposes at specific times, please describe*______________________________

25. Is there a designated bike lane in the street?

Yes	☐ 1
No	☐ 2

26. What is the posted speed limit?

_______ **mph**

If none posted, enter 98.

27. Is there a traffic circle, roundabout or other traffic-calming device (e.g. signs, bumps, marked crosswalk)?

Yes	☐ 1
No	☐ 2

If yes, list:

____

____

28. Do intersections and crosswalks with traffic signals have pedestrian signals?

	Int 1	Int2
No pedestrian signals	☐ 0	☐ 0
Ped signals but not controllable	☐ 1	☐ 1
Ped signals & controllable	☐ 2	☐ 2

29. Time traffic signal (Green) or pedestrian signal if present (Walk):

	Int 1	Int2
Green/WALK	________ sec	__________sec

Please circle what signal you observed.

30. If traffic signals exist, measure length of crosswalks *(in normal paces)*

Int 1	Int 2
________ paces	________paces

31. Width of *paved* sidewalk (in):

	Side 1	Side 2
Max	________	________
Min	________	________

32. Do crossing areas have ramps or curb cuts?

	Side 1	*Side 2*
None	☐ 0	☐ 0
Yes, at some crossing areas	☐ 1	☐ 1
Yes, at all crossing areas	☐ 2	☐ 2

33. Measure height of curbs on this street (in.).

	Side 1	Side 2
1 crossing area	______	______
2 crossing area	______	______
3 crossing area	______	______

Enter 98 if not applicable (fewer than 3 crossing areas without ramps/curb cuts on either side)

34. Width of buffer zone (in):

See picture below for ONE example of a buffer zone.

Side 1	Side 2

_________ _________

35. Count cars going in one direction for 2 minutes. *Repeat for other direction.*

Dir 1 __________ **Dir2** __________

NOTES:

Enter end time__________
Segment Difficulty on a scale of 1(easiest) – 5 (most difficult)
(please describe any specific difficulties you had in assessing this street in the notes section.):

Qualitative Assessment Form

Neighborhood ID ________
Segment ID ________
Secondary observer ID ________

Date________
Start time ________
Temp in Celsius ________
Is it raining? **Yes** _____ **No** _____

Please describe the neighborhood you are assessing in words. Written observations should provide words to describe the overall appearance of the segment and describe any anomalies (elements of the built environment outside the norm) that are observed on the block.

Note a **count of pedestrian traffic** within this segment during your entire observation period. You should note demographic information: **Age, Gender, Ethnicity**.

Other factors to note include **noise level**, **overall pleasantness** for pedestrian travel & 'Street life.'

Appendix D: Summary of Reliability Results by Concept in Conceptual Framework

Inter-rater agreement (36 segments observed)

Concept: Functional

Item	t-test p value		% Agreement		κ		CI	
	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
Functional - Buildings								
Single Family	.06	.32						
Apt/Condo	NA	.32						
Row/town home	NA	.32						
Duplexes	.16	1.00						
Institutional	NA	NA						
Retail	NA	NA						
Commercial	.32	NA						
Public	NA	NA						
Religious	NA	NA						
Mixed Use	NA	NA						
Total Buildings	.20	.27						
Functional - Sidewalk								
Presence of sidewalk			94	94	.80	.80	.53, 1.00	.53, 1.00
When sidewalk present:								
Sidewalk width max	.27	.48						
Sidewalk width min	.01	.33						
Continuous s/w			94	94	.86	.86	.64, 1.00	.65, 1.00
When sidewalk exists:								
Sidewalk slope			92	92	.85	.85	.64, 1.00	.65, 1.00
Asphalt			94	94	.80	.80	.53, 1.00	.53, 1.00
Concrete			94	94	.83	.83	.58, 1.00	.58, 1.00
Bricks			94	94	.80	.80	.53, 1.00	.53, 1.00
Gravel			94	94	.83	.73	.58, 1.00	.48, .97
Dirt			92	94	.72	.80	.47, .98	.53, 1.00
Grass			92	92	.77	.78	.55, .99	.57, 1.00
Under repair			94	94	.80	.80	.53, 1.00	.53, 1.00
Private Lawn			92	94	.72	.80	.47, .98	.53, 1.00
Other Material			94	94	.80	.80	.53, 1.00	.53, 1.00
Sidewalk condition			61	67	.44	.48	.27, .61	.32, .64
No obstructions			67	61	.47	.36	.27, .67	.17, .56
Bump/Crack/hole			72	72	.48	.41	.28, .69	.21, .61
Weeds/leaves			78	78	.54	.46	.34, .75	.27, .66
Poles/signs			92	94	.72	.80	.47, .98	.53, 1.00
Standing water			94	94	.80	.80	.53, 1.00	.53, 1.00
Tables/chairs			94	94	.80	.80	.53, 1.00	.53, 1.00
Trees/shrubs			78	86	.45	.70	.24, .66	.49, .90
Parked cars			92	92	.76	.76	.53, .99	.53, .99
Other Obstructions			83	94	.54	.80	.32, .77	.53, 1.00
Curb Height (see Personal Safety)								
Curb Cuts (See Personal safety)								
Functional - Streetlife								
Presence of Buffer Zone			94	94	.80	.80	.53, 1.00	.53, 1.00

Item	t-test p value		% Agreement		κ		CI	
	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
When Buffer Zone (BZ) present, items in the bufferzone include:								
No items			92	89	.72	.66	.47, .98	.42, .89
Bike racks			94	94	.83	.80	.58, 1.00	.53, 1.00
Controller boxes			94	94	.80	.80	.53, 1.00	.53, 1.00
Fire hydrants			92	92	.85	.77	.64, 1.00	.55, .99
Grate			89	75	.81	.60	.61, 1.00	.40, .80
Mailboxes			94	94	.80	.83	.53, 1.00	.59, 1.00
Newspaper Boxes			94	94	.83	.80	.58, 1.00	.53, 1.00
Parking meter			94	94	.80	.80	.53, 1.00	.53, 1.00
Planter			83	81	.67	.55	.47, .87	.37, .74
Garbage cans			92	94	.72	.80	.47, .98	.53, 1.00
Signal poles			86	86	.60	.66	.38, .82	.45, .87
Signs			81	72	.66	.54	.46, .87	.34, .75
Street lights			83	86	.70	.77	.50, .91	.57, .97
Street furniture			94	94	.80	.80	.53, 1.00	.53, 1.00
Telephone booth			94	94	.83	.80	.58, 1.00	.53, 1.00
Trees			81	78	.69	.65	.48, .89	.45, .85
Utility poles			83	72	.72	.58	.51, .92	.40, .76
Wall			94	94	.80	.80	.53, 1.00	.53, 1.00
Water fountain			94	94	.80	.80	.53, 1.00	.53, 1.00
Other items			86	86	.67	.64	.46, .88	.43, .85
Buildings with porches	.07	.43						
Presence of Benches			100	100	1.00	NA	.73, 1.00	NA
Count of benches	NA	NA						
Other resting places			89	89	.76	.68	.50, 1.00	.41, .95
Count of resting places	.16	.19						
Presence of signs			50	--	-.11	--	-.25, .03	--
Condition of signs (if signs present)			42	--	0.0	--	-.13, .14	--

T-tests were NA when they could not be computed due to lack of observations
Kappa was NA when there was no variability

Concept: Aesthetics

Item	t-test p-value		% Agreement		κ		CI	
Aesthetics - Views	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
1 story buildings	.12	.04						
2 story buildings	.08	.36						
3 story buildings	.57	.32						
4 story buildings	NA	NA						
5+ story buildings	NA	NA						
Buildings with bars	.32	.66						

Item	t-test p-value	% Agreement		κ		CI	
Presence of Yard		97	--	0.0	--	NA	--
Yard Condition		81	--	.45	--	.25, .65	--
Presence of Buildings		92	--	.38	--	.18, .57	--
Bldg condition		72	--	.19	--	.02, .36	--
Litter		81	--	.60	--	.36, .84	--
Condition of benches (when benches present)		100	--	0.0	--	NA	--
Tree height (see Personal Safety)							

T-tests were NA when they could not be computed due to lack of observations
Kappa was NA when there was no variability

Concept: Safety

Item	t-test p-value		%Agreement		κ		CI	
	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
Safety – Personal								
Trees <15 ft	.40	.49						
Trees >15 ft	.89	.50						
Lights crossing	1.00	.10						
Lights other	.18	1.00						
Street lights at transit stops			97	--	.49	--	.36, .63	
Presence of intersections with traffic signals			97	89	.87	.48	.60, 1.00	.24, .71
Pedestrian controlled devices			94	92	.76	.23	.57, .95	.06, .39
Presence of crossing area			94	89	0.0	0.0	NA	NA
When crossing areas present:								
Curb Cuts			67	73	.51	.64	.33, .69	.47, .82
Curb Height a	.09	.24						
Curb Height b	.05	.76						
Buffer Zone width	.67	.53						
Signal Type			100	--	1.00	---	.73, 1.00	--
Signal Time	.76	NA						
Crosswalk Length	.33	NA						
Safety - Traffic								
Car Count	.50	.59						

Item	t-test p-value		%Agreement		κ		CI	
	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
Lanes of Traffic			97	--	.88	--	.65, 1.00	--
Traffic calming device			89	--	.60	--	.33, .87	
Speed limit sign			94	--	.64	--	.41, .87	
Speed limit	NA							
Bike lanes			97	--	.79	--	.52, 1.00	--

T-tests were NA when they could not be computed due to lack of observations
Kappa was NA when there was no variability

Concept: Connectivity

Item	% Agreement		κ		CI	
	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
Destination - Connectivity						
Curbside Parking	100	100	1.00	1.00	.73, 1.00	.73, 1.00
Parking behind buildings	94	94	-.03	-.03	-.30, .25	-.30, .25
Parking between st & bldgs	97	100	1.00	0.0	.61, 1.00	NA
Parking lot	89	92	-.04	.37	-.28, .19	.16, .59
No commercial/retail	89	86	.55	.25	.30, .79	.07, .43
Segment End	100	--	1.00	--	.73, 1.00	--
Presence of Transit Stops	100	--	1.00	--	.73, 1.00	--
Destination – Facilities						
Restrooms	100	--	NA	--	NA	--
Services (see Bldg counts)						

Intra-rater Reliability results (18 segments)
Concept: Functional

Item	t-test p-value		% Agreement		κ		CI	
	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
Functional – Buildings								
Single Family	.58	.58						
Apt/Condo side 1	.33	1.00						
Row/town home	NA	NA						
Duplexes	NA	.33						
Institutional	NA	NA						
Retail	NA	NA						
Commercial	NA	NA						
Public	NA	NA						
Religious	NA	NA						
Mixed Use	NA	NA						
Total Buildings	.58	.58						
Functional – Sidewalk								
Presence s/w			83	78	.61	.51	.22, .99	.13, .88
Sidewalk width max	.54	.34						
Sidewalk width min	.31	.97						
When s/w present:								
Continuous sidewalks			83	78	.71	.64	.42, 1.00	.36, .92
Sidewalk slope			83	78	.71	.63	.43, 1.00	.35, .91
Asphalt			83	78	.61	.51	.22, .99	.13, .88
Concrete			83	78	.61	.51	.22, .99	.13, .88
Bricks			83	78	.61	.51	.22, .99	.13, .88
Gravel			78	78	.58	.51	.27, .89	.13, .88
Dirt			78	78	.52	.51	.17, .87	.13, .88
Grass			78	78	.58	.57	.27, .89	.25, .90
Under repair			83	83	.61	.51	.22, .89	.13, .88
Private Lawn			78	72	.52	.46	.17, .87	.14, .79
Other material			83	78	.64	.54	.22, .99	.19, .89
Sidewalk condition			50	61	.31	.43	.07, .54	.19, .67
No obstructions			67	56	.50	.34	.23, .77	.08, .61
Bump/Crack/hole			67	56	.40	.28	.11, .70	-0.0, .56
Weeds/leaves			67	67	.43	.40	.13, .72	.09, .70
Poles/signs			83	78	.61	.51	.22, .99	.13, .88
Standing water			83	78	.61	.51	.22, .99	.13, .88
Tables/chairs			83	78	.61	.51	.22, .99	.13, .88
Trees/shrubs			78	67	.58	.36	.27, .89	.03, .68
Parked cars			83	78	.61	.51	.22, .99	.13, .88
Other Obstructions			83	78	.66	.59	.33, .99	.28, .90
Curb Height (see Personal Safety)								
Curb Cuts (See Personal safety)								
Functional – Streetlife								
Presence of Buffer Zone (BZ)			83	78	.57	.51	.22, .99	.13, .88
When Buffer is								

Item	t-test p-value		% Agreement		κ		CI	
	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
present:, items in bufferzone include:								
No Items			83	78	.61	.51	.22, .99	.13, .88
Bike racks			83	78	.61	.51	.22, .99	.13, .88
Controller boxes			83	78	.61	.51	.22, .99	.13, .88
Fire hydrants			83	78	.70	.55	.40, 1.00	.21, .89
Grate			78	50	.67	.28	.40, .93	.04, .52
Mailboxes			83	78	.61	.57	.22, .99	.25, .90
Newspaper			83	78	.61	.51	.22, .99	.13, .88
Parking meter			83	78	.61	.51	.22, .99	.13, .88
Planter			78	78	.58	.51	.27, .89	.13, .88
Garbage cans			78	78	.55	.54	.22, .88	.19, .89
Signal poles			78	78	.52	.51	.17, .87	.13, .88
Signs			78	61	.65	.41	.37, .93	.16, .66
Street light			72	72	.44	.57	.12, .77	.29, .84
Street furniture			83	78	.61	.51	.22, .99	.13, .88
Telephone			83	78	.61	.51	.22, .99	.13, .88
Trees			78	72	.67	.57	.39, .94	.30, .84
Utility poles			50	67	.26	.49	.02, .51	.22, .77
Wall			83	78	.61	.51	.22, .99	.13, .88
Water fountain			82	78	.61	.51	.22, .99	.13, .88
Other			72	67	.47	.40	.16, .79	.10, .69
Buildings with porches	.19	.19						
Presence of Benches			100	94	NA	0.0	NA	NA
Count of benches	NA	NA						
Other resting places			89	83	.61	.50	.25, .97	.20, .80
Count of other resting places	.08	1.00						
Presence of signs			67	--	.33	--	-.06, .71	--
Condition of signs (if signs present)			61	--	.28	--	-.04, .61	--

T-tests were NA when they could not be computed due to lack of observations
Kappa was NA when there was no variability

Concept: Aesthetics

Item	t-test p-value		% Agreement		κ		CI	
Aesthetics - Views	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
1 story buildings	.16	.50						
2 story buildings	.27	.05						
3 story buildings	NA	NA						
4 story buildings	NA	NA						
5+ story buildings	NA	NA						
Buildings with bars	.33	.58						
Presence of Yard			67	--	-.08	--	-.44, .28	--

Item	t-test p-value	% Agreement		κ		CI	
Yard Condition		83	--	.25	--	-.03, .53	--
Presence of Buildings		83	--	.49	--	.17, .81	--
Bldg condition		83	--	.49	--	.17, .81	--
Litter		72	--	.24	--	-.06, .55	--
Condition of benches (when benches present)		100	--	NA	--	NA	--
Tree height (see Personal Safety)							

T-tests were NA when they could not be computed due to lack of observations
Kappa was NA when there was no variability

Concept: Safety

Item	t-test p-value		% Agreement		κ		CI	
	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
Safety – Personal								
Trees <15 ft	.22	.80						
Trees >15 ft	.26	.58						
Lights crossing	.38	.43						
Lights other	.33	.24						
Street lights at transit stops			94	--	0	--	NA	--
Presence of intersections with traffic signals			67	72	.25	.35	-.14, .64	-.04, .73
Pedestrian controlled devices			67	72	.30	.37	-.02, .63	.02, .72
Presence of crossing area			83	83	.31	.50	-.07, .68	.19, .80
When crossing areas present:								
Curb Cuts			61	44	.45	.25	.22, .68	.03, .47
Curb Height a	.41	.39						
Curb Height b	.47	.55						
Buffer Zone	.82	.47						
Signal Type			100	--	NA	---	NA	--
Signal Time	NA	NA						
Crosswalk Length	NA	NA						
Safety - Traffic								
Car Count	.25	.04						
Lanes of Traffic			89	--	.70	--	.40, 1.00	--
Traffic			94	--	0.0	--	NA	

Item	t-test p-value		% Agreement		κ		CI	
	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
calming device								
Speed limit sign			100	--	NA	--	NA	
Speed limit	NA	--						
Bike lanes			100	--	NA	--	NA	--

T-tests were NA when they could not be computed due to lack of observations
Kappa was NA when there was no variability

Concept: Connectivity

Item	% Agreement		κ		CI	
	Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
Destination - Connectivity						
Curbside Parking	100	94	1.00	0.0	.61, 1.00	NA
Parking behind buildings	100	100	NA	NA	NA	NA
Parking between street & bldg	100	94	1.00	0.0	.61, 1.00	NA
Parking lot	89	100	-.06	NA	-.45, .32	0.0, 0.0
No commercial/retail	83	83	.47	-.08	.09, .85	-.44, .28
Segment End	100	--	NA	--	NA	--
Presence of Transit Stops	94	--	0.0	--	NA	--
Destination – Facilities						
Restrooms	100	--	NA	--	NA	--
Services (see Bldg counts)						

T-tests were NA when they could not be computed due to lack of observations
Kappa was NA when there was no variability