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The Stanford Healthy Neighborhood Discovery Tool:

A Computerized Tool to Assess Active Living Environments

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Abstract

Background—The built environment can influence physical activity, particularly among older populations with impaired mobility. Existing tools to assess environmental features associated with walkability are often cumbersome, require extensive training, and are not readily available for use by community residents.

Purpose—This project aimed to develop and evaluate the utility of a computerized, tablet-based participatory tool designed to engage older residents in identifying neighborhood elements that affect active living opportunities.

Methods—Following formative testing, the tool was used by older adults (aged ≥ 65 years, in 2011) to record common walking routes (tracked using built-in GPS) and geocoded audio narratives and photographs of the local neighborhood environment. Residents (N=27; 73% women; 77% with some college education; 42% used assistive devices) from three low-income communal senior housing sites used the tool while navigating their usual walking route in their neighborhood. Data were analyzed in 2012.

Results—Elements (from 464 audio narratives and photographs) identified as affecting active living were commensurate with the existing literature (e.g., sidewalk features, aesthetics, parks/playgrounds, crosswalks). However, within each housing site, the profile of environmental elements identified was distinct, reflecting the importance of granular-level information collected by the tool. Additionally, consensus among residents was reached regarding which elements affected active living opportunities.

Conclusions—This tool serves to complement other assessments and assist decision makers in consensus-building processes for environmental change.

Background

There is growing national consensus that the built environment must be redesigned to optimize active living.^{1–5} However, it remains unclear which environmental features best

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support this goal⁶ and how to prioritize environmental changes so that they reflect the needs of the local community. New methods of cost-efficient data collection are needed that can generate local, relevant data to foster community-focused planning and policy solutions.⁷ Unfortunately, tools used to assess active living environments are often insufficient for informing local-level change: they are often cumbersome and can require intensive training^{8,9}; self-report measures often are not correlated with objective measures¹⁰; GIS-based measures are often inaccessible, and microscale data unavailable to identify specific community needs.

This article reports on the development and deployment of the Stanford Healthy Neighborhood Discovery Tool (referred to hereafter as the Discovery Tool), a computerized, tablet-based participatory tool designed to assist residents in identifying neighborhood features that affect active living. Specifically, this paper reports on the following aspects of the Discovery Tool: (1) the development and design process; (2) the process of identification of neighborhood features by residents; and (3) its performance in capturing consensus among residents.

Methods

Tool Development

A community-based participatory research¹¹ orientation and an iterative user-centered design process¹² were used for development (Figure 1). The planning group included an academic–community partnership with the San Mateo County CA Health Department and other local officials in transportation, aging, and housing, in addition to local housing coalitions, public housing management, and community residents.

The target user group was low-income, racial/ethnic-minority older adults (aged ≥ 65 years), the segment of the U.S. population that is most physically inactive.^{13,14} This population has been shown to have higher levels of physical activity when living in pedestrian-friendly “walkable” urban neighborhoods and yet have unique challenges with many urban elements, such as traffic and safety levels.^{15–19} Initial design was driven by informal observations of community-conducted PhotoVoice activities²⁰ and traditional pen-and-paper audits⁷ with residents and local decision makers. Paper prototypes²¹ and an electronic prototype of the Discovery Tool underwent user testing (with six residents) to improve the user interface, device wearability, and user training.

Tool Description

The Discovery Tool is a computerized, handheld tablet–based environment assessment tool that provides contextual (i.e., microscale) data about walking routes; environmental features (e.g., sidewalks, crosswalks); and destinations. Users are prompted to collect geocoded audio narratives and photographs about neighborhood features they perceive as affecting their active living choices. Quantitative data were also collected via a built-in 25-item post-assessment survey.

The Discovery Tool operates on Android 2.3 and newer Google platforms and was optimized for viewing on the Samsung Galaxy Tab 7.7. The Discovery Tool was based on traditional PhotoVoice methodology but leverages mobile technology to track routes walked using GPS and records geocoded audio narratives and photographs. Users reported preferring the 7-inch tablet to a smartphone (which is harder to grasp and has small buttons) or full-sized tablet (which is more cumbersome to carry). Tablets were equipped with wired, clip-on microphone Skullcandy® earbuds for audio instructions and were worn around the neck in a plastic and waterproof MZ Services protective case to allow users to walk hands-free.

Participants

Participants qualified for U.S. Department of Housing and Urban Development low-income housing and resided in three senior housing sites in three San Francisco peninsula-region cities: South San Francisco (40 units); Menlo Park (93 units); and San Mateo (200 units). Participants were recruited after onsite demonstration of the tool and explanation of the study. Residents learned about these demonstrations via housing management and flyers posted onsite. This project was ruled exempt by the local IRB given its focus on neighborhood characteristics (no private, identifiable information was collected).

Neighborhood Assessment Procedures

Residents conducted environmental assessment of the neighborhood surrounding their housing site. Their participation lasted 1 hour and consisted of: (1) training on how to use the Discovery Tool (15 minutes); (2) the environmental assessment (up to 30 minutes); (3) data collection review (5 minutes); and (4) post-assessment survey (10 minutes). Residents were asked to conduct the assessment by navigating their "usual" walking route through their neighborhood (i.e., routes used for leisure, to access transportation or destinations), originating from their housing site. Participants were given a \$10 gift card for participation. Data were collected in 2011.

Data Analysis

Audio narratives and photographs were downloaded for data analysis. The researchers used both inductive and deductive analytic strategies^{22–24} to code the audio narratives and photographs, and they followed recommended procedures^{25,26} to ensure that the coded elements were “believable, accurate, and right.”²⁶ Two coders with expertise in environmental research and not involved in the data collection process independently provided an initial review of the raw data and then met to discuss similarities and differences observed in data coding. A coding schema was generated based on these discussions and existing environmental audit tools.^{27–29} Two additional coders reviewed the schema for construct validity, and four additional coders joined research meetings to discuss the schema.

Data were divided evenly across eight coders such that each audio narrative and photograph was independently reviewed twice (coders spent 4–6 hours to complete this process). A full discussion of the inter-rater reliability of the coding is beyond the scope of this paper and is discussed elsewhere.³⁰ Briefly, for both the audio narratives and photographs, inter-rater reliability was high, with observed agreement of >90%, and prevalence- and bias-adjusted kappa >0.80.

The quantitative analyses of the audio narrative and photographic elements were descriptive. Total frequency refers to overall prevalence of coded neighborhood elements, with more than one instance of a coded element included for each participant. Subject-level frequency refers to the number of participants recording the coded element (for this variable, only one instance of an element was allowed for each participant). Site-level frequency, or “consensus” was defined in legislative procedure terms³¹ such that a supermajority (67%) of participants were needed to identify the coded element for positive consensus, and 33% of participants were needed to identify the coded element for negative consensus. Data were analyzed in 2012.

Results

Participants

Community residents (N=27) conducted neighborhood assessments around three senior housing sites in the San Francisco peninsula region: South San Francisco ($n=7$); Menlo Park ($n=9$); and San Mateo ($n=11$). Participants were English-speaking, primarily women (73%), aged 65–89 years (92%, with two aged 90 years); non-Hispanic white (58%); and with some college education (77%). A number of participants (42%) reported using an assistive device (e.g., walker, scooter, wheelchair) and did so while completing their neighborhood assessment.

Descriptive Geographic, Audio Narrative, and Photographic Data

Residents walked, on average, 1.0 ± 0.6 km (0.6 ± 0.4 miles), and the large majority of residents (89%) did not travel beyond a four-block radius from their residence. A total of 116 audio narratives and 126 photographs were captured. Participants recorded, on average, 3.5 ± 3.5 audio narratives (mean length: 29.7 ± 17.7 seconds) and 4.9 ± 3.6 photographs during their neighborhood assessment. The qualitative analysis yielded a total of 19 coded elements: nine present in the audio narratives and photographs (shared elements); five in audio narratives only (unique elements); and five in photographs only (unique elements). Coded elements had both positive (i.e., facilitators of active living) and negative (i.e., barriers to active living) valences. Because many audio narratives and photographs contained multiple coded elements, 464 total coded elements were included in the analyses.

Neighborhood Elements Identified

Table 1 provides descriptive information about the content of the audio narratives and photographs. Using the audio narratives, participants recorded a relatively equal number of facilitators (52%) and barriers (48%). The most common audio-captured facilitators were aesthetics (e.g., presence of trees, flowers); parks/playgrounds (e.g., walking paths, public garden); amenities/destinations (e.g., shops, restaurants, public services); personal safety (e.g., “crime free,” “upscale living”); and sidewalk features (e.g., convenient routes, well kept).

The most common barriers were negative sidewalk features (e.g., cracks, unevenness); personal safety issues (e.g., afraid of being hit by a vehicle); disability issues (e.g., street not suitable for wheelchair or walker, lack of ramps); crosswalk limitations (e.g., cars do not stop, signals inoperable); and road safety (e.g., speeding cars, blind driveways). Using photographs, participants recorded more facilitators (76%) than barriers (24%). The most common facilitators were aesthetics, sidewalk features, crosswalks, parks/playground, and trails/paths, respectively. The predominant barrier was negative sidewalk features.

Housing Site–Level Comparisons and Local Consensus

Subject-level frequencies and percentages of coded elements are displayed by housing site in Table 2. Supermajority consensus (67% of residents at the given site recording the element) was reached for five housing site–specific elements overall: one at South San Francisco, three at Menlo Park, and one at San Mateo. These elements included positive aesthetics, attractive amenities/destinations, and deleterious sidewalk features. Negative consensus (33% of residents at the given site recording the element) was high for all three sites, indicating that residents could largely agree on what was not important for active living (e.g., public transportation, crime, parking). Total consensus (reflective of combining elements reaching either supermajority or negative consensus) was 90% at South San Francisco and Menlo Park sites, and >70% for the San Mateo site.

Discussion

Participatory data collection methods offer a potentially cost-efficient way to capture data on neighborhood environments. The Discovery Tool engages individuals in the environmental assessment process and can help them reach consensus in identifying active living facilitators and barriers. The Discovery Tool produced similar results to those that have been identified through more-complex and time-intensive methods.

The most common features identified were aesthetics, sidewalk features, and parks/playgrounds. Pleasant scenery (i.e., aesthetics)^{32,33} and access to suitable walking paths³⁴ have been found to be primary drivers of physical activity in midlife and among older adults. Finally, given that a relatively high proportion of the sample relied on an assistive device for ambulation (42%), sidewalk quality was cited as a common barrier. Lighting conditions did not emerge as an important feature, perhaps due to the time of day assessments were conducted or the fact that mobility-impaired older adults may not venture into the neighborhood at night.

Although distinctions occurred among housing sites, there was consensus among residents within housing sites concerning which features affected active living. For example, at the Menlo Park site, only two facilitators (aesthetics and amenities/destinations) and one barrier (sidewalk features) were identified by 67% of residents, suggesting a high level of consensus for the importance of a relatively few number of elements. Conversely, there was a large percentage of elements (84%) deemed unimportant to active living (i.e., negative consensus), suggesting that resources should not be expended within these areas. Finally, consensus was not reached, either positive or negative, for only 8% of elements, suggesting that there was little ambiguity as to which elements were and were not important. These types of metrics give decision makers clear messages about the key areas where improvements are needed.

Limitations

Limitations of the study are small sample size, both within neighborhoods and for housing sites, thus limiting generalizability. Moreover, although the sample was ethnically diverse and of lower SES, participants had a relatively high education level. Finally, because residents were instructed to take their “usual” walking route, all residents did not travel the same path; thus, the authors are unable to make conclusions about specific street segments or less-traveled portions of a neighborhood.

Future Directions

Future directions for the Discovery Tool are to explore alternative methods for classifying the audio narratives and photographs, such as utilizing “lay coders” through crowd-sourced methods (e.g., Amazon Mechanical Turk) or asking users to “self-classify” data based on predefined categories. Also, additional modules could be added that assess various behaviors and contexts (e.g., food, home, school, worksite); population subgroups; and platforms (e.g., basic cellular phones, smartphones). Further refinements of the Discovery Tool are already underway, and beta testing is ongoing. The Discovery Tool will subsequently be available to researchers as a licensed product and interested readers may contact the authors directly.

Conclusion

The Discovery Tool represents a new type of environmental assessment tool that complements existing tools by engaging participants in the data collection process, thereby generating common walking routes and geocoded audio narratives and photographs. These

new types of data-capture tools can help to provide the compelling illustrative examples needed to prioritize and build consensus for change.

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Figure 1.
Stanford Healthy Neighborhood Discovery Tool development process

Table 1

Total frequency^a of coded elements for audio narratives and photographs, ^b *n* (%)

	Audio narratives		Photographs		Total
	Facilitators	Barriers	Facilitators	Barriers	
<i>n</i>	166	151	111	36	464
Shared elements^c					
Sidewalk features	10 (6.0)	49 (32.5)	14 (12.6)	28 (77.8)	101 (21.8)
Public transportation	3 (1.8)	3 (2.0)	0 (0.0)	0 (0.0)	6 (1.3)
Stop light or stop sign	0 (0.0)	5 (3.3)	7 (6.3)	0 (0.0)	12 (2.6)
Aesthetics	60 (36.1)	5 (3.3)	34 (30.6)	3 (8.3)	102 (22.0)
Traffic volume	1 (0.6)	4 (2.6)	2 (1.8)	1 (2.8)	8 (1.7)
Crosswalk	8 (4.8)	12 (7.9)	12 (10.8)	1 (2.8)	33 (7.1)
Park/playground	30 (18.1)	9 (6.0)	12 (10.8)	0 (0.0)	51 (11.0)
Amenities/destinations	27 (16.3)	3 (2.0)	7 (6.3)	1 (2.8)	38 (8.2)
Disability issues	4 (2.4)	18 (11.9)	5 (4.5)	0 (0.0)	27 (5.8)
Unique elements^d					
Crime	3 (1.8)	1 (0.7)	—	—	4 (0.9)
Street lighting	3 (1.8)	2 (1.3)	—	—	5 (1.1)
Road safety	2 (1.2)	10 (6.6)	—	—	12 (2.6)
Parking	4 (2.4)	6 (4.0)	—	—	10 (2.2)
Personal safety	11 (6.6)	24 (15.9)	—	—	35 (7.5)
Another person	—	—	1 (0.9)	1 (2.8)	2 (0.4)
Private residence	—	—	4 (3.6)	0 (0.0)	4 (0.9)
Street features	—	—	2 (1.8)	0 (0.0)	2 (0.4)
Construction	—	—	0 (0.0)	1 (2.8)	1 (0.2)
Trail/path	—	—	11 (9.9)	0 (0.0)	11 (2.4)

^aTotal frequency refers to overall prevalence of coded elements, with more than one instance of a coded element included for each participant.

^bIn total, 116 audio narratives and 126 photographs were captured by participants. Multiple coded elements were present in each of the audio narratives and photographs.

^cElements that were present in both the audio narratives and photographs

^dElements that were present in only the audio narratives or only the photographs

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Table 2
Subject-level frequencies (%)^a and consensus ratings of the coded elements,^b by housing site

	South San Francisco (n=7)		Menlo Park (n=9)		San Mateo (n=11)	
	Facilitators	Barriers	Facilitators	Barriers	Facilitators	Barriers
Shared elements						
Sidewalk features	2 (28.6)	3 (42.9)	5 (55.6)	7 (77.8)	8 (72.7)	5 (45.5)
Public transportation	1 (14.3)	1 (14.3)	1 (11.1)	0 (0.0)	0 (0.0)	1 (9.1)
Stop light or stop sign	1 (14.3)	0 (0.0)	3 (33.3)	1 (11.1)	2 (18.2)	2 (18.2)
Aesthetics	6 (85.7)	2 (28.6)	8 (88.9)	3 (33.3)	7 (63.6)	2 (18.2)
Traffic volume	0 (0.0)	2 (28.6)	2 (22.2)	1 (11.1)	1 (9.1)	0 (0.0)
Crosswalk	2 (28.6)	0 (0.0)	4 (44.4)	3 (33.3)	4 (36.4)	4 (36.4)
Park/playground	3 (42.9)	0 (0.0)	3 (33.3)	2 (22.2)	7 (63.6)	3 (27.3)
Amenities/destinations	4 (57.1)	2 (28.6)	6 (66.7)	1 (11.1)	4 (36.4)	1 (9.1)
Disability issues	1 (14.3)	0 (0.0)	1 (11.1)	2 (22.2)	5 (45.5)	2 (18.2)
Unique elements						
Crime	1 (14.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (9.1)	1 (9.1)
Street lighting	0 (0.0)	0 (0.0)	1 (11.1)	1 (11.1)	0 (0.0)	0 (0.0)
Road safety	1 (14.3)	1 (14.3)	0 (0.0)	2 (22.2)	0 (0.0)	2 (18.2)
Parking	0 (0.0)	0 (0.0)	0 (0.0)	1 (11.1)	0 (0.0)	1 (9.1)
Personal safety	2 (28.6)	0 (0.0)	1 (11.1)	5 (55.6)	2 (18.2)	5 (45.5)
Another person	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (9.1)	1 (9.1)
Private residence	1 (14.3)	0 (0.0)	1 (11.1)	0 (0.0)	1 (9.1)	0 (0.0)
Street features	0 (0.0)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)	0 (0.0)
Construction	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (9.1)
Trail/path	3 (42.9)	0 (0.0)	0 (0.0)	0 (0.0)	3 (27.3)	0 (0.0)
Consensus						
Positive ^c	1 (5.3)	0 (0.0)	2 (10.5)	1 (5.3)	1 (5.3)	0 (0.0)
Negative ^d	15 (78.9)	18 (94.7)	15 (78.9)	17 (89.5)	12 (63.2)	16 (84.2)
Total ^e	33 (89.5)		32 (92.1)		28 (74.4)	

^aNumber of participants recording the coded element

^bAudio narrative and photographs have been collapsed together.

^cRecorded by supermajority (67%) of residents

^dRecorded by 33% of residents

^ePositive and negative consensus combined, collapsed across facilitators and barriers