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Virtual and Actual: Relative Accuracy of On-Site and Web-based Instruments in Auditing the Environment for Physical Activity

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Abstract

Objectives—To assess the relative accuracy and usefulness of web tools in evaluating and measuring street-scale built environment characteristics.

Methods—A well-known audit tool was used to evaluate 84 street segments at the urban edge of metropolitan Boston, Massachusetts, using on-site visits and three web-based tools. The assessments were compared to evaluate their relative accuracy and usefulness.

Results—Web-based audits, based-on Google Maps, Google Street View, and MS Visual Oblique, tend to strongly agree with on-site audits on land-use and transportation characteristics (e.g., types of buildings, commercial destinations, and streets). However, the two approaches to conducting audits (web versus on-site) tend to agree only weakly on fine-grain, temporal, and qualitative environmental elements. Among the web tools used, auditors rated MS Visual Oblique as the most valuable. Yet Street View tends to be rated as the most useful in measuring fine-grain features, such as levelness and condition of sidewalks.

Conclusion—While web-based tools do not offer a perfect substitute for on-site audits, they allow for preliminary audits to be performed accurately from remote locations, potentially saving time and cost and increasing the effectiveness of subsequent on-site visits.

Introduction

The relationships between the built environment and physical activities have attracted the interest of researchers and planners from disciplines that include public health, urban design, and transportation planning. An ongoing challenge in this line of research is the development of reliable and valid micro-scale measures of pedestrian and street environments that may influence behaviors such as walking and bicycling for utilitarian or recreation purposes (Ewing et al., 2006; Forsyth et al., 2008; Lovasi et al., 2009). As part of this research effort, researchers have developed and tested several audit tools aimed at assessing the physical qualities of the built environment (especially street scale) by visiting sites in the field (Fänge and Iwarsson, 1999; Hoehner et al., 2005; Pikora et al., 2002; Moudon and Lee, 2003; Brownson et al., 2004a; Brownson et al., 2004b).

Planners and researchers now have a set of powerful tools, developed for general use or specifically for planning purposes, to help design, visualize, and study the implications of urban planning approaches (Mitchell, 2003; Zeile et al., 2007; Batty, 2007). In particular, Google Maps™ mapping service and Google Street View™ mapping service, which integrate photos in a geospatial framework, provide a rich experience of visual evidence in a study area (O'Reilly, 2006; Ratti and Berry, 2007; Ben-Joseph, 2011). At present, web-based urban imaging tools have become an important resource available to all. More practitioners, researchers, and students are relying on web tools, such as Google Maps, Google Street View, and Microsoft Oblique Viewer, to perform quantitative and qualitative audits and assessments of sites remotely before visiting them or as a substitute for visiting a site at all. Evidence of the widespread use of these tools is Planetizen, a leading urban information exchange portal, offering courses on the use of Google Maps for urban planning (Planetizen, 2009). Each of the three tools provides views of the street environment.

Google Maps provides two-dimensional aerial photographs with streets and roads labeled by name. It also includes information about the direction of traffic (one-way or two-way), public transit, and the presence of destinations, such as retail shops, parks, and hospitals. In addition, its distance measurement tool allows users to take measurements of built environment attributes such as “building setback” and “width of the street and sidewalk”.

Google Street View provides street-level images. These images replicate an “eye level” experience, allowing the user to virtually walk down the street. These images not only provide information about detailed urban features such as “road material”, and “relative height of trees” but also convey qualitative information about the site such as “comfort level” and “aesthetics”.

Microsoft Oblique Viewer (Bing Maps) provides a bird’s-eye view from a low viewing angle, providing three-dimensional information about a site. These images show the height of buildings and trees, clearly depict building setbacks and reveal the presence of detailed features such as fences, streetlights and benches.

Though the data generated by traditional on-site audit tools generally appears accurate, auditing large numbers of street segments can be time- and cost-intensive. The use of web tools may reduce costs of on-site auditing, while generating valid data. Despite the

convenience of these web-based tools, few studies have examined their strengths and limitations in auditing quantitative and qualitative urban features of a given site. In the study of public open space quality in Sydney, Australia, investigators compared a remote-assessment with Google Earth Pro to direct observation (Taylor et al., 2011). Their analysis found that a remote-access method can provide a reliable and time-efficient alternative to direct observation. Clark et al. (2010) evaluated the reliability of a virtual audit instrument, using Google Street View, and found that Google Street View was a reliable method for measuring recreational facilities and general land use. However, the virtual tool was less reliable auditing fine-grain features. Assessing the level of agreement between on-site and web-based (using Google Street View) audits, Badland and colleagues (2010) revealed that a web-based audit can save time, while demonstrating acceptable agreement with an on-site audit. Comparing in-person and Google Street View-based audits on neighborhood characteristics, Rundle et al. (2011) found a high level of concordance for measures of pedestrian safety, traffic and parking, and infrastructure for activity. However, “temporal” (likely to move or change within 1 week) or “small” (smaller than a backpack) features had lower levels of concordance. While these studies investigated the accuracy of web-based audit instruments, none of them comprehensively employed multiple web-based tools available online, comparing their usefulness.

To examine the potential of web-based tools for substituting or complementing on-site visits and assessment, this study compared two separate audit approaches – (1) on-site and (2) web-based, simultaneously using Google Maps, Google Street View, and Microsoft Visual Oblique – in order to evaluate the extent to which on-site and web-based audits agree. Then, we compared the three web tools’ usefulness, rated by auditors while conducting the web-based audit.

Methods

Audit Instruments

Two instruments were developed to conduct the on-site and web-based audits, based on two established audit instruments developed by Brownson et al (2004). The instruments cover 6 major domains – land-use environment, transportation environment, recreational facilities, physical disorder (aesthetics), signage, and social environment. Items pertaining to transportation environment and social environment domains utilize Likert-scale and ordinal response choices, designed to capture variation across street segments. The items are designed to assess the quantitative physical features of the site such as “the approximate width of the sidewalks.” Items for land-use environment, recreational facilities, aesthetics, and signage domains contain dichotomous response choices (e.g., visible/not visible), since these questions simply ask whether a rater can identify certain physical elements (e.g., single-family homes, supermarket, and library) and qualitative features (e.g., attractive features and physical disorder).

While the on-site and web-based versions of the audit tool contained identical items in the 6 domains, the web-based instrument included additional questions to evaluate the usefulness of the three web tools, Google Maps, Google Street View, and Microsoft Visual Oblique, in answering each item (i.e., not used, not useful, somewhat useful, and very useful). Auditors

conducted the web-based audits, using the three web tools simultaneously, and then, compared the usefulness of the web-based tools, in completing individual items. Hence, the evaluation of web-based audits was intended to measure (1) relative accuracy – i.e., treating the on-site audits as the “gold standard” and testing accuracy of the web-based audits – as well as (2) usefulness of the three web tools.

Selection of Study Areas

This evaluation of Google Maps, Google Street View, and Microsoft Visual Oblique was part of a larger study designed to examine cross-sectional relationships between objective built environment characteristics and physical activity in suburban communities. To test these tools, street segments were identified for 21 participants in the larger study who resided at locations 10-20 miles north, west, and south of downtown Boston. The nearest street intersection to each respondent's geocoded address was used to map street segments within 1000 m of the intersection. A total of 84 suburban residential street segments were audited.

Training

A protocol for audit-tool data collection was developed to address both on-site audit issues (e.g., safety) and web-based issues (e.g. use of software interface). Four auditors participated in a one-day training session that covered audit protocols. The training also included on-site and web-based audits of one street segment not included in the study.

Data Collection

During the summer of 2010 each auditor was required to conduct two separate audits (a web-based audit and an on-site audit) on a single street segment within each buffer for one participant-resident. The auditors produced a single web-based audit dataset by utilizing all three web tools (Google Maps, Google Street View, and Microsoft Oblique Viewer) simultaneously. When producing the web-based dataset, the auditors evaluated the usefulness of each web tool. This phase was prerequisite to conducting the on-site audit. Most planning professionals compile some level of information about a site from published maps or the Internet before actually visiting it. For this reason, we decided to follow the same approach and conduct the web-based audits before the actual visit.¹ Auditors were also required to rate the relative usefulness of each web tool in providing the evaluation.

Data Editing and Analysis

Data on individual street segments were coded and combined into two datasets in Microsoft Excel – the on-site and web-based audit databases – and subsequently reviewed for missing and miscoded data. The two audit files were combined, matching unique identifiers for individual street segments. Text responses were recoded into numeric values (e.g., visible = 1, not visible = 0; none = 0, a little = 1, some = 2, a lot = 3). The final dataset was exported into Stata 10.1 for statistical analyses. We used kappa to measure the strength of agreement between on-site and web-based audits. Kappa can vary from -1.0 (complete disagreement) to

¹Web audits were conducted between July 28, 2010 and July 28, 2010. Site audits were conducted from August 2, 2010 to August 5, 2010, as well as from September 7, 2010 to September 11, 2010. All observations occurred between 10AM-3:00PM.

+1.0 (complete agreement). Negative kappa values indicate the level of agreement was below that expected by chance. Landis and Koch have classified kappa coefficients as follows: < 0.20 (poor), 0.21 – 0.40 (fair), 0.41 – 0.60 (moderate), 0.61 – 0.80 (substantial), 0.81 – 1.00 (almost perfect) (Landis and Koch, 1977).

Cohen's kappa was also used to compare the usefulness of the three web tools. While conducting the single web-based audit, the usefulness of each web tool for each audit item was scored on four-point scales (extremely not useful = 0, not useful = 1, somewhat useful = 2, and very useful = 3). In this ordinal case, a weighted kappa is necessary, since the distance (or difference) between “extremely not useful (0)” and “very useful (3)” is greater than the distance between “extremely not useful (0)” and “not useful (1).” We applied a weight matrix, assuming the linear increase of distances between response categories. With k ordinal categories, the maximum distance between any two categories is $k-1$, which is equal to 3 in this case. Hence, the weight for any particular cell in the weight matrix is: $1 - (\text{distance} / \text{maximum possible distance})$. For example, the distance between “extremely not useful (0)” and “not useful (1)” is equal to 1, and therefore its weight is: $1 - (1 / 3) = 0.67$. We also used the weighted kappa statistics for other ordinal responses in the transportation environment and social environment domains, using similar linear weighting matrixes.

Results

Comparison of On-site and Web-based Audits

Table 1a shows the levels of agreement between on-site and web-based audits for land-use environment. The first question, which assesses land-use environments, finds substantial agreement between the two audit approaches. Among 55 items on specific destinations, agreement between the on-site and web-based tools was moderate for 17 items and substantial for 13 items. The strength of agreement on destinations that are rarely observed in suburbs, such as schools, universities, and mountains was poor or fair for 16 out of 55 items. The agreement on post office, library, and museum was almost perfect for 4 items. In identifying hidden from view features, such as outdoor pools and small bodies of water, the web-based audits tend to be better than the on-site audits.

The agreement on the overall availability of alternative transportation modes is moderate (the first item in Table 1b). Among 23 transportation environment items, the strength of agreement on the presence, location, and width of sidewalks and bike lanes, as well as street design characteristics to reduce traffic speed, availability of on-street parking, and pedestrian safety features was moderate for 2 items, substantial for 8 items, and almost perfect for 1 item. However, the two audit approaches tended to agree poorly on the questions about fine-grain features such as continuity of sidewalks and bike lanes, obstruction and levelness of bike lanes, the presence of bike racks, the presence of traffic calming devices, and aggressive drivers. Out of 23 items, 7 had “poor” agreement and 3 items had “fair” agreement.

In Table 1c with 13 items on facilities, the kappa coefficients of the first two questions that asked about overall visibility of recreational facilities were moderate or fair. Among the 11 specific items, the levels of agreement on fine-grain facilities were generally low: poor or

fair for 8 items. Likewise in Table 1d agreement levels of the first two questions that assessed overall visibility of aesthetic features are moderate. Kappa coefficients on physical fine-grain aesthetic features were poor for 9 out of 10 items.

In Table 1e, the agreement on the visibility of signage was also poor or fair for 13 out of 15 items. The percentages in which the on-site audit identifies signs were higher than those of the web-based audit. These results indicated that the agreement between the two audits on micro-scale features tended to be poor, while the on-site audit was more useful than the web-based on in identifying signage. The agreement between the two audits on all 9 questions in the social environment domain was poor (Table 1f), which implied that the web tools are weak in detecting daily activities: the percentages for which web tools identify no activities range from 95.2 to 100.

Ratings of Usefulness for Google Maps, Google Street View, and MS Visual Oblique

MS Visual Oblique was generally rated as the most useful tool, followed closely by Google Maps (see Table 2a-c). Google Street View was rated as the least useful tool. However, Google Street View was rated as more useful than Google Maps in measuring micro features, such as levelness and condition of sidewalks, obstructions, and presence of bike racks (Table 2b), as well as in identifying physical disorder and signage (Table 2c).

Agreement of Google Maps, Google Street View, and MS Visual Oblique

For the seven land-use environment items (Table 2a), the pair-wise kappa coefficients between Google Street View and Google Maps and between Google Street View and MS Visual Oblique were all poor. The agreement between Google Maps and MS Visual Oblique on land-use environment was “substantial” for 5 items and “moderate” for 2 items.

Pair-wise kappa coefficients for Google Street View and Google Maps ratings of 23 transportation items was moderate for 2 items, fair for 9 items and poor for 12 items (Table 2b). For Google Street View and MS Visual Oblique, kappa coefficients were poor or fair for 16 out of 23 items. The agreement between MS Visual Oblique and Google Maps on transportation environment was moderate for 2 items, substantial for 12 items, and almost perfect for 9 items.

Evaluating the three items on facilities (Table 2c), the usefulness ratings of Google Street View agree with Google Maps poorly for all 3 items, as well as agree with MS Visual Oblique poorly for 2 items and moderately for 1 item. Agreement between MS Visual Oblique and Google Maps was substantial for 2 items and almost perfect for 1 item.

For the four aesthetics items (Table 2d), the agreement between usefulness ratings of Google Street View and Google Maps was “poor” for all 4 items. For Google Street View and MS Visual Oblique, the kappa coefficients are also poor for 4 items. Agreement between MS Visual Oblique and Google Maps are moderate for 3 items and substantial for 1 item.

For the single item on signage (Table 2e), the usefulness ratings of Google Street View agree poorly with Google Maps, as well as MS Visual Oblique. Yet the agreement between MS Visual Oblique and Google Maps was moderate. Lastly, the kappa coefficients on the

social environment item are “poor” (Google Street View and Google Maps), “fair” (Google Street View and MS Visual Oblique), and “almost perfect (MS Visual Oblique and Google Maps).

Discussion

For evaluating the effects of the built environment on physical activities, it is essential to improve and explore new measurement methods to assess environmental characteristics. We compared on-site and web-based (using Google Maps, Google Street View, and MS Visual Oblique) audits, evaluating 84 street segments at the urban edge of metropolitan Boston. The usefulness ratings of the three web tools were also compared. Web-based technologies have made web-based audits a viable option. A few studies have tested the accuracy of Google Earth and Google Street View as audit tools, concluding that virtual audits based on the two web tools are generally valid and save cost and time, compared to on-site audits (Badland HM et al 2010; Clarke et al. 2010; Rundle AG et al. 2011; Taylor et al., 2011). These studies also found that web-based audits are not adequately accurate measuring micro-scale features, such as garbage, litter, or broken glass. Our results are consistent to the previous findings. The three web-based tools offer relatively accurate instruments for auditing street-level environments, but are less effective measuring temporal and fine-grain features. We also identified different levels of usefulness among the three tools: Google Earth and MS Visual Oblique are generally more useful than Google Street View as an audit instrument. However, Google Street View was more useful measuring small features than the other two tools.

The web tools tend to be effective for capturing elements in land-use environment, transportation environment, and recreational facilities, while less effective measuring aesthetics features and aspects of the social environment. This is indicated by relatively stronger agreement between on-site and web-based audits on land-use environment, transportation environment, and recreational facilities than those on aesthetics and social environment. Another advantage of web-tools is their capability of showing adjacent areas that are not physically assessable or partially hidden, such as private pools and small ponds. In general, web tools are useful in measuring street-scale (i.e., presence of sidewalks, facilities, etc.) environment, whereas less useful in identifying fine-grain features (i.e., sidewalk levelness, signage, etc.). Another drawback of the web tools, which use snapshots of the built environment, is that they cannot capture non-static aspects of environments, such as time of day and year, social activities, or buildings undergoing construction, and other qualitative features like level of congestion, physical disorder, etc. More generally, on-site audit provides a better understanding of context for a streetscape because auditors have to travel through neighboring areas to reach specific street segments. This process may be more difficult or omitted with the web tools.

Among the three web tools, auditors generally found MS Visual Oblique to be the most useful one, since it provides not only a bird's eye view of study areas, but also elevations of buildings from different angles. Google Maps, which shows aerial images on the top, was rated as the second most useful. Google Street View, although offering virtual eye-level experiences of streets, was generally perceived as the least useful tool. In particular, when

identifying land-use characteristics, Google Street View tends to be ineffective, not providing the bird's-eye view of segments. Yet Google Street View tend to be rated as more useful than Google Maps in measuring fine-grain features, such as levelness and condition of sidewalk, or obstructions, by providing closer views of streetscapes. Due to this unique nature of Google Street View, ratings of built environment characteristics using this tool tend to be in weak agreement with ratings based on Google Maps, as well as MS Visual Oblique. In contrast, ratings of built environment characteristics using Google Maps and MS Visual Oblique, both viewing environments from the air, tend to strongly agree. This suggests that the combination of the three web tools may help auditors establish a comprehensive understanding of environmental characteristics, since the strength of each web tool lies in different aspects of environments. Overall, while web-based tools do not offer a substitute for an actual on-site audit, they do allow for preliminary audits to be performed accurately from remote locations, potentially saving time and cost and supplementing an actual site visit.

However, we find that there are several limitations of using web tools to evaluate attributes of a street segment. First, the evaluation is highly dependent on when the images are taken by the administrators of the web tool. The time when the images are taken is not noted. Therefore, any current changes on the site might not be reflected in these web images. Hence, web tools are generally useful for static elements, but not effective in capturing transient features or recent modifications in the built environment, such as sidewalk improvements. Second, the resolution of internet images is limited, making it more difficult for planners and designers to evaluate detailed urban features such as sidewalk conditions or signage. This results in the ineffectiveness of web tools in measuring fine-grain features.

It is possible to envision a future in which the process of computer recognition of specific features in the built environment will be automated. One could forecast that a computer algorithm could be developed to scan images on Google Street View and identify all streets that have sidewalks with curbs, streetlights, or curb parking. An example of this process can be seen in the work of image/object recognition. For example, recent developments in this field have yielded interesting results in describing the contents of images (GWAP, 2011; LabaleME, 2011; Mechanical Turk, 2011). Object recognition will allow users to access a vast amount of image data and organize it (or have the computer organize it) through numerous associations. For example, images can be arranged and retrieved according to their association with a particular land use such as a store, mid-rise housing, etc. Or they can be stratified and recalled according to a specific feature or color, for example a lamppost, a pine tree or a wooden bench. Such tools would provide an added dimension by which web images could be used by researchers to evaluate the built environment without the need to physically visit neighborhood sites.

Limitations and Future Research

While availability and usefulness of web tools differ across the types of neighborhoods (e.g., urban, suburban, rural), our analysis includes only the limited number of observations in a relatively homogenous area. For example, Google Street View is not available in some suburban local neighborhoods, while it covers most urban streets.

Our research can be expanded in two important ways. It would be important to test the possibilities of user-based input tools (e.g., image/object recognition tools, tagging by users) in capturing qualitative and temporal features of neighborhood environments and their potential for site audits. Second, we will develop flexible audit tools that can be adapted to diverse neighborhood types (e.g., urban or suburban), so as to expand the geographic coverage of our analysis, reflecting idiosyncratic features of neighborhood types.

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Table 1a**Agreement between On-Site and Web-based Audits on Land Use Environment**

LAND USE ENVIRONMENT	<i>On-site, Visible % (n)</i>	<i>Web-based, Visible % (n)</i>	<i>Observed Agreement</i>	<i>Kappa</i>
Are residential and non-residential land uses visible in this segment?	29.76 (25)	27.38 (23)	90.48	0.77
What types of Buildings or features are presented in this segment?				
a. Single-family home?	89.29 (75)	94.05 (79)	92.86	0.54
b. Two-, three-, four-, five-, or six-family home?	15.48 (13)	25.00 (21)	83.33	0.49
c. Apartment building/complex or condominium?	8.33 (7)	11.90 (10)	91.67	0.54
d. Apartment over retail in multi-story building?	3.57 (3)	5.95 (5)	97.62	0.74
e. Mobile home or trailer?	0 (0)	0 (0)	-	-
What types of commercial destinations are visible in this segment?				
a. Gas station?	3.57 (3)	2.38 (2)	98.81	0.79
b. Fast food restaurant?	10.71 (9)	9.52 (8)	94.05	0.67
c. Other restaurants?	10.71 (9)	8.33 (7)	92.86	0.59
d. Conveniences or small grocery store?	7.14 (6)	7.14 (6)	95.24	0.64
e. Supermarket?	2.38 (2)	3.57 (3)	98.81	0.79
f. Bank or credit union?	4.76 (4)	4.76 (4)	95.24	0.48
g. Pharmacy or drug store?	4.76 (4)	1.19 (1)	96.43	0.39
h. Coffee shop?	7.14 (6)	2.38 (2)	92.86	0.22
i. Laundry or dry cleaners?	7.14 (6)	3.57 (3)	94.05	0.42
j. Movie theater?	0 (0)	0 (0)	-	-
k. Other entertainment?	1.19 (1)	0 (0)	98.81	0.00
l. Hotel or motel?	2.38 (2)	1.19 (1)	98.81	0.66
m. Indoor mall or super center?	0 (0)	0 (0)	-	-
n. Department store or "big box" store?	1.19 (1)	2.38 (2)	98.81	0.66
o. Strip mall or shopping center?	9.52 (8)	7.14 (6)	97.62	0.84
p. Warehouses, factories, or industrial buildings?	3.57 (3)	4.76 (4)	94.05	0.26
q. Office building?	10.71 (9)	10.71 (9)	92.86	0.63
r. Bar? Liquor store?	5.95 (5)	1.19 (1)	95.24	0.32
s. Auto shop?	4.76 (4)	4.76 (4)	97.62	0.74
t. Other retail?	8.33 (7)	8.33 (7)	90.48	0.38
u. Other services?	22.62 (19)	11.90 (10)	86.90	0.55
What types of public or government service destinations are visible in this segment?				
a. Post office?	1.19 (1)	1.19 (1)	100.00	1.00
b. Library?	1.19 (1)	1.19 (1)	100.00	1.00
c. Place of worship?	7.14 (6)	7.14 (6)	92.86	0.46
d. Day care or preschool?	1.19 (1)	2.38 (2)	98.81	0.66
e. Elementary school?	3.57 (3)	1.19 (1)	97.62	0.49
f. Middle school, junior high school or high school?	0 (0)	1.19 (1)	98.81	0.00
g. Junior college, college or university campus?	0 (0)	1.19 (1)	98.81	0.00
h. Health or social services?	4.76 (4)	2.38 (2)	97.62	0.66

LAND USE ENVIRONMENT	<i>On-site, Visible % (n)</i>	<i>Web-based, Visible % (n)</i>	<i>Observed Agreement</i>	<i>Kappa</i>
i. Airport, train station, bus station, or other transportation facility?	1.19 (1)	0 (0)	98.81	0.00
j. Police department or fire department?	1.19 (1)	1.19 (1)	97.62	-0.01
k. Museum?	1.19 (1)	1.19 (1)	100.00	1.00
l. Community Center?	1.19 (1)	2.38 (2)	98.81	0.66
What types of recreational facilities/destinations are visible in this segment?				
a. Indoor fitness facility?	4.76 (4)	0 (0)	95.24	0.00
b. Park?	8.33 (7)	9.52 (8)	91.67	0.49
c. Playground?	7.14 (6)	4.76 (4)	95.24	0.58
d. Outdoor pool?	1.19 (1)	7.14 (6)	94.05	0.27
e. Beach?	2.38 (2)	3.57 (3)	98.81	0.79
f. Golf course?	0 (0)	0 (0)	-	-
g. Sports/playing field, basketball court or tennis court?	3.57 (3)	7.14 (6)	94.05	0.42
h. Sports track?	0 (0)	1.19 (1)	98.81	0.00
i. Marina?	0 (0)	0 (0)	-	-
What other types of destinations are visible in this segment?				
a. Parking lot or parking garage?	32.14 (27)	38.10 (32)	77.38	0.51
b. Driveway?	92.86 (78)	97.62 (82)	90.48	-0.04
c. Abandoned building or vacant lot?	5.95 (5)	9.52 (8)	94.05	0.59
d. Railroad, bridge, tunnel, highway, or overpass?	4.76 (4)	5.95 (5)	94.05	0.41
What types of natural features are visible in this segment?				
a. Large body of water?	7.14 (6)	8.33 (7)	94.05	0.58
b. Small body of water?	9.52 (8)	15.48 (13)	89.29	0.51
c. Mountains or canyons?	0 (0)	1.19 (1)	98.81	0.00
d. Open natural space?	35.71 (30)	48.81 (41)	70.24	0.40

Table 1b

Agreement between On-Site and Web-based Audits on Transportation Environment

TRANSPORTATION ENVIRONMENT	On-site, Visible % (n)	Web-based, Visible % (n)	Observed Agreement	Kappa
How much availability to alternative transportation modes is visible in this segment?			85.37	0.60
<i>No availability</i>	40.48 (34)	44.05 (37)		
<i>A little availability</i>	15.48 (13)	21.43 (18)		
<i>Some availability</i>	34.52 (29)	27.38 (23)		
<i>A lot of availability</i>	9.52 (8)	7.14 (6)		
How would you rate the walkability of this segment?				
a. Presence of sidewalks?			90.48	0.76
<i>None</i>	53.57 (45)	60.71 (51)		
<i>One side of street</i>	27.38 (23)	20.24 (17)		
<i>Both sides of street</i>	19.05 (16)	19.05 (16)		
b. Location of sidewalks (presence of buffer)?			86.67	0.69
<i>Adjacent to street or curb (no buffer)</i>	46.15 (18)	55.88 (19)		
<i>Within 2 ft of street (buffer)</i>	30.77 (12)	20.59 (7)		
<i>Between 2 & 6 ft of street (buffer)</i>	17.95 (7)	23.53 (8)		
<i>Greater than 6 ft of street (buffer)</i>	5.13 (2)	0 (0)		
c. Continuity of sidewalks (on at least one side of street)?			87.93	0.15
<i>Not continuous</i>	10.53 (4)	6.06 (2)		
<i>Continuous at one end</i>	7.89 (3)	6.06 (2)		
<i>Continuous at both ends</i>	817.58 (31)	87.88 (29)		
d. Sidewalk width?			92.59	0.66
<i>0 to 3 ft</i>	29.73 (11)	37.50 (12)		
<i>> 3 to < 6 ft</i>	67.57 (25)	62.50 (20)		
<i>> 6 ft</i>	2.70 (1)	0 (0)		
e. Levelness and condition of sidewalk?			80.00	0.38
<i>None</i>	60 (15)	68.75 (11)		
<i>A little</i>	40 (10)	18.75 (3)		
<i>Some</i>	0 (0)	12.50 (2)		
<i>A lot</i>	0 (0)	0 (0)		
f. Obstructions?			75.00	0.20
<i>None</i>	63.74 (7)	63.64 (7)		
<i>A little</i>	27.27 (3)	36.36 (4)		
<i>Some</i>	9.09 (1)	0 (0)		
<i>A lot</i>	0 (0)	0 (0)		
g. Curvilinear curbs (not orthogonal) or curb cuts?			89.29	0.63
<i>None</i>	3.45 (1)	5.26 (1)		
<i>On only one end</i>	51.72 (15)	57.89 (11)		
<i>On both ends</i>	44.83 (13)	36.84 (7)		
<i>On both sides & ends</i>	0 (0)	0 (0)		

TRANSPORTATION ENVIRONMENT		<i>On-site, Visible % (n)</i>	<i>Web-based, Visible % (n)</i>	<i>Observed Agreement</i>	<i>Kappa</i>
How would you rate the bikability of this segment?					
a. Presence of bike lane or marked shoulder?				91.67	0.66
	<i>None</i>	84.52 (71)	84.52 (71)		
	<i>One side of street</i>	1.19 (1)	3.57 (3)		
	<i>Both sides of street</i>	14.29 (12)	11.90 (10)		
b. Location of bike lane (marked lane)?				97.73	0.92
	<i>No shoulder (no marked lane)</i>	55.17 (16)	61.29 (19)		
	<i>Narrow paved (<3ft) shoulder (no marked lane)</i>	37.93 (11)	29.03 (9)		
	<i>Wide paved (>3ft) shoulder (no marked lane)</i>	0 (0)	0 (0)		
	<i>Narrow (<3ft) marked lane</i>	6.90 (2)	6.45 (2)		
	<i>Wide (>3ft) marked lane</i>	0 (0)	3.23 (1)		
c. Continuity of bike lane?				83.33	0.00
	<i>Continuous 1 side 1 end</i>	0 (0)	7.69 (1)		
	<i>Continuous 1 side 2 ends</i>	7.69 (1)	15.38 (2)		
	<i>Continuous 1 side 2 ends, 1 side 1 end</i>	0 (0)	7.69 (1)		
	<i>Continuous 2 sides 1 end</i>	0 (0)	0 (0)		
	<i>Continuous all</i>	92.31 (12)	69.23 (9)		
d. Levelness and condition of bike lane?				40.00	-0.36
	<i>None</i>	55.56 (5)	66.67 (6)		
	<i>A little</i>	44.44 (4)	33.33 (3)		
	<i>Some</i>	0 (0)	0 (0)		
	<i>A lot</i>	0 (0)	0 (0)		
e. Obstructions?				75.00	0.00
	<i>None</i>	50.00 (4)	71.43 (5)		
	<i>A little</i>	37.50 (3)	28.57 (2)		
	<i>Some</i>	12.50 (1)	0 (0)		
	<i>A lot</i>	0 (0)	0 (0)		
f. Presence of bike racks?				98.81	0.00
	<i>None</i>	98.81 (83)	100.00 (84)		
	<i>One side of street</i>	1.19 (1)	0 (0)		
	<i>Both sides of street</i>	0 (0)	0 (0)		
How would you rate the availability of transit for this segment?					
a. Presence of bus or other transit stops?				-	-
	<i>None</i>	33.33 (1)	100.00 (3)		
	<i>A little</i>	33.33 (1)	0 (0)		
	<i>Some</i>	33.33 (1)	0 (0)		
b. Presence of bench or covered shelter at transit stops?				-	-
	<i>Continuous 1 side 1 end</i>	0 (0)	50.00 (1)		
	<i>Continuous 1 side 2 ends</i>	0 (0)	0 (0)		
	<i>Continuous 1 side 2 ends, 1 side 1 end</i>	0 (0)	50.00 (1)		
	<i>Continuous 2 sides 1 end</i>	0 (0)	0 (0)		

TRANSPORTATION ENVIRONMENT		<i>On-site, Visible % (n)</i>	<i>Web-based, Visible % (n)</i>	<i>Observed Agreement</i>	<i>Kappa</i>
<i>Continuous all</i>		0 (0)	0 (0)		
This segment has on-street parking available.				82.14	0.62
	<i>No</i>	59.52 (50)	63.10 (53)		
	<i>Yes</i>	40.48 (34)	36.90 (31)		
Please indicate your agreement with the following statements about street characteristics.					
a. Street types?				94.42	0.74
	<i>Divided > 4 lanes</i>	2.38 (2)	3.57 (3)		
	<i>Undivided > 4 lanes</i>	1.19 (1)	3.57 (3)		
	<i>2 marked lanes</i>	40.48 (34)	38.10 (32)		
	<i>No marked lanes</i>	55.95 (47)	53.57 (45)		
b. Connectivity				70.13	0.42
	<i>Segment has unidirectional intersection</i>	1.23 (1)	7.50 (6)		
	<i>Segment has 2 directions at intersection(s)</i>	70.37 (57)	53.75 (43)		
	<i>Segment has 3-4 directions at intersection(s)</i>	28.40 (23)	35.00 (28)		
	<i>Segment has 5+ directions at intersection(s)</i>	0 (0)	3.75 (3)		
c. Other street design characteristics to reduce volume or speed?				96.07	0.58
	<i>None</i>	91.67 (77)	84.52 (71)		
	<i>A little</i>	7.14 (6)	11.90 (10)		
	<i>Some</i>	0 (0)	2.38 (2)		
	<i>A lot</i>	1.19 (1)	1.19 (1)		
d. Traffic calming devices to reduce volume or speed?				83.81	0.23
	<i>None</i>	60.71 (51)	80.95 (68)		
	<i>A little</i>	27.38 (23)	11.90 (10)		
	<i>Some</i>	10.71 (9)	5.95 (5)		
	<i>A lot</i>	1.19 (1)	1.19 (1)		
e. Aggressive drivers?				90.48	0.00
	<i>None</i>	85.71 (72)	100.00 (84)		
	<i>A little</i>	9.52 (8)	0 (0)		
	<i>Some</i>	4.76 (4)	0 (0)		
	<i>A lot</i>	0 (0)	0 (0)		
f. Crossing aids for pedestrians and bicyclists to cross the street safely?				91.71	0.61
	<i>None</i>	79.76 (67)	71.43 (60)		
	<i>A little</i>	10.71 (9)	16.67 (14)		
	<i>Some</i>	7.14 (6)	7.14 (6)		
	<i>A lot</i>	2.38 (2)	4.76 (4)		
g. Street lighting for sidewalks, street shoulders, and/or bike lanes at night?				77.45	0.33
	<i>None</i>	39.29 (33)	58.33 (49)		
	<i>A little</i>	33.33 (28)	13.10 (11)		
	<i>Some</i>	21.43 (18)	25.00 (21)		
	<i>A lot</i>	5.95 (5)	3.57 (3)		

Table 1c

Agreement between On-Site and Web-based Audits on Facilities

FACILITIES	<i>On-site, Visible % (n)</i>	<i>Web-based, Visible % (n)</i>	<i>Observed Agreement</i>	<i>Kappa</i>
Is availability of recreational facilities visible in this segment?	8.33 (7)	7.14 (6)	91.67	0.42
Is availability of recreational equipment visible in this segment?	13.10 (11)	4.76 (4)	86.90	0.21
What types of recreational equipment are visible in this segment?				
a. Playground equipment	10.71 (9)	8.33 (7)	88.10	0.31
b. "Complete" sports equipment	3.57 (3)	2.38 (2)	94.05	-0.03
c. "Incomplete" sports equipment	5.95 (5)	0 (0)	94.05	0.00
What types of service amenities are visible in this segment?				
a. Equipment rental	0 (0)	0 (0)	-	-
b. Sports stands/seating	1.19 (1)	1.19 (1)	97.62	-0.01
c. Picnic tables and/or grills	1.19 (1)	2.38 (2)	96.43	-0.02
d. Water fountains	0 (0)	1.19 (1)	98.81	0.00
e. Restrooms	1.19 (1)	1.19 (1)	97.62	-0.01
f. Vending machines	0 (0)	0 (0)	-	-
g. Public telephones	3.57 (3)	1.19 (1)	97.62	0.49
h. Trash bins	4.76 (4)	4.76 (4)	92.86	0.21

Table 1d

Agreement between On-Site and Web-based Audits on Aesthetics

AESTHETICS	<i>On-site, Visible % (n)</i>	<i>Web-based, Visible % (n)</i>	<i>Observed Agreement</i>	<i>Kappa</i>
Are attractive features visible in this segment?	64.29 (54)	67.86 (57)	75.00	0.44
Are comfort features visible in this segment?	7.14 (6)	5.95 (5)	94.05	0.51
Are there street trees in this segment?				
a. Presence of street trees in sidewalk area?	23.81 (20)	16.67 (14)	76.19	0.27
b. Presence of street trees in yards shading sidewalk?	86.90 (73)	90.48 (76)	79.76	-0.01
Is physical disorder visible in this segment?				
a. Are there whole or broken beer or liquor bottles or cans visible in streets, yards, or alleys?	8.33 (7)	0 (0)	91.67	0.00
b. Are there cigarette or cigar butts or discarded cigarette packages on sidewalk or in gutters?	26.19 (22)	0 (0)	73.81	0.00
c. Are there condoms on the sidewalk, in gutters, or on the street?	2.38 (2)	0 (0)	97.62	0.00
d. Are there needles, syringes, or drug-related paraphernalia on sidewalk, or on the street?	2.38 (2)	0 (0)	97.62	0.00
e. Is there garbage, litter, or broken glass in the street or on the sidewalks?	30.95 (26)	0 (0)	69.05	0.00
f. Are there abandoned cars?	1.19 (1)	0 (0)	98.81	0.00
g. Is there graffiti on the buildings, signs or walls?	1.19 (1)	0 (0)	98.81	0.00
h. Are there broken windows on the buildings?	2.38 (2)	0 (0)	97.62	0.00

Table 1e

Agreement between On-Site and Web-based Audits on Signage

SIGNAGE	<i>On-site, Visible % (n)</i>	<i>Web-based, Visible % (n)</i>	<i>Observed Agreement</i>	<i>Kappa</i>
What types of signs are visible in this segment?				
a. Cultural or religious message or event?	26.19 (22)	5.95 (5)	75.00	0.14
b. Political message or event?	11.90 (10)	1.19 (1)	86.90	-0.02
c. Neighborhood/social message or event?	9.52 (8)	3.57 (3)	89.29	0.14
d. "Share the road" sign?	5.95 (5)	3.57 (3)	92.86	0.22
e. Other pedestrian or bicyclist friendly traffic sign?	26.19 (22)	9.52 (8)	73.81	0.15
f. Physical activity message?	0 (0)	0 (0)	-	-
g. Athletic event?	0 (0)	1.19 (1)	98.81	0.00
h. Other entertainment or event?	2.38 (2)	0 (0)	97.62	0.00
i. Neighborhood/crime watch?	0 (0)	0 (0)	-	-
j. Security warning sign?	7.14 (6)	2.38 (2)	90.48	-0.04
k. No trespassing/beware of dog?	8.33 (7)	0 (0)	91.67	0.00
l. Tobacco or alcohol billboard?	3.57 (3)	0 (0)	96.43	0.00
m. Fast food billboard?	1.19 (1)	0 (0)	98.81	0.00
n. Physical activity billboard?	1.19 (1)	0 (0)	98.81	0.00
o. Unreadable sign or billboard?	5.95 (5)	17.86 (15)	76.19	-0.10

Table 1f

Agreement between On-Site and Web-based Audits on Social Environment

SOCIAL ENVIRONMENT	On-site, Visible % (n)	Web-based, Visible % (n)	Observed Agreement	Kappa
How many people are visible in this segment?				
a. Are there any people visible in this segment?			72.31	0.03
None	40.48 (34)	95.24 (80)		
A few (1-3)	40.48 (34)	0 (0)		
Some (4-6)	11.90 (10)	2.38 (2)		
A lot (>7)	7.14 (6)	2.38 (2)		
b. Are there any children visible in this segment?			91.71	0.07
None	79.76 (67)	98.81 (83)		
A few (1-3)	16.67 (14)	1.19 (1)		
Some (4-6)	1.19 (1)	0 (0)		
A lot (>7)	2.38 (2)	0 (0)		
c. Are there any teenagers or adults visible in this segment?			91.07	0.00
None	84.52 (71)	100.00 (84)		
A few (1-3)	13.10 (11)	0 (0)		
Some (4-6)	2.38 (2)	0 (0)		
A lot (>7)	0 (0)	0 (0)		
d. Are there children engaging in active behaviors?			83.82	0.08
None	59.52 (50)	96.43 (81)		
A few (1-3)	33.33 (28)	1.19 (1)		
Some (4-6)	4.76 (4)	2.38 (2)		
A lot (>7)	2.38 (2)	0 (0)		
e. Are there any older adults visible in this segment?			89.29	0.07
None	83.33 (70)	97.62 (82)		
A few (1-3)	13.10 (11)	1.19 (1)		
Some (4-6)	3.57 (3)	1.19 (1)		
A lot (>7)	0 (0)	0 (0)		
f. Are there older adults engaging in active behaviors?			95.26	0.00
None	89.29 (75)	100.00 (84)		
A few (1-3)	8.33 (7)	0 (0)		
Some (4-6)	1.19 (1)	0 (0)		
A lot (>7)	1.19 (1)	0 (0)		
g. Are there people stopping to talk or greet one another?			97.62	0.00
None	97.62 (82)	100.00 (84)		
A few (1-3)	2.38 (2)	0 (0)		
Some (4-6)	0 (0)	0 (0)		
A lot (>7)	0 (0)	0 (0)		
h. Are there people fighting, acting hostile or threatening?			92.26	0.00
None	89.29 (75)	100.00 (84)		
A few (1-3)	5.95 (5)	0 (0)		

SOCIAL ENVIRONMENT		<i>On-site, Visible % (n)</i>	<i>Web-based, Visible % (n)</i>	<i>Observed Agreement</i>	<i>Kappa</i>
i. Are there stray dogs or animals in the segment?	<i>Some (4-6)</i>	4.76 (4)	0 (0)	98.81	0.00
	<i>A lot (>7)</i>	0 (0)	0 (0)		
	<i>None</i>	98.81 (83)	100.00 (84)		
	<i>A few (1-3)</i>	1.19 (1)	0 (0)		
	<i>Some (4-6)</i>	0 (0)	0 (0)		
	<i>A lot (>7)</i>	0 (0)	0 (0)		

Table 2a

Usefulness of Three Web Interfaces and Agreement on Land Use Environment

LAND USE ENVIRONMENT	Mean and Count					MS Visual Oblique (MVO)	GS-GM Pair-wise Kappa	MVO-GS Pair-wise Kappa	MVO-GM Pair-wise Kappa
	Google Map (GM)	Google Street View (GS)							
Are residential and non-residential land uses visible in this segment?									
Mean	2.50	1.44	2.61	0.12 (−1.06 [*])	0.12 (1.67 [*])				0.61 (0.11)
not used (0)	1	41	2						
not useful (1)	0	2	1						
somewhat useful (2)	39	4	25						
very useful (3)	44	37	56						
What types of Buildings or features are presented in this segment?									
Mean	2.36	1.45	2.58	0.06 (−0.91 [*])	0.12 (1.13 [*])				0.45 (0.22)
not used (0)	1	41	2						
not useful (1)	1	0	1						
somewhat useful (2)	49	7	27						
very useful (3)	33	36	54						
What types of commercial destinations are visible in this segment?									
Mean	2.24	1.36	2.29	0.12 (−0.88 [*])	0.16 (0.93 [*])				0.70 (0.05)
not used (0)	6	43	7						
not useful (1)	0	2	2						
somewhat useful (2)	46	5	35						
very useful (3)	32	34	40						
What types of public or government service destinations are visible in this segment?									
Mean	2.18	1.25	2.25	0.10 (−0.93 [*])	0.17 (1.00 [*])				0.70 (0.07)
not used (0)	6	45	7						
not useful (1)	1	1	2						
somewhat useful (2)	49	10	38						
very useful (3)	28	28	37						
What types of recreational facilities/destinations are visible in this segment?									

LAND USE ENVIRONMENT	Mean and Count					GS-GM Pair-wise Kappa	MVO-GS Pair-wise Kappa	MVO-GM Pair-wise Kappa
	Google Map (GM)	Google Street View (GS)	MS Visual Oblique (MVO)					
<i>Mean</i>	2.36	1.25	2.37			(-1.11) [*]	(1.12) [*]	(0.01)
<i>not used (0)</i>	5	45	6					
<i>not useful (1)</i>	2	2	1					
<i>somewhat useful (2)</i>	35	8	33					
<i>very useful (3)</i>	42	29	44					
What other types of destinations are visible in this segment?								
<i>Mean</i>	2.64	1.49	2.71			-0.02 (-1.15) [*]	0.06 (1.22) [*]	0.55 (0.07)
<i>not used (0)</i>	0	40	1					
<i>not useful (1)</i>	2	1	1					
<i>somewhat useful (2)</i>	26	5	19					
<i>very useful (3)</i>	56	38	63					
What types of natural features are visible in this segment?								
<i>Mean</i>	2.70	1.35	2.76			0.01 (-1.35) [*]	0.04 (1.41) [*]	0.64 (0.06)
<i>not used (0)</i>	1	40	2					
<i>not useful (1)</i>	1	3	0					
<i>somewhat useful (2)</i>	20	13	14					
<i>very useful (3)</i>	62	28	68					

Note:

* The Bonferroni multiple-comparison test that indicates statistically significantly different means at the 0.95 alpha level

Table 2b

Usefulness of Three Web Interfaces and Agreement on Transportation Environment

TRANSPORTATION ENVIRONMENT	Mean and Count				MS Visual Oblique (MVO)	GS-GM Pair-wise Kappa	MVO-GS Pair-wise Kappa	MVO-GM Pair-wise Kappa
	Google Map (GM)	Google Street View (GS)						
How much availability to alternative transportation modes is visible in this segment?								
Mean	2.02	1.56	2.18			0.09 (−0.46) [*]	0.11 (0.62) [*]	0.73 (0.16)
not used (0)	4	39	5					
not useful (1)	7	1	5					
somewhat useful (2)	56	2	44					
very useful (3)	17	42	30					
How would you rate the walkability of this segment?								
a. Presence of sidewalks?								
Mean	1.99	1.62	2.26			0.11 (−0.37)	0.12 (0.64) [*]	0.56 (0.27)
not used (0)	3	38	4					
not useful (1)	15	1	7					
somewhat useful (2)	46	0	36					
very useful (3)	20	45	37					
b. Location of sidewalks?								
Mean	1.05	0.89	1.20			0.39 (−0.16)	0.41 (0.31)	0.81 (0.15)
not used (0)	36	58	37					
not useful (1)	12	0	7					
somewhat useful (2)	32	3	26					
very useful (3)	4	23	14					
c. Continuity of sidewalks?								
Mean	1.07	0.79	1.14			0.42 (−0.28)	0.47 (0.35)	0.82 (0.07)
not used (0)	38	60	39					
not useful (1)	10	1	7					
somewhat useful (2)	28	4	25					
very useful (3)	8	9	13					
d. Sidewalk width?								

TRANSPORTATION ENVIRONMENT	Mean and Count					GS-GM Pair-wise Kappa	MVO-GS Pair-wise Kappa	MVO-GM Pair-wise Kappa
	Google Map (GM)	Google Street View (GS)	MS Visual Oblique (MVO)					
<i>Mean</i>	0.94	0.82	1.04			0.36 (−0.12)	0.42 (0.22)	0.78 (0.10)
<i>not used (0)</i>	38	60	39					
<i>not useful (1)</i>	15	0	11					
<i>somewhat useful (2)</i>	29	3	26					
<i>very useful (3)</i>	2	21	8					
e. Levelness and condition of sidewalk?								
<i>Mean</i>	0.64	0.79	0.73			0.26 (0.15)	0.32 (−0.06)	0.79 (−0.09)
<i>not used (0)</i>	38	60	39					
<i>not useful (1)</i>	38	0	29					
<i>somewhat useful (2)</i>	8	6	16					
<i>very useful (3)</i>	0	18	0					
f. Obstructions?								
<i>Mean</i>	0.66	0.76	0.79			0.28 (0.10)	0.36 (0.03)	0.76 (0.13)
<i>not used (0)</i>	39	60	40					
<i>not useful (1)</i>	36	0	26					
<i>somewhat useful (2)</i>	8	8	14					
<i>very useful (3)</i>	1	16	4					
g. Curvilinear curbs or curb cuts?								
<i>Mean</i>	0.66	0.71	0.69			0.26 (0.05)	0.28 (−0.02)	0.86 (0.03)
<i>not used (0)</i>	39	61	40					
<i>not useful (1)</i>	36	0	31					
<i>somewhat useful (2)</i>	8	9	12					
<i>very useful (3)</i>	1	14	1					
How would you rate the bikability of this segment?								
a. Presence of bike lane or marked shoulder?								
<i>Mean</i>	1.80	1.52	1.94			0.11 (−0.28)	0.14 (0.42)	0.72 (0.14)
<i>not used (0)</i>	9	41	11					
<i>not useful (1)</i>	13	0	8					
<i>somewhat useful (2)</i>	48	1	40					

TRANSPORTATION ENVIRONMENT	Mean and Count					GS-GM Pair-wise Kappa	MVO-GS Pair-wise Kappa	MVO-GM Pair-wise Kappa
	Google Map (GM)	Google Street View (GS)	MS Visual Oblique (MVO)					
b. Location of bike lane (marked lane)?	14	42	25					
<i>very useful (3)</i>								
<i>Mean</i>	0.83	0.63	0.92			0.35 (−0.20)	0.40 (0.29)	0.86 (0.09)
<i>not used (0)</i>	47	66	47					
<i>not useful (1)</i>	10	0	8					
<i>somewhat useful (2)</i>	21	1	18					
<i>very useful (3)</i>	6	17	11					
c. Continuity of bike lane?								
<i>Mean</i>	0.55	0.46	0.63			0.49 (−0.09)	0.65 (0.17)	0.82 (0.08)
<i>not used (0)</i>	57	67	57					
<i>not useful (1)</i>	10	5	7					
<i>somewhat useful (2)</i>	15	2	14					
<i>very useful (3)</i>	2	10	6					
d. Levelness and condition of bike lane?								
<i>Mean</i>	0.42	0.52	0.46			0.40 (0.10)	0.48 (−0.06)	0.89 (0.04)
<i>not used (0)</i>	57	67	57					
<i>not useful (1)</i>	20	0	17					
<i>somewhat useful (2)</i>	6	7	8					
<i>very useful (3)</i>	1	10	2					
e. Obstructions?								
<i>Mean</i>	0.39	0.54	0.48			0.38 (0.15)	0.52 (−0.06)	0.83 (0.09)
<i>not used (0)</i>	57	67	57					
<i>not useful (1)</i>	21	0	15					
<i>somewhat useful (2)</i>	6	6	11					
<i>very useful (3)</i>	0	11	1					
f. Presence of bike racks?								
<i>Mean</i>	1.27	1.32	1.45			0.07 (0.05)	0.13 (0.13)	0.72 (0.18)
<i>not used (0)</i>	9	43	10					
<i>not useful (1)</i>	45	0	33					

TRANSPORTATION ENVIRONMENT	Mean and Count					GS-GM Pair-wise Kappa	MVO-GS Pair-wise Kappa	MVO-GM Pair-wise Kappa
	Google Map (GM)	Google Street View (GS)	MS Visual Oblique (MVO)					
<i>somewhat useful (2)</i>	28	12	34					
<i>very useful (3)</i>	2	29	7					
How would you rate the availability of transit for this segment?								
a. Presence of bus or other transit stops?						0.07 (−0.42) [*]	0.19 (0.43) [*]	0.72 (0.01)
<i>Mean</i>	1.63	1.21	1.64					
<i>not used (0)</i>	7	44	8					
<i>not useful (1)</i>	24	3	24					
<i>somewhat useful (2)</i>	46	12	42					
<i>very useful (3)</i>	7	25	10					
b. Presence of bench or covered shelter at transit stops?						0.30 (−0.31)	0.43 (0.36) [*]	0.87 (0.05)
<i>Mean</i>	0.75	0.44	0.80					
<i>not used (0)</i>	43	69	44					
<i>not useful (1)</i>	19	0	14					
<i>somewhat useful (2)</i>	22	8	25					
<i>very useful (3)</i>	0	7	1					
This segment has on-street parking available.								
<i>Mean</i>	2.20	1.39	2.25			0.05 (−0.81) [*]	0.10 (−0.86) [*]	0.74 (0.05)
<i>not used (0)</i>	3	43	4					
<i>not useful (1)</i>	11	0	8					
<i>somewhat useful (2)</i>	36	6	35					
<i>very useful (3)</i>	34	35	37					
Please indicate your agreement with the following statements about street characteristics.								
a. Street types?						0.05 (−1.00) [*]	0.06 (1.06) [*]	0.72 (0.06)
<i>Mean</i>	2.49	1.49	2.55					
<i>not used (0)</i>	2	42	3					
<i>not useful (1)</i>	3	0	1					
<i>somewhat useful (2)</i>	31	1	27					

TRANSPORTATION ENVIRONMENT	Mean and Count			MS Visual Oblique (MVO)	GS-GM Pair-wise Kappa	MVO-GS Pair-wise Kappa	MVO-GM Pair-wise Kappa
	Google Map (GM)	Google Street View (GS)					
b. Connectivity	very useful (3)	48	41	53			
	Mean	2.67	1.21	2.58	0.08 (−1.46)	0.17 (1.37)	0.67 (−0.09)
	not used (0)	5	45	6			
	not useful (1)	1	5	0			
	somewhat useful (2)	11	5	17			
	very useful (3)	67	29	61			
	c-g. Other street design characteristics to reduce volume or speed?				−0.01 (−0.40)	0.05 (0.63)	0.49 (0.23)
	Mean	1.83	1.43	2.06			
	not used (0)	2	42	3			
	not useful (1)	15	0	10			
somewhat useful (2)	62	6	50				
	very useful (3)	5	36	21			

Note:

* The Bonferroni multiple-comparison test that indicates statistically significant means at the 0.95 alpha level

Table 2c

c Usefulness of Three Web Interfaces and Agreement on Facilities

FACILITIES	Mean and Count			GS-GM Pair-wise Kappa	MVO-GS Pair-wise Kappa	MVO-GM Pair-wise Kappa
	Google Map (GM)	Google Street View (GS)	MS Visual Oblique (MVO)			
Is availability of recreational facilities/ equipment visible in this segment?						
Mean	2.12	1.32	2.19	0.14 (−0.80 [*])	0.18 (0.87 [*])	0.75 (0.07)
not used (0)	4	43	5			
not useful (1)	9	0	3			
somewhat useful (2)	44	12	47			
very useful (3)	27	29	29			
What types of recreational equipment are visible in this segment?						
Mean	1.56	0.95	1.64	0.18 (−0.61 [*])	0.26 (0.69 [*])	0.82 (0.08)
not used (0)	19	53	21			
not useful (1)	13	0	6			
somewhat useful (2)	38	13	39			
very useful (3)	14	18	18			
What types of service amenities are visible in this segment?						
Mean	1.77	1.26	1.92	0.00 (−0.51 [*])	0.11 (0.66 [*])	0.71 (0.15)
not used (0)	5	43	6			
not useful (1)	17	0	11			
somewhat useful (2)	54	17	51			
very useful (3)	8	24	16			

Note:

* The Bonferroni multiple-comparison test that indicates statistically significantly different means at the 0.95 alpha level

Table 2d

Usefulness of Three Web Interfaces and Agreement on Aesthetics

AESTHETICS	Mean and Count			GS-GM Pair-wise Kappa	MVO-GS Pair-wise Kappa	MVO-GM Pair-wise Kappa
	Google Map (GM)	Google Street View (GS)	MS Visual Oblique (MVO)			
Are attractive features visible in this segment?						
	1.96	1.37	2.23	0.08 (−0.59 [*])	0.11 (0.86 [*])	0.58 (0.27)
not used (0)	3	43	4			
not useful (1)	14	0	6			
somewhat useful (2)	50	8	41			
very useful (3)	17	33	33			
Are comfort features visible in this segment?						
Mean	1.56	1.36	1.81	−0.04 (−0.20)	0.02 (0.45 [*])	0.59 (0.25)
not used (0)	3	42	3			
not useful (1)	39	0	27			
somewhat useful (2)	34	12	37			
very useful (3)	8	30	17			
Are there street trees in this segment?						
Mean	2.26	1.43	2.38	0.07 (−0.83 [*])	0.12 (0.95 [*])	0.73 (0.12)
not used (0)	4	43	5			
not useful (1)	5	0	2			
somewhat useful (2)	40	3	33			
very useful (3)	35	38	44			
Is physical disorder visible in this segment?						
Mean	1.96	1.37	2.23	0.08 (0.12)	0.11 (0.13)	0.58 (0.25)
not used (0)	9	43	9			
not useful (1)	66	1	47			
somewhat useful (2)	9	27	26			
very useful (3)	0	13	2			

Note:

* The Bonferroni multiple-comparison test that indicates statistically significantly different means at the 0.95 alpha level

Table 2e

Usefulness of Three Web Interfaces and Agreement on Signage and Social Environment

	Mean and Count			GS-GM Pair-wise Kappa	MVO-GS Pair-wise Kappa	MVO-GM Pair-wise Kappa
	Google Map (GM)	Google Street View (GS)	MS Visual Oblique (MVO)			
SIGNAGE						
What types of signs are visible in this segment?						
Mean	1.06	1.14	1.32	0.03 (0.08)	0.09 (0.18)	0.47 (0.26)
not used (0)	6	44	7			
not useful (1)	67	0	47			
somewhat useful (2)	11	24	26			
very useful (3)	0	16	4			
SOCIAL ENVIRONMENT						
How many people are visible in this segment?						
Mean	1.04	0.86	1.08	0.16 (−0.18)	0.25 (0.22)	0.83 (0.04)
not used (0)	19	54	21			
not useful (1)	48	0	45			
somewhat useful (2)	12	18	8			
very useful (3)	5	12	10			

Note:

*: The Bonferroni multiple-comparison test that indicates statistically significantly different means at the 0.95 alpha level