Validity of Google Earth Aerial and Street Views for Measuring Land Uses: Comparisons to Field Observations

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Background

Land-use mix reflects the availability of diverse destinations
  ◦ Diverse and available destinations provide opportunities for active transportation
    
    Duncan et al., 2010; McConville et al., 2011

Land uses can be measured by **in-person** field audits or **virtual** audits
  ◦ Virtual audits have gained favor by being valid and reliable while taking less time to complete

    Ben-Joseph et al., 2013

Google mapping platforms show promise for measuring neighborhood features due to their ease of use and accessibility to the public

    Lefer et al., 2008
Background

Google *Street View* offers a panoramic view of the street and local establishments at ground level.
Google Aerial View offers a "bird’s eye view" with a quick search option to find neighborhood destinations.

- Which view do you see when you open your Maps app??
Background and Purpose

- The best Google mapping platform (*Aerial View, Street View, combination of Views*) has yet to be empirically identified for assessing land uses

**Objective:**
- To evaluate the validity of Google *Aerial View, Street View*, and the sum of non-overlapping land uses from both *Views* compared to field observations

- Agreement explored prior to and after stratifying by high/low SES
## Methods - Sampling

San Diego, CA and Phoenix, AZ block groups
- High vs. low walkability (GIS-measured)
- High vs. low SES (income)
- Routes chosen equally among 4 quadrants

<table>
<thead>
<tr>
<th>Walkability</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego, n=15</td>
<td>San Diego, n=15</td>
<td></td>
</tr>
<tr>
<td>Phoenix, n=15</td>
<td>Phoenix, n=15</td>
<td></td>
</tr>
</tbody>
</table>

- **Residential routes** – pre-determined 0.25 mile route toward a commercial destination
- **Commercial routes** – nearest cluster of 3 or more commercial land uses
Methods - Measurement

Microscale Audit of Pedestrian Streetscapes (Millstein et al. 2013)
- Developed to assess details of streetscapes relevant for physical activity
- Sections include a Route, Segments, Crossings, and Cul-de-sac tools
- Route section includes land use destinations along entire route

Land uses tallied using MAPS for field and virtual audits
- Assessed 30 land use items over 5 categories
  - Food-related
  - Retail and Service Oriented
  - Government and Community Services
  - Other
  - Recreation
- Scale - 0 (none), 1, or ≥ 2 land use establishments
- Street View and Aerial View also required additional tally sheet
- Noting all establishments and method of collection
Methods - Measurement

- Field Audits – tallied land uses on both sides of street of route/cluster
- *Street View* – traveling the route similarly to field audit, rotating 180 degrees every 100 feet
- *Aerial View* – conducted from approximately 2000 feet (search)
- Total – calculated as sum of *Street* and *Aerial View* tallies (unique count)

- San Diego field auditors virtually assessed Phoenix routes and vice-versa Spring/Summer 2013
Methods – Analysis

Individual Items
- Percent (%) agreement
- Weighted kappa statistic
  - Agreement controlling for chance
  - Kappas not possible with field audits in which ≥ 95% of routes had 0 establishments

Subscales – sum of individual items
- ICCs

Positive, negative, and overall land use scores
- ICCs
Results - Items

% AGREEMENT TO FIELD OBS.

Aerial View
- 21 out of 30 items showed agreement > 85%
- 29 out of 30 items showed agreement > 75%
- Health-related professionals = 74.2%

Street View
- 25 out of 30 items showed agreement > 85%
- 30 out of 30 items showed agreement > 75%

Total
- 24 out of 30 items showed agreement > 85%
- 30 out of 30 items showed agreement > 75%

KAPPA STATISTIC (WEIGHTED)

Aerial View
- 1 out of 19 rated almost perfect (Food κ=0.81)
- 10 out of 19 rated substantial
- 7 out of 19 rated moderate, 1 rated fair

Street View
- 2 out of 19 rated almost perfect
- 9 out of 19 rated substantial
- 8 out of 19 rated moderate

Total
- 2 out of 19 rated almost perfect
- 12 out of 19 rated substantial
- 3 out of 19 rated moderate, 1 rated fair
## Results – Subscales

### Agreement between subscales of field observations and virtually observed land-uses

<table>
<thead>
<tr>
<th>Land-Use Subscale</th>
<th>Field Observed</th>
<th>Field vs. Virtually Observed ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Shops(^2)</td>
<td>2.2</td>
<td>2.43</td>
</tr>
<tr>
<td>Restaurant and Entertainment(^3)</td>
<td>1.7</td>
<td>1.90</td>
</tr>
<tr>
<td>Institution Service(^4)</td>
<td>1.9</td>
<td>2.03</td>
</tr>
<tr>
<td>Government Service(^5)</td>
<td>0.1</td>
<td>0.34</td>
</tr>
<tr>
<td>Public Recreation(^6)</td>
<td>0.1</td>
<td>0.40</td>
</tr>
<tr>
<td>Private Recreation(^7)</td>
<td>0.3</td>
<td>0.58</td>
</tr>
<tr>
<td>Commercial Destination Land-Use(^8)</td>
<td>5.8</td>
<td>6.00</td>
</tr>
<tr>
<td>Positive Destination Land-Uses(^9)</td>
<td>6.7</td>
<td>6.46</td>
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<tr>
<td>Negative Destination Land-Uses(^10)</td>
<td>0.4</td>
<td>0.86</td>
</tr>
<tr>
<td>Overall Destination Land-Uses(^11)</td>
<td>6.3</td>
<td>6.60</td>
</tr>
</tbody>
</table>
Results – SES stratification

Individual Items – agreement between Field and Views by SES

- *Aerial View* - 5 out of 17 items differed between SES (high SES better on 4/5)
- *Street View* – 6 out of 17 items differed between SES (high SES better on 3/6)
- Total – 4 out of 17 items differed between SES (high SES better on 2/4)

Subscales - agreement between Field and Views by SES

- *Aerial View*
  - Better high SES – Government Services and Negative Land Uses
  - Better low SES – Public Recreation
- *Street View*
  - Better high SES – Government Services and Negative Land Uses
  - Better low SES – Private Recreation
- Total offered no unique information
Discussion

No clear distinction on which method was consistently better
- Both Aerial View and Street View performed well
- Total of unique places counted by both Views showed no clear advantage
- No clear method best when stratifying by SES
  - No clear differences in qualitative classifications of items
  - High SES Views showed better agreement for Government Services and Neg. Land uses

Summary
- Google MAPS is a valid method of assessing land uses
- Consensus is to use Aerial View based on results and team feedback – searching area using *loc:*
Google MAPS

Thank You...!
- All Google MAPS team members for their work on this project
- The ALR committee for this opportunity to present this research

References

QUESTIONS??
### Table 3. Agreement between subscales of field observations and virtually observed land-uses

<table>
<thead>
<tr>
<th>Land-Use Subscale</th>
<th>Field vs. Virtually Observed ICC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aerial</td>
</tr>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Shops</td>
<td>0.82</td>
</tr>
<tr>
<td>Restaurant and Entertainment</td>
<td>0.91</td>
</tr>
<tr>
<td>Institution Service</td>
<td>0.83</td>
</tr>
<tr>
<td>Government Service</td>
<td><strong>0.14</strong></td>
</tr>
<tr>
<td>Public Recreation</td>
<td>0.60</td>
</tr>
<tr>
<td>Private Recreation</td>
<td>0.55</td>
</tr>
<tr>
<td>Commercial Destination Land-Use</td>
<td>0.90</td>
</tr>
<tr>
<td>Positive Destination Land-Uses</td>
<td>0.89</td>
</tr>
<tr>
<td>Negative Destination Land-Uses</td>
<td><strong>0.28</strong></td>
</tr>
<tr>
<td>Overall Destination Land-Uses</td>
<td>0.88</td>
</tr>
</tbody>
</table>
Results - Items

Percent Agreement to Field Obs.

**Aerial View to Street View**
- 9 out of 30 favored *Aerial View*
- 13 out of 30 favored *Street View*
- 8 were equal

**Aerial View to Total**
- 3 out of 30 favored *Aerial View*
- 11 out of 30 favored Total
- 16 were equal

**Street View to Total**
- 13 out of 30 favored *Street View*
- 10 out of 30 favored Total
- 7 were equal

Kappa Statistic

**Aerial View to Street View**
- 4 out of 19 favored *Aerial View* (κ > 0.05)
- 11 were equal (κ ≤ 0.05)

**Aerial View to Total**
- 1 out of 19 favored *Aerial View*
- 14 were equal (κ ≤ 0.05)

**Street View to Total**
- 4 favored *Street View*
- 6 favored Total
- 9 were equal (κ ≤ 0.05)