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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

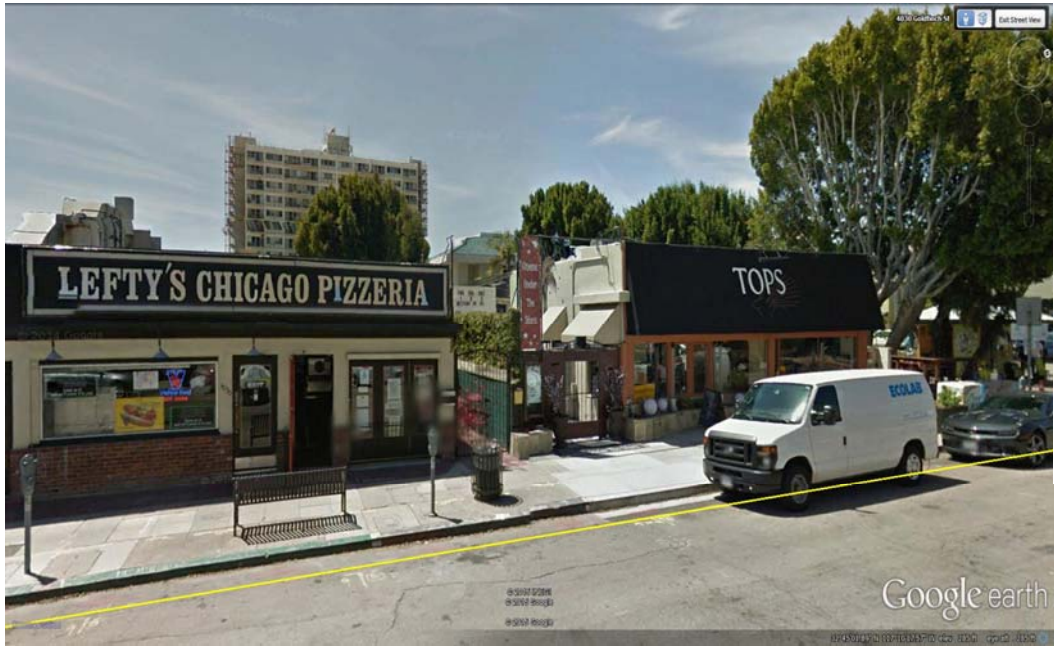
Ben-Joseph et al., 2013

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

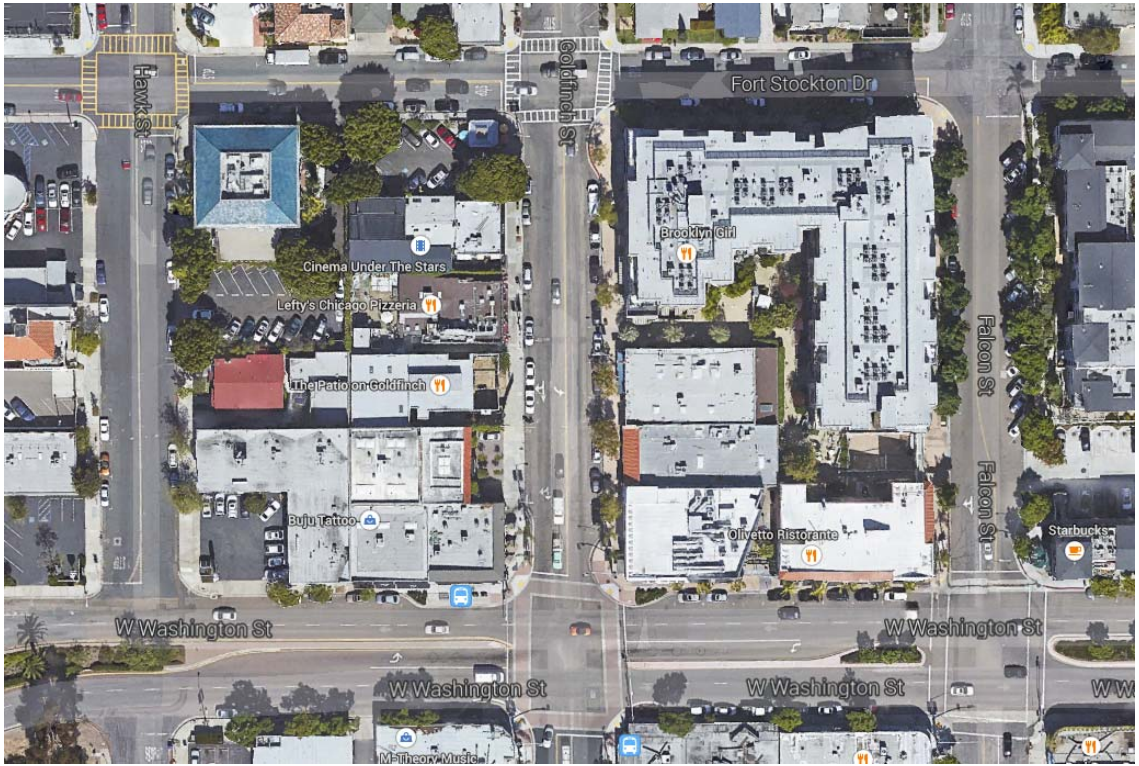
Google *Street View* offers a panoramic view of the street and local establishments at ground level



Background

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*, Google *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

SES	Walkability: High	Walkability: Low
High	San Diego, n=15 Phoenix, n=15	San Diego, n=15 Phoenix, n=15
Low	San Diego, n=15 Phoenix, n=15	San Diego, n=15 Phoenix, n=15

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

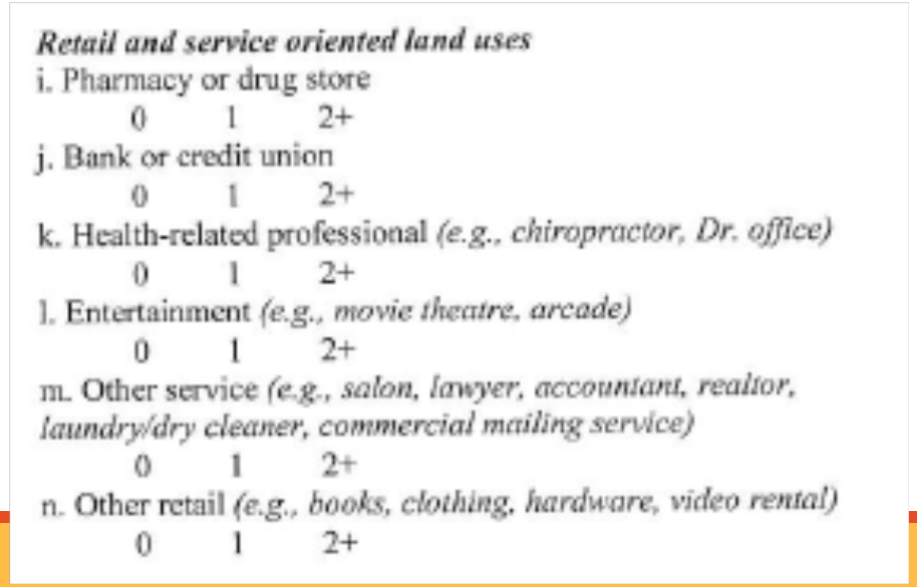
Methods - Measurement

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



Retail and service oriented land uses

i. Pharmacy or drug store
0 1 2+

j. Bank or credit union
0 1 2+

k. Health-related professional *(e.g., chiropractor, Dr. office)*
0 1 2+

l. Entertainment *(e.g., movie theatre, arcade)*
0 1 2+

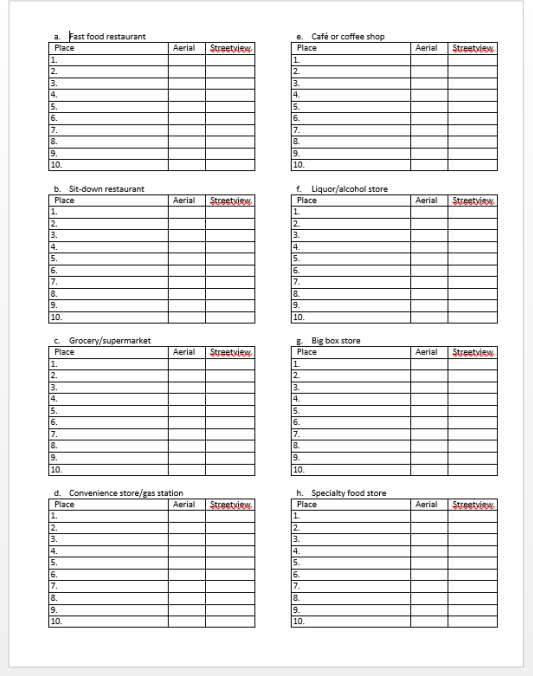
m. Other service *(e.g., salon, lawyer, accountant, realtor, laundry/dry cleaner, commercial mailing service)*
0 1 2+

n. Other retail *(e.g., books, clothing, hardware, video rental)*
0 1 2+

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



a. Fast food restaurant

Place	Aerial	Streetview
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

b. Sit-down restaurant

Place	Aerial	Streetview
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

c. Grocery/supermarket

Place	Aerial	Streetview
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

d. Convenience store/gas station

Place	Aerial	Streetview
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

e. Café or coffee shop

Place	Aerial	Streetview
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

f. Liquor/alcohol store

Place	Aerial	Streetview
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

g. Big box store

Place	Aerial	Streetview
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

h. Specialty food store

Place	Aerial	Streetview
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

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

0.81-1.00	Almost perfect
0.61-0.80	Substantial
0.41-0.60	Moderate
0.21-0.40	Fair

Results – Subscales

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

Land-Use Subscale	Field Observed		Field vs. Virtually Observed ICC		
	Mean	SD	Aerial	Streetview	Virtual
Shops[2]	2.2	2.43	0.86	0.82	0.87
Restaurant and Entertainment[3]	1.7	1.90	0.92	0.86	0.93
Institution Service[4]	1.9	2.03	0.85	0.89	0.88
Government Service[5]	0.1	0.34	0.27	0.40	0.27
Public Recreation[6]	0.1	0.40	0.50	0.59	0.54
Private Recreation[7]	0.3	0.58	0.61	0.57	0.69
Commercial Destination Land-Use[8]	5.8	6.00	0.93	0.90	0.93
Positive Destination Land-Uses[9]	6.7	6.46	0.92	0.89	0.92
Negative Destination Land-Uses[10]	0.4	0.86	0.48	0.44	0.48
Overall Destination Land-Uses[11]	6.3	6.60	0.91	0.89	0.92

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

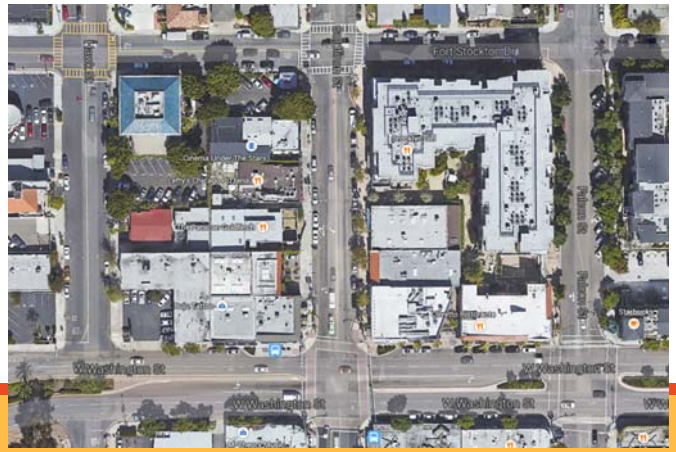
Discussion

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

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QUESTIONS??

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

	Field vs. Virtually Observed ICC					
	Aerial		Streetview		Virtual	
	Low	High	Low	High	Low	High
Land-Use Subscale						
Shops	0.82	0.90	0.82	0.82	0.81	0.93
Restaurant and Entertainment	0.91	0.93	0.86	0.86	0.93	0.93
Institution Service	0.83	0.87	0.87	0.90	0.86	0.90
Government Service	0.14	0.39	0.14	0.57	0.14	0.39
Public Recreation	0.60	0.27	0.62	0.51	0.59	0.40
Private Recreation	0.55	0.67	0.71	0.44	0.70	0.68
Commercial Destination Land-Use	0.90	0.96	0.89	0.90	0.90	0.97
Positive Destination Land-Uses	0.89	0.94	0.89	0.89	0.89	0.95
Negative Destination Land-Uses	0.28	0.60	0.29	0.54	0.28	0.60
Overall Destination Land-Uses	0.88	0.94	0.90	0.89	0.88	0.95

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* ($\kappa > 0.05$)
- 4 out of 19 favored *Street View* ($\kappa > 0.05$)
- 11 were equal ($\kappa \leq 0.05$)

Aerial View to Total
- 1 out of 19 favored *Aerial View*
- 4 out of 19 favored Total
- 14 were equal ($\kappa \leq 0.05$)

Street View to Total
- 4 favored *Street View*
- 6 favored Total
- 9 were equal ($\kappa \leq 0.05$)