Measuring Perceived Environments through Ecological Momentary Assessment
Correspondence with Objective GIS Indicators

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Environment and Physical Activity

- Vehicular traffic
- Poor walkability
- Crime
- Foliage
- Public transit
- Bike routes

Bauman, et. al. (2012)
Perceptions vs. Objective Data

- Objective indicators and subjective reports are only weakly in agreement.
- Lack of correspondence can occur due to participant distance perception or incongruent constructs.

Greenness

- Trees and plants improve perceived aesthetics and access to natural shade.
- Individuals in greener areas report:
  - greater engagement in physical activity.
  - better overall health.
  - improved mental health.
- Findings are inconsistent when using objective measures.

Leslie, Sugiyama, Ierodiaconou, & Kremer (2010)
Perceived Neighborhood Traffic

- Vehicular traffic presents physical hazards to pedestrians, acting as a barrier to physical activity.
- Individuals are 22% more likely to engage in physical activity when reporting no heavy traffic.
- Findings are inconsistent when using objective and subjective measures.

Duncan, Spence, & Mummery (2005)
Measurement Problems

- Subjective measures are obtained retrospectively and are:
  - prone to recall bias.
  - lacking immediate spatial relationship to data.
- One rating for the neighborhood leads to:
  - loss of neighborhood diversity data.
  - influence from areas rarely encountered.

Dunton, Intille, Wolch, & Pentz (2012)
Measurement Solutions

• Ecological momentary assessment (EMA) provides a solution for measuring perceived neighborhood characteristics.

• Real-time assessment:
  • is not prone to recall bias.
  • can directly link spatial data to the response.
  • provides multiple ratings depending on where the individual is in the neighborhood.
  • only measures parts of the neighborhood that are encountered.
Objective

• Assess convergent construct validity of EMA self-report of *perceived traffic* and *greenness*.

• How well do measures taken from a map correspond to those reported by individuals on their phones?
Subjects

- 43 individuals (165 EMA surveys)
- Age: 40 (SD: 6, 29-59)
- 81% Female
- 35% Hispanic
- BMI: 29 (SD: 7, 18-56)
- 67% overweight or obese
- 83% more than 1.6 km away from home at EMA
Chino, CA
Design

- Data was obtained from baseline and second wave of an ongoing study in Chino, CA.

<table>
<thead>
<tr>
<th>Day</th>
<th>6:30-6:45am</th>
<th>8-10am</th>
<th>10am-12pm</th>
<th>12-2pm</th>
<th>2-4pm</th>
<th>4-6pm</th>
<th>6-8pm</th>
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<tbody>
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<tr>
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<td>X</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Note: Question sequences are prompted at a random time within each interval.

- Questions on greenness/traffic were only asked outside.
Measures

• EMA reported:
  • Greenness
    • How many TREES AND PLANTS are there in the area where you are right now?
      • No, few, some, or a lot
  • Shade
    • How much SHADE FROM THE SUN is there in the area where you are standing right now?
      • No shade, partially shaded, or completely shaded
  • Nearby Traffic
    • How much TRAFFIC is on the closest street to where you are right now?
      • No, a little, some, or a lot
Measures

- Traffic
  - Vehicular collisions (2006-2012)
- Normalized Difference Vegetation Index (NDVI)
  - Infrared vs. visible light difference based on satellite photos.
  - High values represent greenery.
  - Values around zero represents rock/cement.
  - Negative values represent water.
3 Kilometer Street Network Buffer

Data Analysis

• Validity was tested using a multi-level model with:
  • EMA self-reports as the outcome
  • objective GIS indicators as predictors
  • nesting within subjects
  • adjusting for wave
Descriptive Statistics

- Compliance: 81% (SD: 13, 32-100%)
- EMA Reported:
  - Traffic: 2.1 (SD: 1.0, 1-4)
  - Shade: 2.1 (SD: 0.8, 1-3)
  - Trees: 2.6 (SD: 1.1, 1-4)
- GIS Measured:
  - Collisions: 15.9 (SD: 13.4, 0-40)
  - NDVI: 0.02 (SD: 0.03, 0-0.12)
Results: Greenness on NDVI

<table>
<thead>
<tr>
<th>Buffer</th>
<th>( \beta )</th>
<th>SE</th>
<th>z</th>
<th>95% CI</th>
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</thead>
<tbody>
<tr>
<td>500m</td>
<td>-0.64</td>
<td>1.06</td>
<td>-0.61</td>
<td>-2.71, 1.43</td>
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<tr>
<td>1000m</td>
<td>0.014</td>
<td>1.14</td>
<td>0.01</td>
<td>-2.23, 2.25</td>
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<tr>
<td>3000m</td>
<td>11.59</td>
<td>4.35</td>
<td>2.66</td>
<td>3.06, 20.12</td>
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</table>
# Results: Shade on NDVI

<table>
<thead>
<tr>
<th>Buffer</th>
<th>$\beta$</th>
<th>SE</th>
<th>$z$</th>
<th>95% CI</th>
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<tr>
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<td>-0.31</td>
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<td>1000m</td>
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<td>-1.00</td>
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<td>3000m</td>
<td>4.13</td>
<td>2.42</td>
<td>1.71</td>
<td>-0.60, 8.86</td>
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</table>
## Results: Traffic on Traffic Collisions

<table>
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<tr>
<th>Buffer</th>
<th>$\beta$</th>
<th>SE</th>
<th>z</th>
<th>95% CI</th>
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</thead>
<tbody>
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<td>0.14</td>
<td>2.52</td>
<td>0.079, 0.63</td>
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<tr>
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<td>0.049</td>
<td>3.33</td>
<td>0.067, 0.26</td>
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<tr>
<td>3000m</td>
<td>0.018</td>
<td>0.0077</td>
<td>2.41</td>
<td>0.0034, 0.033</td>
</tr>
</tbody>
</table>
Conclusions

• There is preliminary evidence of the construct validity of EMA-reported perceptions of neighborhood traffic and greenness.

• Reported shade was not a valid measure of greenness, possibly due to the wording of the EMA question.
Limitations

• 4 day sample design (2 waves)
• 1 item validation
• Missing data due to:
  • EMA conditionals/randomization
  • GPS error
  • Collisions
• Unknown distance from home in responses (over 1.6 km)
Future Implications

• When collecting data on traffic and vegetation, we can:
  • improve EMA efficiency through reduction in battery usage over GPS.
  • reduce data loss on low-signal days or indoors where GPS is not available.
  • fully integrate subjective and objective data into research questions while minimizing limitations.
Acknowledgment

• Stephen Intille, PhD
• Michael Jerrett, PhD
• Jennifer Wolch, PhD
• Keito Kawabata, MPA (Project Manager)
• Jennifer Beaudin, SM (Programmers)
• Cesar Aranguri, Robert Gomez (Data collectors)
• ACS (118283-MRSGT-10-012-01-CPPB) (Dunton, PI)
• NCI (R01CA123243) (Pentz, PI)
References


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