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

Eldin Dzubur, MS
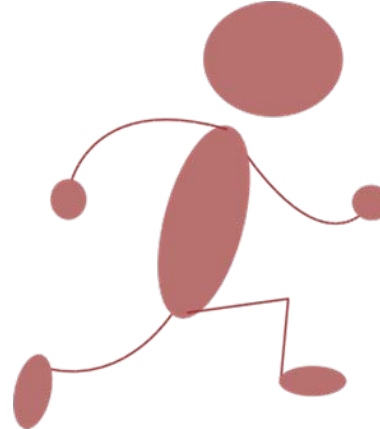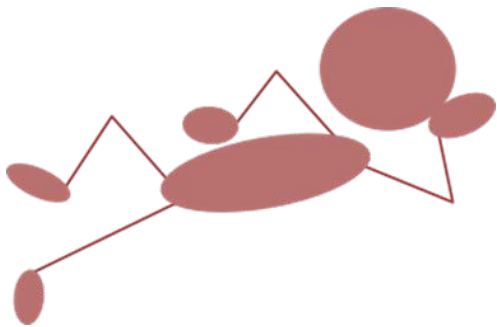Yue Liao, MPH
Mary-Ann Pentz, PhD
Genevieve Dunton, PhD MPH

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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.

Kirtland, et. Al. (2003)

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.
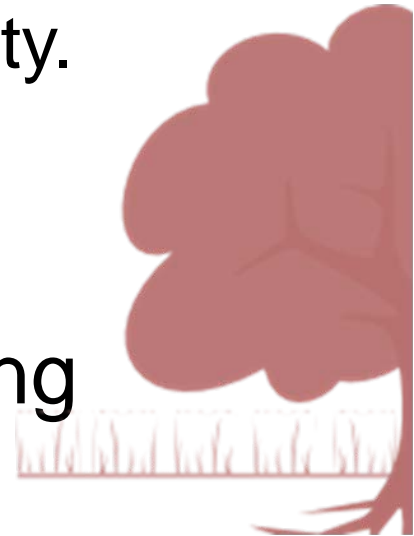
Leslie, Sugiyama, Ierodiaconou, & Kremer (2010)

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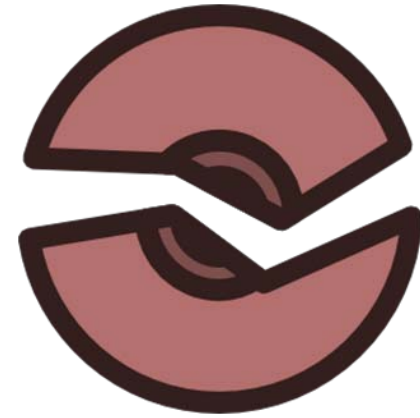
- Subjective measures are obtained retrospectively and are:
  - prone to recall bias.
  - lacking immediate spatial relationship to data.
- One rating for the neighborhood leads to:
  - loss of neighborhood diversity data.
  - influence from areas rarely encountered.

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.
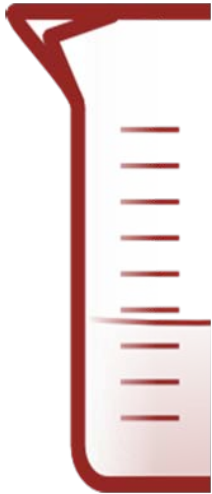
Objective

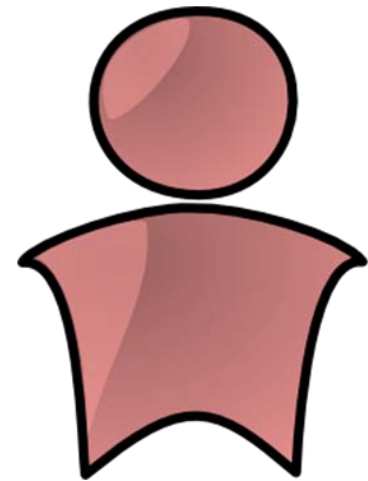- Assess convergent construct validity of EMA self-report of *perceived traffic* and *greenness.*

- 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.

Ecological Momentary Assessment Prompting Schedule

Day	6:30-6:45am	8-10am	10am-12pm	12-2pm	2-4pm	4-6pm	6-8pm	8-10pm
Saturday	X	X	X	X	X	X	X	X
Sunday	X	X	X	X	X	X	X	X
Monday	X	X	X	X	X	X	X	X
Tuesday	X	X	X	X	X	X	X	X

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

- Questions on greenness/traffic were only asked outside.

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Measures
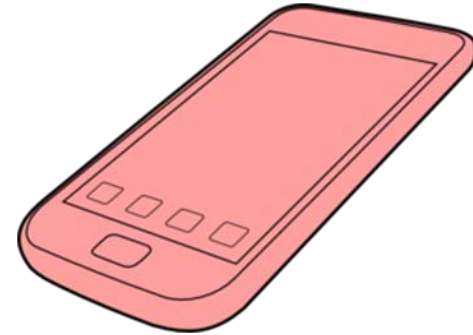
- EMA reported:
  - *Greenness*
    - How many TREES AND PLANTS are there in the area where you are right now?
      - No, few, some, or a lot
  - *Shade*
    - How much SHADE FROM THE SUN is there in the area where you are standing right now?
      - No shade, partially shaded, or completely shaded
  - *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

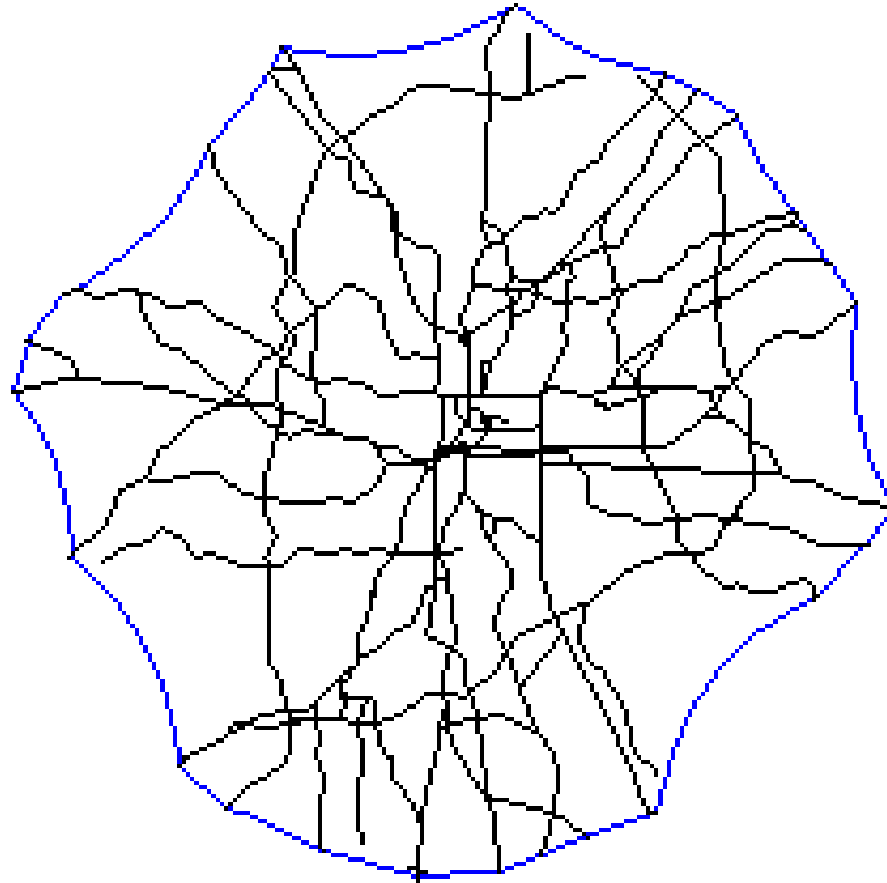Image Source: http://proceedings.esri.com/library/userconf/proc97/proc97/to300/pap296/p296.htm

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

Buffer	β	SE	z	95% CI
500m	-0.64	1.06	-0.61	-2.71 , 1.43
1000m	0.014	1.14	0.01	-2.23, 2.25
3000m	11.59	4.35	**2.66**	3.06, 20.12

Results: Shade on NDVI

Buffer	β	SE	z	95% CI
500m	-0.31	-0.31	-0.69	-1.20, 0.58
1000m	-0.46	0.46	-1.00	-1.36, 0.44
3000m	4.13	2.42	*1.71*	-0.60, 8.86

Results: Traffic on Traffic Collisions

Buffer	β	SE	z	95% CI
500m	0.354	0.14	**2.52**	0.079, 0.63
1000m	0.16	0.049	**3.33**	0.067, 0.26
3000m	0.018	0.0077	**2.41**	0.0034, 0.033

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.

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