Contribution of Streetscape Audits to Explanation of Physical Activity in Four Age Groups: Validity of the Microscale Audit of Pedestrian Streetscapes (MAPS)

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Background

- Built environment factors related to physical activity and walking.
- Microscale features affect people's experience-have been less studied.
- The Microscale Audit of Pedestrian Streetscapes (MAPS) tool designed to measure:
  - street design, transit stops, sidewalk qualities, street crossing amenities, social features, aesthetics

A “Data Blizzard” In Need Of Taming

Objectives

1. Examine associations of microscale environmental attributes
   - Using a reliable instrument and systematic scoring system (Millstein et al., 2013)
   - With multiple physical activity measures
   - In four age groups
   - In three US regions
2. Present findings with and without adjustments for macro-level neighborhood walkability
   - Assessing individual microscale attributes and cumulative scores

Hypotheses:

1. Microscale characteristics expected to be significantly associated primarily with walking for transportation
2. Cumulative scores expected to be stronger correlates of walking for transport than any individual characteristic

MAPS' Development and Use

Tool Development Process

- Started in 2003 as sub-study of NQLS in Seattle.
- New tool, adapted from Analytic Audit Tool (Brownson, Ramirez, Hoehner, & Cook, 2004; HAN).
  - New items developed largely by Jim Sallis, Larry Frank, and Brian Saelens

Overview Of the Tool

- Route
  - A route is approximately .25 miles from the participant's home toward a pre-determined destination (commercial cluster, park, school).
  - Land use and destinations
  - Streetscape
  - Aesthetics and social environment
- Segments
  - Each route composed of one or more (up to eight) segments.
  - A segment is a section of street between two crossings.
- Crossings
  - Crossings are located between segments (up to five crossings per route).
  - A crossing occurs when the rater must go through an intersection
- Cul-de-sacs
  - A cul-de-sac or street dead-end must be within 400 feet of the participants' home and will usually (but not always) be the dead-end part of the participants' street.

How Has It Been Used? Study Design and Areas

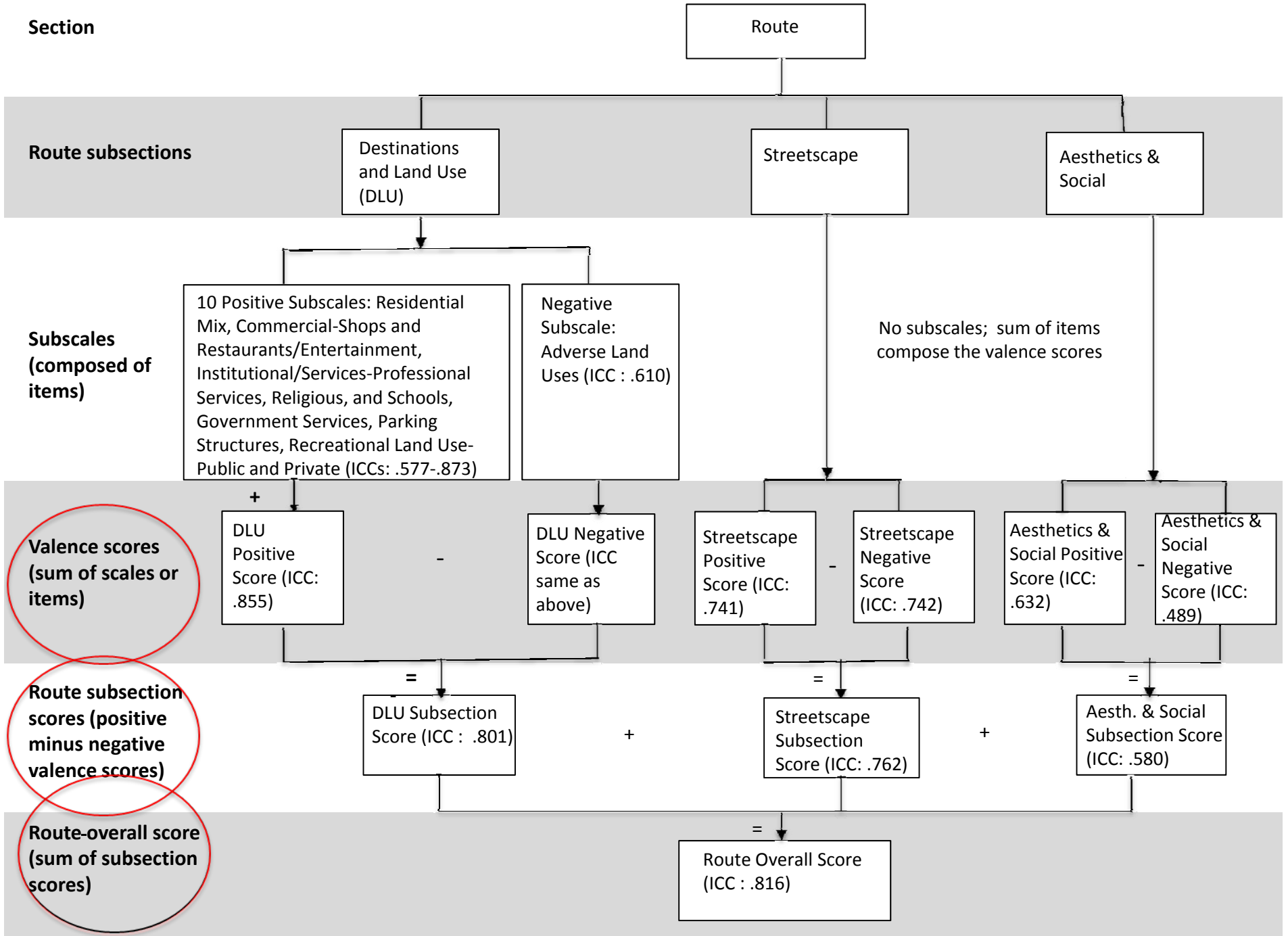
- Series of studies provided data: SNQLS, TEAN, NIK, 2005-2010
  - Seniors, teens, children wore accelerometers, completed surveys (+ adults for surveys) (n=3677)
  - Seattle/King Co., Baltimore/DC 5 Co.'s, San Diego
  - 4-quadrant design:
    - high/low income, high/low walkability (TEAN, SNQLS)
    - high/low nutrition, high/low activity (NIK)
- Reliability testing of subscales, results published (Millstein et al., 2013)
- Validity testing presented here
  - MS submitted/revisions

A Brief Explanation of A (Not-So Brief) Scoring System

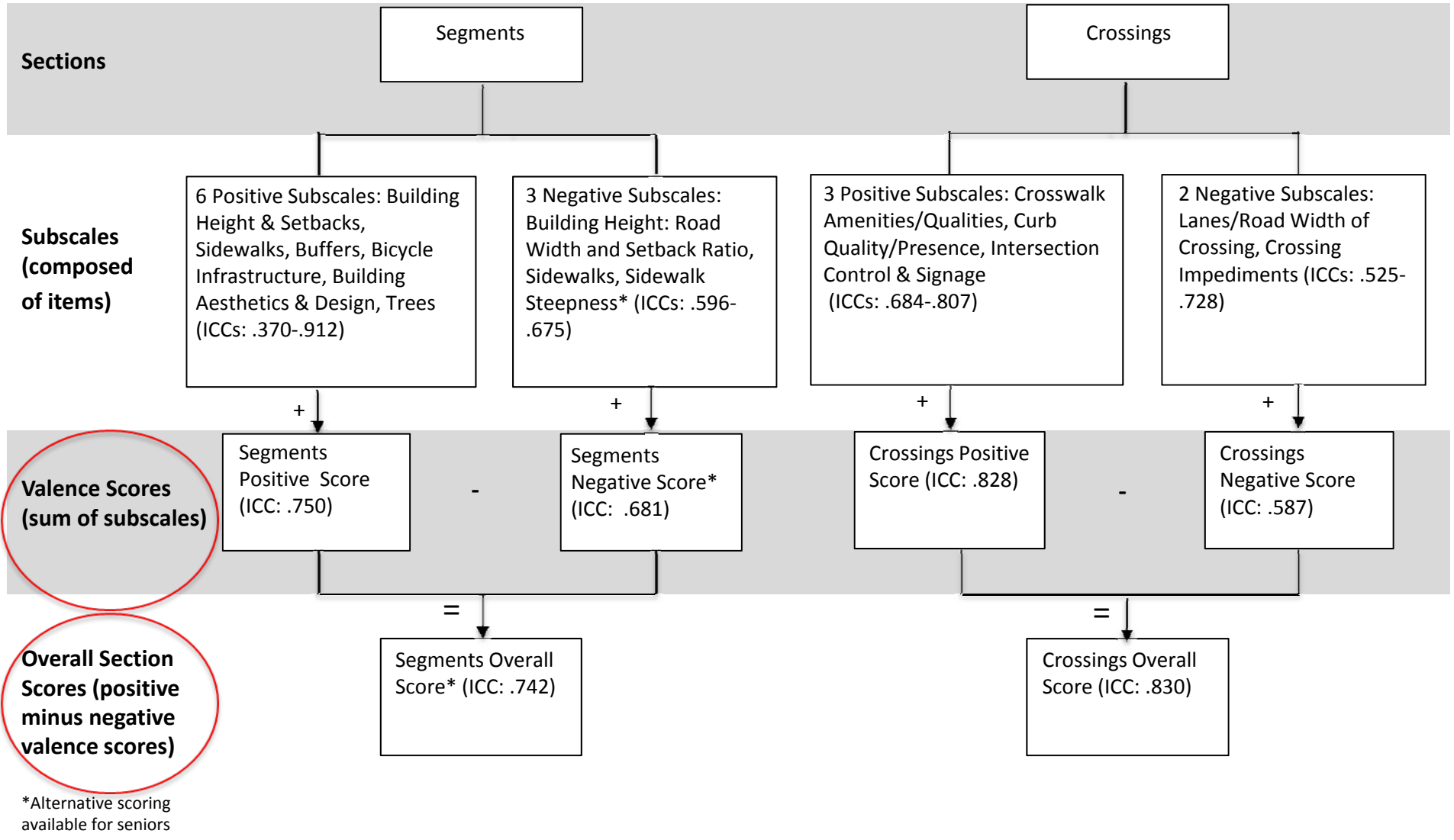
Scoring Process

- Independent subscales for scoring each section:
  - route, segments, crossings, cul-de-sacs
- A positive, negative, and overall (positive-negative) score for each of three main sections
  - most interpretable and policy/change-relevant
- Positive score: subscales thought to be positively related to physical activity
- Negative score: subscales thought to be unfavorable for physical activity.

MAPS scoring structure and summary of inter-rater reliability: Route section (one survey)



MAPS scoring structure and summary of inter-rater reliability: Segments and Crossings sections (multiple surveys per route)



Notes: Intraclass Correlation Coefficient (ICC). The "+" and "-" are used to indicate arithmetic functions. For example, subscale scores are added to create valence scores. Negative valence scores are subtracted from positive valence scores to create overall section scores.

Validity Analyses

How do these subscale scores perform with physical activity outcomes in different populations?

Overview of Findings

- Many significant associations across all age groups
  - after adjusting for macro-level walkability
- Significant MAPS score relationships:
  - 51.2% with walking/biking for transport
  - 22.1% with leisure/neighborhood physical activity
  - 15.7% with objectively-measured MVPA

Summary of significant associations of physical activity outcomes with MAPS Route valence and overall scores

Outcome	Score	Destinations & Land Use	Streetscape Characteristics	Aesthetics & Social Characteristics
Walking/ biking for transport	**+ Valence**	**Children Adolescents Adults Older adults**	**Children Adolescents Adults**	**Older adults**
	- Valence		Children Adolescents Adults Older adults	*Adolescents* *Adults*
	Overall Score	**Children Adults Older adults**	**Children Adolescents Adults Older adults**	***Adults*** ***Older adults***
Leisure/ neighborhood physical activity	**+ Valence**	***Children***		**Children Adults**
	- Valence	Children		Children Adults
	Overall Score		***Adolescents***	**Children Adults**
Objective physical activity (MVPA)	**+ Valence**		**Children**	
	- Valence			
	Overall Score	**Children**		

Summary of significant associations of physical activity outcomes with MAPS Crossing, Segment, and Cul-de-sac valence and overall scores

Outcome	Score	Crossings/ Intersections	Street Segments	Cul-de-sacs	Grand Scores
Walking/ biking for transport	**+ Valence**	**Children** **Older adults**	**Children** **Adolescents** **Adults** **Older adults**		**Children** **Adolescents** **Adults** **Older adults**
	- Valence	Older adults	Children Adults		Children Adults
	Overall Score	**Children** **Older adults**	**Children** **Adults** **Older adults**		**Children** **Adolescents** **Adults** **Older adults**
Leisure/ neighborhood physical activity	**+ Valence**		**Older adults**	**Children** **Adolescents**	***Adolescents***
	- Valence	*Adolescents*	Children		Children
	Overall Score	***Adolescents***	**Children** **Older adults**		***Adolescents***
Objective physical activity (MVPA)	**+ Valence**	**Older adults**	**Older adults**	**Adolescents**	**Children**
	- Valence	Children	Children		Children
	Overall Score	**Older adults**			**Children** **Older adults**

In Sum

- Destinations and land use, streetscape, segment, and intersection variables related to transport walking/biking.
- Aesthetic variables were related to leisure/neighborhood physical activity.
- The overall summary score was related to total MVPA in children and older adults.
- Cul-de-sacs were related to neighborhood physical activity in children and adolescents.
- In general, the strongest associations were seen with the MAPS summary scores.

Conclusions

Review of Findings

- MAPS explained physical activity among four age groups, adjusting for macro-level walkability.
  - Demonstrated value of using observational measures of streetscapes
- Many modifiable built environment attributes are related to physical activity.
- Environment-physical activity associations were:
  - Domain specific
  - Consistent with hypotheses, previous research.

That's pretty cool.

Implications for Practice and Policy

Let's Use MAPS to Make Changes

- Strong evidence that microscale environment features are related to physical activity patterns
  - across age groups
  - independent of macro-level walkability
- Pattern of findings: cumulative effect of multiple attributes likely mechanism of effect
- MAPS can identify built environment changes, can be achieved:
  - reasonable cost
  - feasible time frame
  - likelihood of improving physical activity

That's also pretty cool.

References, Funding, Acknowledgements

- Bauman, A.E., Reis, R.S., Sallis, J.F., Wells, J.C., Loos, R.J.F., & Martin, B.W. on behalf of the Lancet Physical Activity Series Working Group. (2012). Correlates of physical activity: Why are some people physically active and others not? *The Lancet, 380,* 258-271.
- Millstein, R.A., Cain, K.L., Sallis, J.F., Conway, T.L., Geremia, C., Frank, L.D., Chapman, J., Van Dyck, D., Dipzinski, L., Kerr, J., Glanz, K., Saelens, B.E. (2013). Development, scoring, and reliability of the Microscale Audit of Pedestrian Streetscapes (MAPS). *BMC Public Health*, *13, 403*.

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- Background photo courtesy of Mariela Alfonzo, Ph.D.

Extra slides if needed

Training Procedure: Observers, Training and Certification

- Student interns and paid staff
  - Tip: get reasonable people, then train well (it's more about the training).

1. Training: 1 full day in office to go through slides (on CD).
2. Everyone goes out on a route together and talks through.
3. Raters do the same route independently.

   -Has previously been rated by the "gold-standard" rater.

4. All go out and rate
5. Reliability: get certified when achieve a certain % agreement with gold-standard rater and between other raters.

Data collection procedure

- Route items were collected across entire ¼ mile.
- When rater crossed street, a new survey was completed for that crossing, and a new segment.
- New segment survey also when street changed names.
- Cul-de-sacs survey (also for dead-ends) within 400 feet of a participant's home.
- Raters met with supervisor at the end of each day to review the maps and surveys
  - Exactly the same route (same side of the street), that crossings were completed in the same direction, and ending at the same point.
- If deviation, the reliability rating was completed again.
- Raters were given feedback from a supervisor, but their responses were not corrected.
- Residential route surveys were completed in 28.5 minutes on average (range=5-120 minutes)
- Commercial route surveys were completed in 18.5 minutes on average (range=2-75 minutes).

Conceptual Approaches to MAPS Subscale Development

- *A priori* theoretical framework
- Factors that might influence people's perceptions of their PA environments.
  - Safety, aesthetics, functionality, destinations (Pikora et al., 2003/2)
  - Arterial or thoroughfare roads, walkable neighborhood, physical incivilities, and decoration (Evenson et al., 2009)
  - Land use, recreational facilities, transportation environment, aesthetics, and social environment (Hoehner et al., 2005)

Actual Scoring/Sorting Framework Used: Route

1. Destinations and Land Use (all positive influences except for adverse land uses)

- a: Residential Density/Mix
- b: Commercial
  1. Shops
  2. Restaurants/entertainment
- c: Institutional/Services
  1. Professional services
  2. Religious (single item)
  3. Schools (single item)
  4. Government services
- d: Adverse land uses (negative influences on PA): Industrial, Abandoned lot/building, Surface and large parking lot or garage
- e: Transit stop
- f: Parking structures (positive influences on PA)
- g: Rec. land use
  1. Public rec facility
  2. Private rec facility

2. Route Section: Streetscape

- a: Positive Streetscape Elements (e.g., speed limits, pedestrian signage, fountains)
- b: Negative Streetscape Elements (e.g., high speed limits, roll-over curbs, driveways)
- c: Overall Streetscape Scale (Pos - Neg subscales)

3. Route Section: Aesthetics & Social

- a: Positive Aesthetic/Social Elements (e.g., public art, landscaping maintenance)
- b: Negative Aesthetic/Social Elements (e.g., graffiti, physical disorder, broken windows)
- c: Overall Aesthetics & Social Scale (Pos - Neg subscales)

Actual Scoring/Sorting Framework Used: Crossings

1. Positive subscales

a. Crosswalks

1. Amenities/qualities
2. Curb quality/presence

b. Intersection control and signage: general, positive

c. Overall positive subscale (sum of the above)

2. Negative subscales

a. Lanes/road width of crossing

b. Crossing Impediments

c. Overall negative subscale (sum of the above)

3. Overall Crossing Score (Positive-Negative subscale score)

Actual Scoring/Sorting Framework Used: Segments

1. **Positive subscales**
   a. Building height and setbacks
   b. Sidewalk positive qualities: presence/quality/width
   c. Buffer/path/shoulder (sidewalk alternatives) presence/width
   d. Bicycle infrastructure
   e. Building aesthetics and design
   f. Trees
   g. Overall positive subscale score (sum of these)
2. **Negative subscales**
   a. Building height: setback + road width ratio
   b. Traffic lanes and street design
   c. Sidewalk negative qualities: presence/width/quality
   d. Sidewalk steepness (separate scoring for children/teens/adults and seniors)
   e. Overall negative subscale score (sum of these)
3. **Overall segment score (Positive-Negative subscales)** (separate scores for children/teens/adults and seniors)

Scoring system

- Scales created and analyzed based on the reliability samples-all studies combined
- Poor agreement items dropped scales unless expert opinion determined their necessity/relevance
  - Kappa or ICC <0.40 or % agreement <60
  - Some item reliabilities low (low variability) but item was strong conceptual indicator
- Items sorted into appropriate subscales by group consensus-lots of long calls!
- Scoring conventions were developed to simplify scoring
- Most items were coded dichotomously (yes/no) and scored as 0/1.
- Frequency items (0, 1, 2+) scored as 0/1/2, except in the case of infrequent items when 1s and 2s were combined for scale consistency
- Continuous/descriptive items di- or trichotomized based on their distributions, theoretical relevance, and in compatibility with other scale items' scoring.
- Weighting in cases of theoretically determined relevance.
- Several related items combined into single variables to be meaningful components of their respective subscales.

Scale Creation

- Scores of original or modified items were summed to create each subscale.
- Subscales were sorted into their relevant broad category: positive attributes or negative attributes
- Negative items were not recoded, so overall subtraction would make sense.
  - higher negative scores are worse
- Finally, an overall (positive-negative) score was calculated for each of the three main sections.
- A total MAPS score can be calculated by summing the three (or four, if cul-de-sacs were present) overall summary scores.

Key Points, Next Steps

- 1. We have a tool
- 2. We have a scoring system
- 3. It works, our scores are differentially associated with physical activity
- Developed a MAPS short form
  - May use in field testing in August
- Validity analyses on short form
- Validity paper under review
- iPad app for automated scoring