

## **bridging the gap**

Research Informing Policies & Practices  
for Healthy Youth

# Measuring the Built Environment Using a Street Segment Instrument

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## Presentation Objectives

- Describe Street Segment observational data collection instrument for assessing community-level walkability and bikeability
- Describe protocol for reliability studies
- Summarize results from inter-rater reliability studies
- Describe changes made to instrument and protocols based on study findings
- Describe street segment sampling strategy

## Active Living Research Gaps

- Measures of actual environment may differ from measures of perceived environment
- Need ways to measure features of actual built environments
  - To date, primarily archival data and macro-scale analysis (e.g., residential density, traffic zones)
  - Need to understand non-motorized travel, i.e., what features of built environment support walking and biking?
  - There has been some work in matching microscale street measures to PA/walking behavior, but the field is still in its infancy.

# Street Segment Observation Form

- Aid researchers and practitioners in determining which aspects of the built environment are most likely to influence physical activity

- Developed using:

- Published evidence
- Existing audit tools
- Consultation with an expert panel

- Purpose of Current Study:

1. To develop a tool that could be used across urban, suburban and rural areas.
2. To test instrument reliability (inter-rater reliability walking study)
3. To test method reliability (inter-rater reliability walking vs. driving study)

# Street Segment Observation Form Objectives:

## Systematic observation of actual physical environment

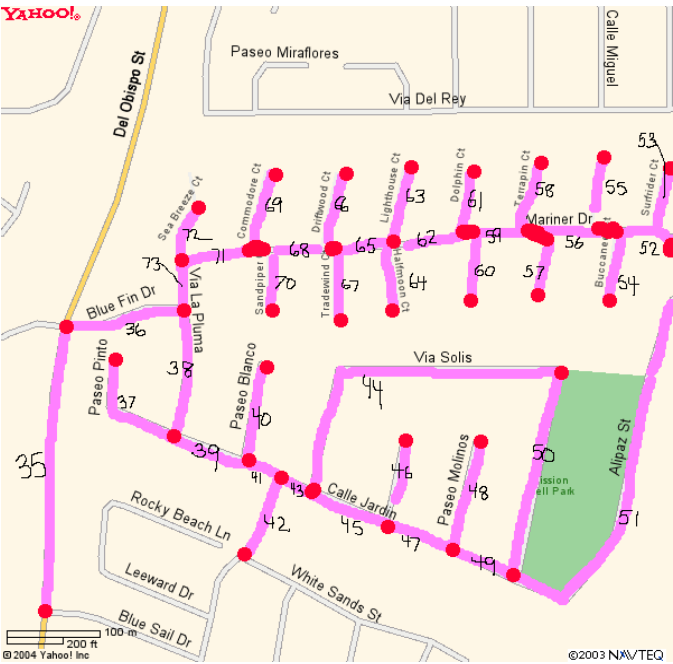
- Presence, qualities of environmental features potentially linked to physical activity (PA)
  - Land Use
  - Street pattern
  - Traffic Calming Features
  - Walkability/Bikeability
  - Presence of amenities
  - Quality of public spaces



# Street Segment Definition

=2 facing sides of street block

In most instances extends from one intersection to the next



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# Study Design

- 8 trained teams audited a total of 120 street segments each
  - The street segments are divided into sectors of 20 pre-determined street segments located in the Chicagoland area
  
- A total of 3 catchment areas will be visited in the this study
  - 1 Urban (544 street segments)
  - 1 Suburban (673)
  - 1 Rural (655)
  
- Each team audited a total of 40 street segments (2 sectors) per catchment area for a total of 120 segments per team

# Data Collection Protocol

- Data collection occurred during a two-week period in July 2009
- 4 Teams were assigned to independently walk street segments
- 4 Teams were assigned to first walk street segments and then two weeks later, drive them.
- Walk only teams independently observed/coded street segments
- Walk vs. Drive teams observed/coded street segments together
- A total of 480 randomly selected street segments (4 forms per segment=1920) were observed.
- Average time to complete observation:
  - 8.11 minutes walk/no talk
  - 10.83 minutes walk/talk
  - 7.77 minutes drive/talk



SEG ADDRESS RANGE:  ZIP:  SEG ID:  -   
 START TIME :  am/pm GPS ID  START WAYPOINT  END WAYPOINT   
 END TIME :  am/pm DATE --2009 STAFF ID 1  ID 2

WEATHER		FINAL STATUS CODE		SAFETY AND COMMENTS		
Sunny	1	COMPLETE – BY WALKING	01	<i>Is the segment safe:</i>	NO	YES
Overcast	2	COMPLETE – BY DRIVING	02	a. for walking?	0	1
Rain	3	INCOMPLETE - Not safe	03	b. for biking?	0	1
Snow	4	INCOMPLETE – Inclement weather	04			
Fog	5	INCOMPLETE – Not accessible	05			
Other	6	NOT ELIGIBLE – Segment listing not an on-site match	96			

**A. LAND USES**

**A1. Scan both sides of the street for presence of:**

	NO	YES, ONE SIDE	YES, BOTH SIDES
a. Housing – Single family	0	1	2
b. Housing – Multifamily	0	1	2
c. Housing – Mobile homes	0	1	2
d. Public / Civic	0	1	2
e. Office / Professional	0	1	2
f. Institutional	0	1	2
g. Service	0	1	2
h. Retail	0	1	2
i. Industrial/ Manufacturing	0	1	2
j. Recreation/Leisure/Fitness	0	1	2
k. Parking	0	1	2
l. Public Space	0	1	2
m. Agricultural	0	1	2
n. Undeveloped	0	1	2
o. Vacant Building or Lot	0	1	2

**A2. Select predominant Land Use and write letter from A1**

**A3. Parking facilities**

	NO	YES
a. On-street angled or parallel	0	1
b. Small lot (30 or fewer spaces)	0	1
c. Medium to large lot/garage/structure	0	1
d. Visible bicycle parking facilities	0	1

**A4. Natural Features**

	NO	YES
a. Large body of water - lake, river, ocean	0	1
b. Small body of water - pond, stream	0	1
c. Mountains or canyon	0	1

**A5. Recreational Facilities**

	NO	YES
a. Indoor commercial PA facility	0	1
b. Park with exercise/sport facilities/equip .	0	1
c. Park, green space without equipment	0	1
d. Stand-alone playing court	0	1
e. Stand-alone playing field	0	1
f. School / school yard (any grade level)	0	1
g. Golf Course	0	1
h. Beach	0	1
i. Outdoor pool	0	1
j. Off-road trails	0	1

**A6. Tally the number of buildings:**

	TALLY	TOTAL
a. All in segment	<input type="text"/>	<input type="text"/>
b. With bars on windows	<input type="text"/>	<input type="text"/>
c. With broken windows	<input type="text"/>	<input type="text"/>
d. With visible tagging	<input type="text"/>	<input type="text"/>

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**B. TRAFFIC AND PEDESTRIANS**

**B1. Street Type**

Through-street	1
Dead end or cul-de-sac with pedestrian thru-way	2
Dead end or cul-de-sac without thru-way	3

**B2. Number of lanes of vehicular traffic**

**B3. Traffic direction**

One-way	1
Two-way	2
Don't Know	7

**B4. Traffic features**

	NO	YES
a. Traffic circle / roundabout / rotary	0	1
b. Speed humps	0	1
c. Median with traffic island	0	1

**B5. Designated bike lanes**

	NO	ONE SIDE	BOTH SIDES
a. Designated by lines or reflectors	0	1	2
b. Designated by physical barrier	0	1	2

**B6. Shoulders / sidewalks**

	NO	ONE SIDE	BOTH SIDES
a. Street shoulder	0	1	2
b. Shoulder has major bumps, cracks, holes, or weeds	0	1	2
c. Curb	0	1	2
d. Curb extension/bulb-out	0	1	2
d. Sidewalk	0	1	2
e. Buffer between street and sidewalk most of the segment	0	1	2
f. Continuous sidewalk in segment	0	1	2
g. Sidewalk continuous between segments at both ends	0	1	2
h. Sidewalk has major bumps, cracks, holes, or weeds	0	1	2
i. Curb cuts or ramps missing at crossing points	0	1	2
j. Permanent obstructions block the sidewalk	0	1	2
k. Street or sidewalk lighting	0	1	2

<b>B7. Intersection and crossing</b>	NO	YES
a. Traffic light	0	1
b. Flashing warning light	0	1
c. Pedestrian signal at traffic light	0	1
d. Stop sign	0	1
e. Marked crosswalk	0	1

**C. SIGNAGE**

<b>C1. Signage present</b>	NO	YES
a. Bicycle crossing	0	1
b. Other bicycle-related signage	0	1
c. Pedestrian crossing	0	1
d. Children at play / special population	0	1
e. Neighborhood or Community signs	0	1

**C2. Regular speed limit** (00 if None)

**C3. Special speed limit** (00 if None)

**D. AMENITIES AND LITTER**

**D1. Aesthetics**

	NO	YES
a. Sidewalk and/or shoulder shade	0	1
b. Public gardens, flower beds, planters, or other landscaping	0	1
b. Public art, statue, or monument	0	1
c. Decorative water fountain	0	1

**D2. Amenities**

	NO	YES
a. Public trash cans	0	1
b. Street dispensers/ vending machines	0	1
c. Benches or other seating	0	1
d. Drinking fountain(s)	0	1
e. Outdoor dining area(s)	0	1

**D3. Transit facilities**

	NO	YES
a. Bus stop	0	1
b. Rail or bus station	0	1
c. Light rail or trolley	0	1
d. Bench or covered shelter at transit stop	0	1

<b>D4. Garbage or litter</b>	NONE	SOME	A LOT
	0	1	2

## Average Reliability Measures for Walk/No Talk

Measure	Kappa/ICC	% Agreement	Range
Land Use (16 items)	0.67	92%	0.19 - 0.99
Parking Facilities (4)	0.68	95%	0.45 - 0.87
Natural Features (3)	0.66	99%	0.66 - 1.00
Physical Activity Venues (10)	0.68	99%	0.41 - 1.00
Physical Disorder (4)	0.75	--	0.57 - 0.98
Traffic Calming (6)	0.73	94%	0.40 - 0.88
Bike Lane Measures (2)	0.96	99%	0.92 - 1.00
Shoulder/Sidewalk (12)	0.67	91%	0.11 - 0.95
Traffic Control Devices (5)	0.75	96%	0.21 - 0.96
Signage (7)	0.77	96%	0.35 - 0.96
Amenities/Aesthetics (9)	0.62	93%	0.37 - 0.74
Public Transportation (4)	0.54	98%	0.00 - 0.82
Litter (1)	.60	71%	--

## Average Reliability Measures for Walk Vs. Drive

Measure	Kappa/ICC	% Agreement	Range
Land Use (16 items)	0.80	94%	0.50 - 0.91
Parking Facilities (4)	0.67	94%	0.47 - 0.82
Natural Features (3)	0.89	99%	0.66 - 1.00
Physical Activity Venues (10)	0.76	99%	0.57 - 1.00
Physical Disorder (4)	0.75	--	0.59 - 0.96
Traffic Calming (6)	0.78	96%	0.56 - 0.88
Bike Lane Measures (2)	0.95	99%	0.89 - 1.00
Shoulder/Sidewalk (12)	0.65	92%	0.01 - 0.96
Traffic Control Devices (5)	0.87	96%	0.80 - 0.96
Signage (7)	0.85	98%	0.66 - 1.00
Amenities/Aesthetics (9)	0.70	94%	0.54 - 1.00
Public Transportation (4)	0.87	99%	0.72 - 1.00
Litter (1)	.73	77%	--

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## Revisions to Street Segment Observation Form Based on Reliability Study

- Revised/tightened definitions for problematic land use measures (undeveloped land vs. vacant building/lot)
- Dropped Physical Disorder tally, now capture presence of physical disorder measures
- Dropped condition of shoulders and sidewalks
- Dropped permanent obstruction on sidewalk
- Retrained on sidewalk/shoulder shade and benches/other seating

# Census of Street Segments

Inter-Rater Reliability Results

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# Data Collection Protocol

- Purpose of street segment census was to determine sampling strategy across communities.
- Data collection occurred during a four-week period in October 2009
- A census of street segments for our three sites were audited (N=1872 segments).
- 4 Teams were also assigned to independently walk a random sample of street segments to test the revised instrument.
- Each team independently observed/coded 45 street segments
- A total of 180 randomly selected street segments were observed.
- Average time to complete the observation was 4.55 minutes

## Average Reliability Measures for Follow Up Inter-Rater Reliability

Measure	Kappa/ICC	% Agreement	Range
Land Use (16 items)	0.88	96%	0.75 - 1.00
Parking Facilities (3)	0.90	96%	0.78 - 0.97
Natural Features (3)	0.99	99%	0.98 - 1.00
Physical Activity Venues (10)	0.98	99%	0.97 - 1.00
Physical Disorder (4)	0.65	91%	0.53 - 0.76
Traffic Calming (7)	0.97	99%	0.94 - 1.00
Bike Lane Measures (2)	1.00	100%	1.00 - 1.00
Shoulder/Sidewalk (9)	0.75	88%	0.51 - 0.98
Traffic Control Devices (4)	0.89	97%	0.82 - 0.95
Signage (6)	0.94	98%	0.85 - 0.99
Amenities/Aesthetics (7)	0.84	96%	0.55 - 0.95
Public Transportation (4)	0.94	98%	0.89 - 0.99
Litter (1)	0.78	84%	--

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## Street Segment Sampling Strategy Based on Census of Street Segment Study

- Analyses run separately by urbanization and street classification (arterial vs. residential).
- Draw sample of street segments that provide 90% CI with 20% width.
- Yields a sample size of between 55 to 70 street segments per community.
- Street segment sample drawn using PPS strategy.
- Street segments stratified by: school buffer (2 mile radius), arterial, and residential.
- Street segments randomly drawn from each strata proportionate % of streets that fall within each strata.

## Street Segment Observation Form Inter-Reliability Results

- Presence of Street Shoulder still had lower reliability (ICC=0.63, 88% Agreement)
- Sidewalk buffer still had lower reliability (ICC=0.64, 78% Agreement)
- Sidewalk Shade still had lower reliability (ICC=0.51, 63% Agreement)
- Added a measure of yard debris to pick up physical disorder in rural areas

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- Kevin Gibbs
- Chris Quinn
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- Kelly Clifton, PhD
- Christine Hoehner, PhD
- Rebecca Lee, PhD
- Jim Sallis, PhD
- Marc Schlossberg, PhD

## Audit Tools:

- Analytic Audit Tool, Saint Louis University
- Checklist Audit Tool, Saint Louis University
- Active Neighborhood Checklist, Saint Louis University
- Irvine Minnesota Inventory, University of California, Irvine and University of Minnesota
- Pedestrian Environment Data Scan (PEDS), University of Maryland