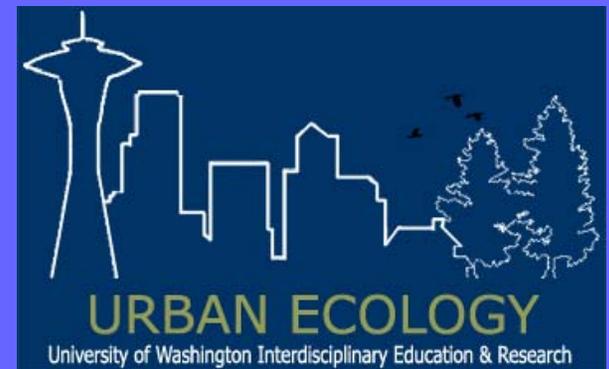


Neighborhood Greenness, Walkable Destinations and Health

Jenna Tilt, College of Forest Resources

Thomas Unfried, College of Forest Resources

Belen Roca, Urban Planning



Purpose

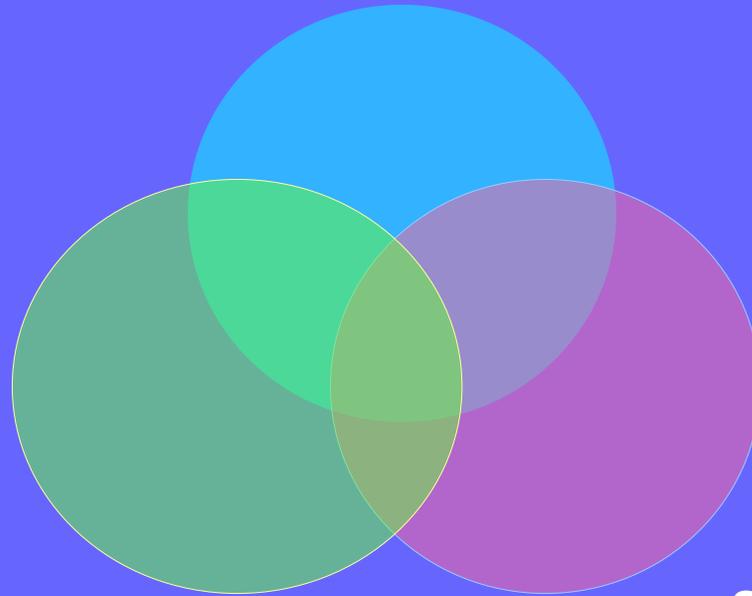
To examine influence of:

- 1) Destinations within walking distance
- 2) The natural environment

on self-reported walking trips, BMI and quality of life measures.

Study Design

GIS Network Analysis
(objective walkability measurement)

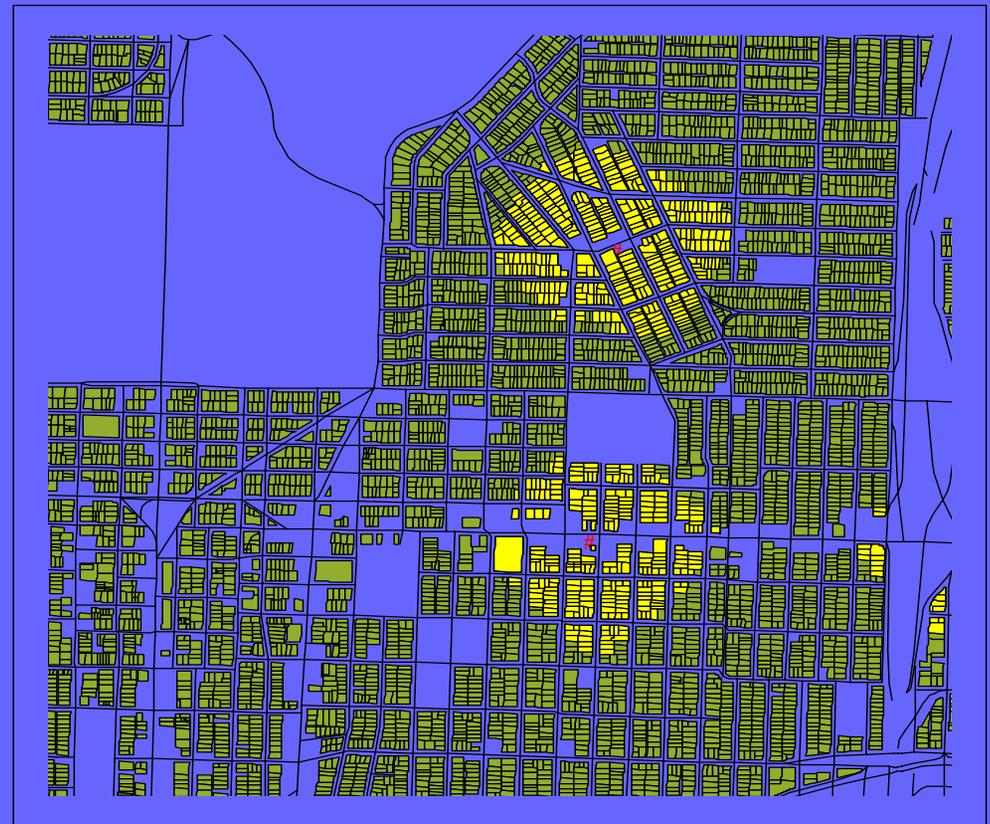


**Normalized Difference
Vegetation Index (NDVI)**
(objective greenness measurement)

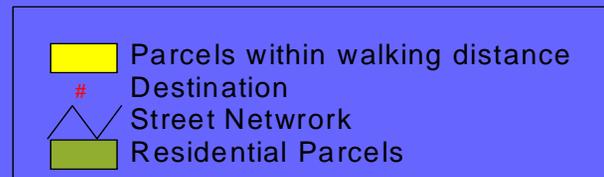
**Survey to
Seattle Residents**
(subjective walkability and greenness,
QOL, BMI, walking trips)

GIS Network Analysis

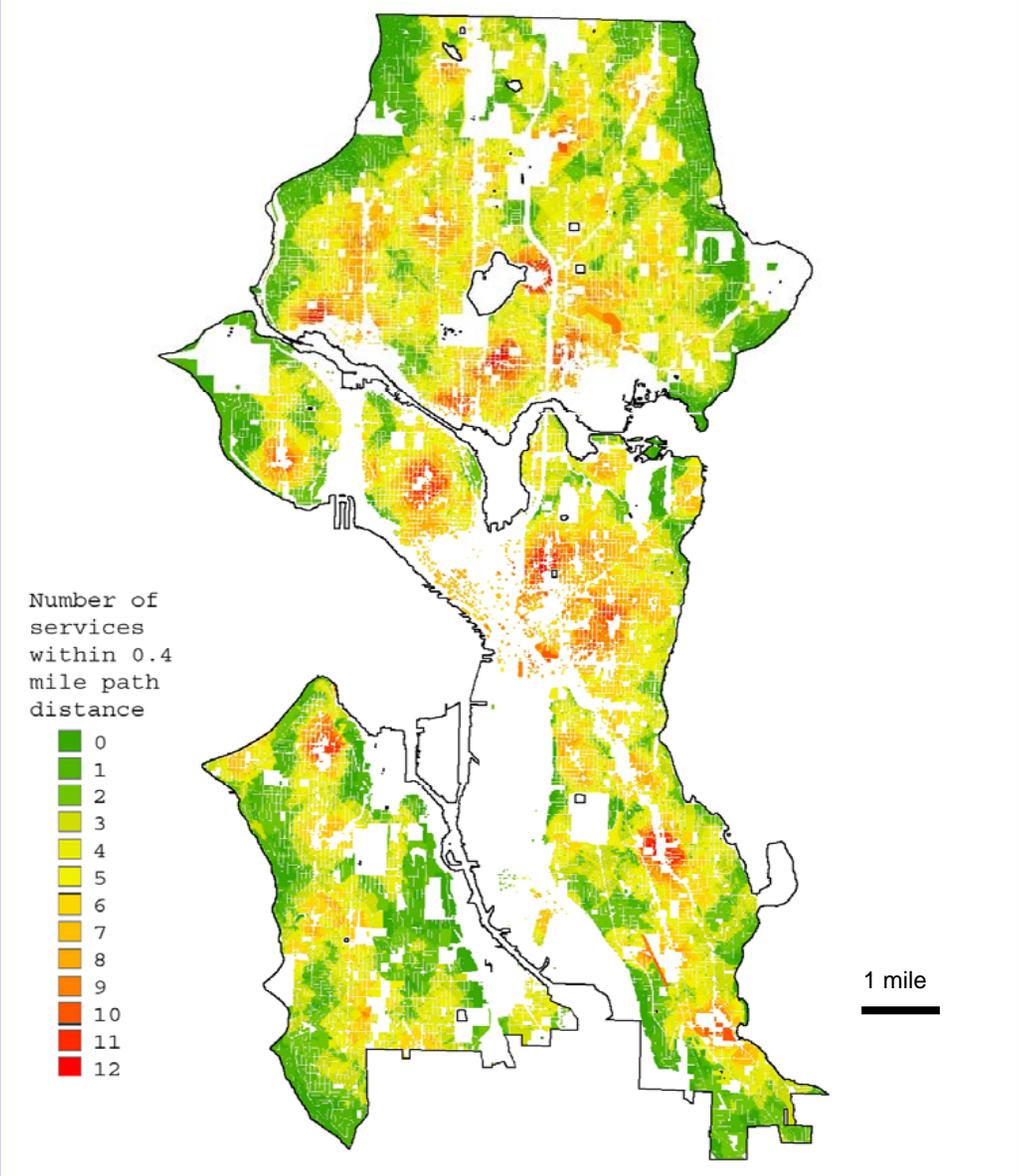
- 1) Calculated a service area of 0.4 miles network distance around each destination
- 2) Selected residential parcels found in that service area.
- 3) Overlaid all service areas for every destination



3000 0 3000 6000 Feet

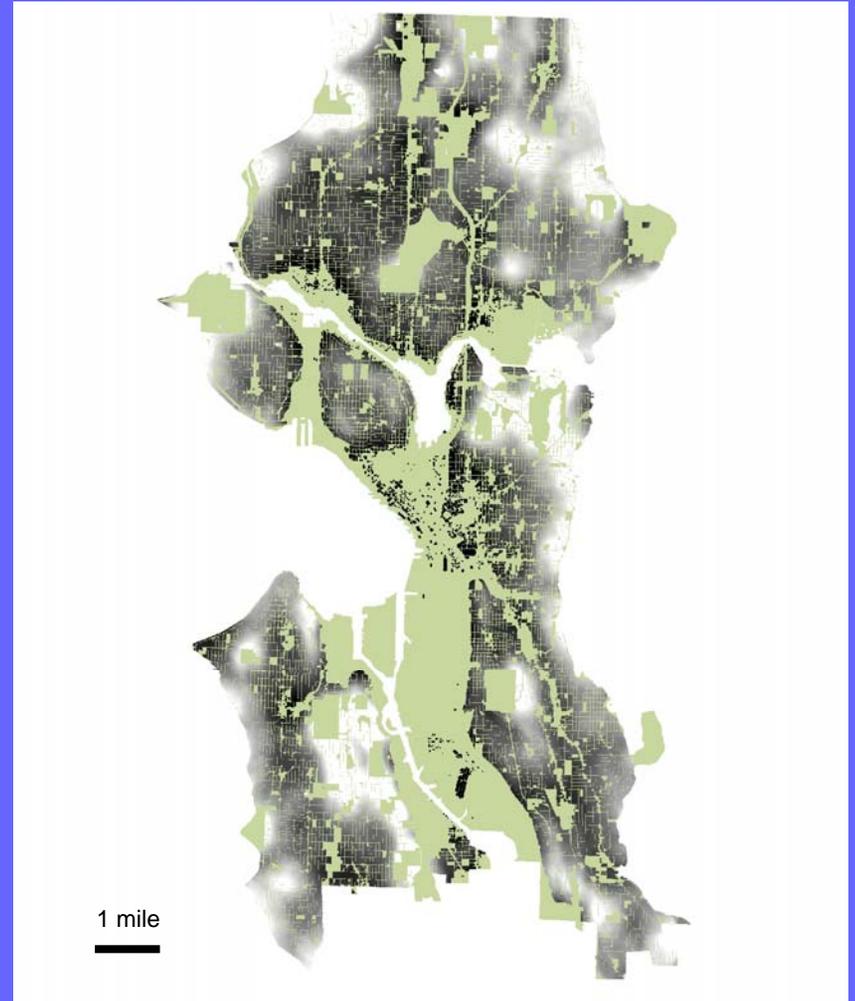


Walkability Map of Seattle, Washington



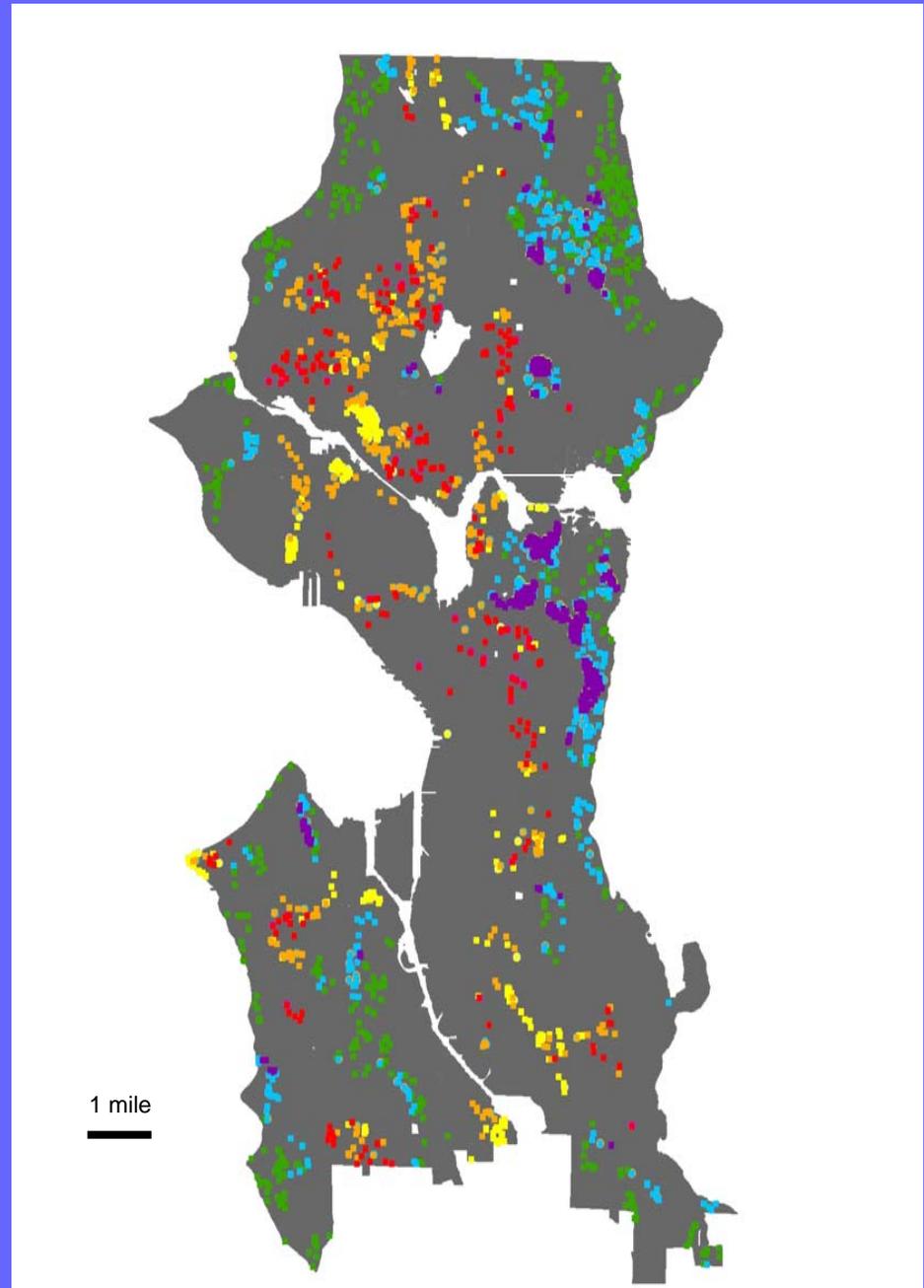
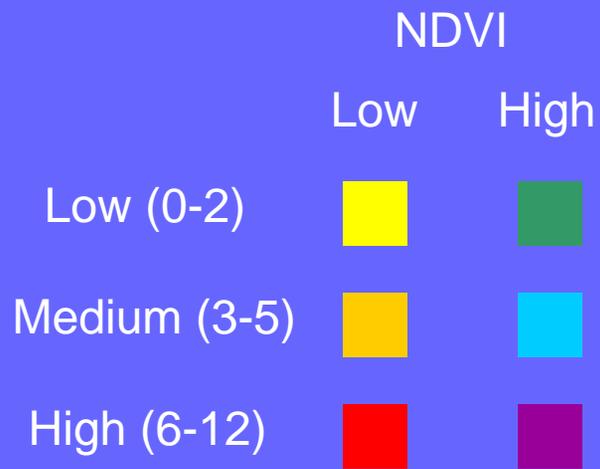
Normalized Difference Vegetation Index (NDVI)

- Remotely-sensed spectral vegetation index
- Related to the amount green, i.e. vegetation, in survey pixel
 - higher values (lighter on map) generally associated with more vegetation
- NDVI varies among different zoning categories (Wilson et al., 2003)



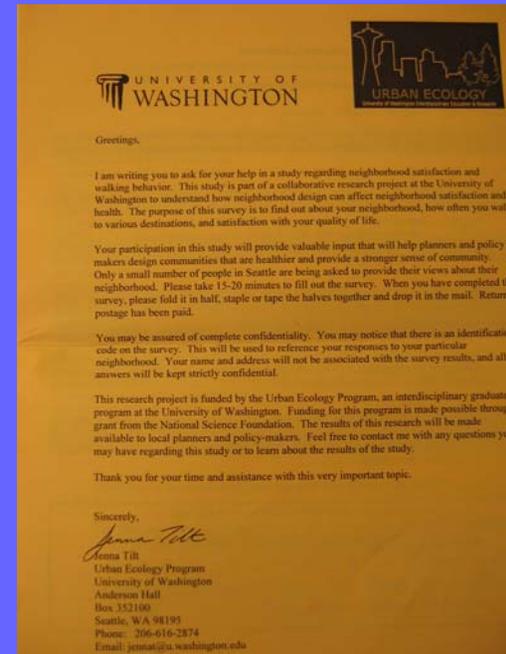
Walkable Destinations and NDVI

Walkability



Residential Survey

- Self-reported walking trips to destinations (within 0.5 mile distance)
- Self-reported natural features in the neighborhood (within 0.5 mile distance)
- Quality of Life
- Sense of Community
- Importance of Destinations
- BMI
- Demographics (age, sex, income and education)



10) How often do you walk to the following places in your neighborhood (approximately the area within a mile distance in all directions from your home—everything reachable by roughly a 10-15 minute walk or about 10 blocks)? Please check if the feature is in your neighborhood, then circle how often you walk there. If the feature is not found in your neighborhood, leave the entire line blank.

	Check only if FOUND in your neighborhood	Never	About once a year	About once a month	About once a week	More than once a week
Community Centers	<input type="checkbox"/>	1	2	3	4	5
Community centers/bookstores	<input type="checkbox"/>	1	2	3	4	5
Play areas and playgrounds	<input type="checkbox"/>	1	2	3	4	5
P-patches	<input type="checkbox"/>	1	2	3	4	5
Libraries	<input type="checkbox"/>	1	2	3	4	5
Bars or pubs	<input type="checkbox"/>	1	2	3	4	5
Banks	<input type="checkbox"/>	1	2	3	4	5
Restaurants	<input type="checkbox"/>	1	2	3	4	5
Coffee shops	<input type="checkbox"/>	1	2	3	4	5
Parks	<input type="checkbox"/>	1	2	3	4	5
Post Office	<input type="checkbox"/>	1	2	3	4	5
Schools	<input type="checkbox"/>	1	2	3	4	5
Theaters (playhouses or libraries)	<input type="checkbox"/>	1	2	3	4	5
Public swimming pools	<input type="checkbox"/>	1	2	3	4	5
Beaches	<input type="checkbox"/>	1	2	3	4	5
Churches or places of worship	<input type="checkbox"/>	1	2	3	4	5
Natural areas (not parks)	<input type="checkbox"/>	1	2	3	4	5
Place of your employment	<input type="checkbox"/>	1	2	3	4	5
Other places (please list below)	<input type="checkbox"/>	1	2	3	4	5

7

Respondent Population

- Response Rate= 17.5%
- Female= 57%
- Age over 51= 52.6%
- College Education or above = 80%
- Income, 50K or above = 57.7%
- NDVI mean = 0.360 (non-respondent mean = 0.336)
- GIS Destination mean = 4.18 (non-respondent mean = 4.16)



Medium Walkability
Low NDVI

Results

Walking trips were correlated with number of destinations in walking distance ($r=.329$, $p=.01$).

Destinations	Walking Trips Per Month		<i>P</i> *
	Destination within 0.4 mile walking distance	Destination <i>not</i> within 0.4 mile walking distances	
Grocery Stores	Men=26.45	Men=19.01	.0014
	Women=26.07	Women=19.45	.0013
P-Patches	Men=29.58	Men=21.50	.0087
	Women=31.88	Women=20.72	.0002
Libraries	Men=26.42	Men=22.10	.1882
	Women=29.45	Women=21.10	.0047
Banks	Men=30.21	Men=20.35	.0003
	Women=28.72	Women=20.69	.0023
Restaurants	Men=24.61	Men=19.10	.0262
	Women=23.70	Women=19.90	.0699
Parks	Men=24.78	Men=19.14	.0198
	Women=25.84	Women=16.98	.0001
Schools	Men=26.11	Men=19.79	.0068
	Women=24.90	Women=19.55	.0088
Beaches	Men=45.21	Men=22.72	.0651
	Women=37.78	Women=21.65	.0024

* P values represent t-test on regression coefficient for each destination

Walking trips and Quality of Life

Walking trips per month are positively associated with the following Quality of Life Measurements:

- **Quality of life** ($r^2 = .16$, $p < .0001$ (model); t-test on regression coefficient for walking trips $p = .0003$)
- **Sense of Community** ($r^2 = .15$, $p < .0001$ (model); t-test on regression coefficient for walking trips $p < .0001$)
- **Importance of destinations** ($r^2 = .34$, $p < .0001$ (model); t-test on regression coefficient for walking trips $p < .0001$)



Medium Walkability, High NDVI

Perception of Walkable Destinations

Destinations	Subjective Destinations (Self-report)	Objective Destinations (GIS Network Analysis)
Parks	415 (79%)	327 (62%)†
Grocery stores/ markets	420 (80%)	241 (46%)†
Restaurants	421 (80%)	322 (61%)†
Play areas and playgrounds	428 (81%)	260 (49%)†
Banks	286 (54%)	107 (20%)†
Bars or pubs	347 (66%)	65 (12%)*
Libraries	274 (52%)	76 (14%)†
Post Office	236 (45%)	25 (5%)†
Beaches	197 (37%)	13 (3%)†
Community Center	290 (55%)	50 (10%)†
Schools	320 (61%)	254 (48%)†
Theaters	145 (28%)	46 (9%)†
Churches or places of worship	275 (52%)	321 (61%)†
P-patches	163 (31%)	81 (15%)†
Public swimming pools	122 (23%)	8 (2%)*

* Pearson Correlation significant at the $p < 0.05$ level (2-tailed)

† Pearson Correlation significant at the $p < .01$ level (2-tailed)

Vegetation and Walkable Destinations

- Respondents in low NDVI areas overestimated destinations within 0.4 mile ($F_{1,499} = 10.15, p = .002$).
- Respondents in low NDVI areas did not make more walking trips per month ($F_{1,451} = .682, p = .409$).



Low NDVI, Low Walkability



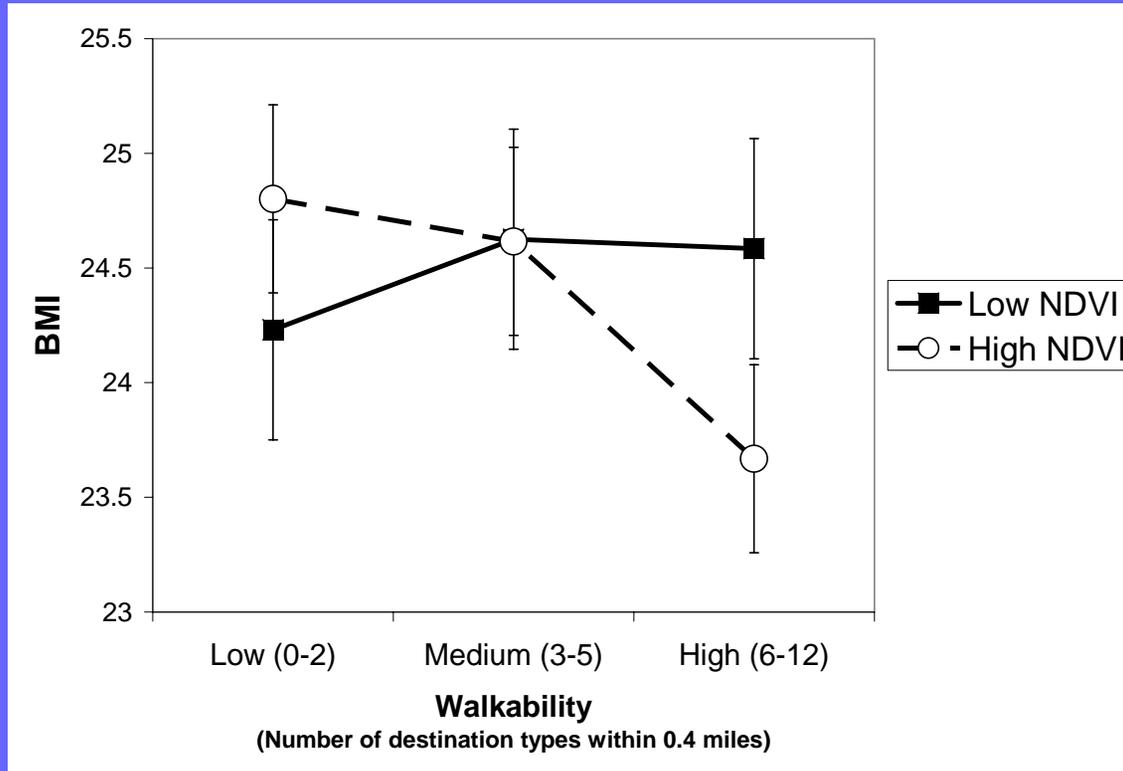
High NDVI, Low Walkability

Perception of Vegetation and Walkable Destinations

- Subjective greenness is moderately correlated with walking trips per month ($r = .155$, $p = .01$).
- Subjective greenness of vegetation is moderately correlated with the NDVI ($r = .230$, $p = .01$).

Natural Features	Number of respondents
Opportunities to see birds, squirrels, rabbits	493 (93%)
Opportunities to see larger wildlife	221 (42%)
Large trees in neighborhood	488 (92%)
Lakes or streams	315 (60%)
Street trees	470 (89%)
View of nature from your home	448 (85%)
Natural vegetation in yards (e.g. ferns, shrubs, pine trees and little or no lawn)	460 (87%)
Scenic vistas or views	445 (84%)

NDVI, BMI and Walkability

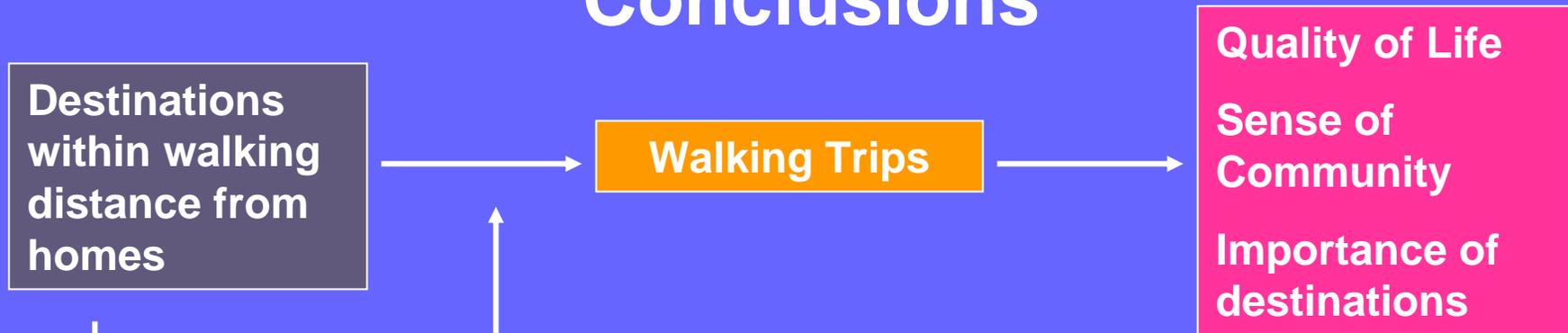


Low NDVI, High Walkability



High NDVI, High Walkability

Conclusions



Importance of vegetation in the built environment

- Defensible space and safety (Kuo et al., 2001)
- Social well being (Kearney, 2005; Coley et al., 1997)
- Attention restoration (Kaplan, 1995)
- Air and water quality (Dwyer et al., 1992)
- Sidewalk preservation (McPherson et al., 2005)

Acknowledgements

- Urban Ecology Program Faculty:
Gordon Bradley, Marina Alberti, John Marzluff, Clare Ryan, and Craig ZumBrunnen
- Anne Vernez Moudon and Urban Form Lab at the University of Washington
- NSF Integrative Graduate Education and Research Traineeship (IGERT) program