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:

Destinations within walking distance
 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
- Selected residential parcels found in that service area.
- 3) Overlayed all service areas for every destination



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





Residential Survey

BUSINESS REPLY MAIL

- 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)



Descention Control Image: Section Control		Check only if FOUND in your seighborhood	Never	About once a year	About once a month	About noce a week	More than once a week
Observed Main data is an out in weight	Community Contern	The store of the set	1	2	161	4	4
Programmed programmed	Grocery stores/markets	D New office do you wold there?	204	2	3	4	
Pipeladas Impactional source and intervious 2 3 4 5 Extension Impacting and intervious 1 2 3 4 5 Brain or public Impacting and intervious 1 2 3 4 5 Brain or public Impacting and intervious 1 2 3 4 5 Brain or public Impacting and intervious 1 2 3 4 5 Brain or public Impacting and intervious 1 2 3 4 5 Brain or public Impacting and intervious 1 2 3 4 5 Partice Impacting and intervious and intervious 1 2 3 4 5 Stations Impacting and intervious and intervious 1 2 3 4 5 Stations Impacting and intervious all intervious 1 2 3 4 5 Stations Impacting and intervious all intervious 1 2 3	Play areas and playgrounds	D Strate down with days"		2	3	4	4
Litrecter: Bin or public days walk lited: 1 2 3 4 5 Bin or public Bin days days walk lited: 1 2 3 4 5 Binks Bin days days walk lited: 1 2 3 4 5 Binks Bin days days walk lited: 1 2 3 4 5 Colfer Maps Bin days days walk lited: 1 2 3 4 5 Parks Bin days days walk lited: 1 2 3 4 5 Parks Bin days days walk lited: 1 2 3 4 5 Parks Bin days days walk lited: 1 2 3 4 5 Parks Bin days days walk lited: 1 2 3 4 5 Parks Bin days days walk lited: 1 2 3 4 5 Parks Bin days days walk lited: 1 2 3 4 5 Parks days days wal	P-patches	Her ofer dryon wall they?	e a	2			
Binn or puls The deter days with laws 1 2 1 4 5 Binks The deter days with laws 1 2 3 4 5 Binks The deter days with laws 1 2 3 4 5 Binks The deter days with laws 1 2 3 4 5 Cottle The date date days with laws 1 2 3 4 5 Park The date date date with laws 1 2 3 4 5 Park The date date with laws 1 2 3 4 5 Park The date date with laws 1 2 3 4 5 Dest Office The date date with laws 1 2 3 4 5 Dest office The date date with laws 1 2 3 4 5 Dest office The date date with laws 1 2 3 4 5 Dest office <th< td=""><td>Libraries</td><td>Construction and start</td><td>1.1</td><td></td><td>-</td><td>14</td><td></td></th<>	Libraries	Construction and start	1.1		-	14	
Basks Basks Bask devices well device 1 2 3 4 5 Rentagene Bask devices well device 1 2 3 4 5 Offen Marge Bask devices well device 1 2 3 4 5 Parks Bask devices well device 1 2 3 4 5 Parks Bask devices well device 1 2 3 4 5 Parks Bask devices well device 1 2 3 4 5 Parks Bask devices well device 1 2 3 4 5 Parks Bask devices well device 1 2 3 4 5 Parks Bask devices well device 1 2 3 4 5 Parks Bask devices well device 1 2 3 4 5 Parks Bask devices well device 1 2 3 4 5 Parks <t< td=""><td>Bars or pubs</td><td>Contraction do you walk stars"</td><td>5.1</td><td>84</td><td>1</td><td>-</td><td></td></t<>	Bars or pubs	Contraction do you walk stars"	5.1	84	1	-	
Restaurum Impeddend zwe und indexe 1 2 3 4 5 Collifies Marga Impeddend zwe und indexe 1 2 3 4 5 Parks Impeddend zwe und indexe 1 2 3 4 5 Parks Impeddend zwe und indexe 1 2 3 4 5 Parks Impeddend zwe und indexe 1 2 3 4 5 Street Office Name and Indexe 1 2 3 4 5 Parker (Mell Name and Indexe 1 2 3 4 5 Parker (Mell Name and Indexe 1 2 3 4 5 Parker (Mell Name and Indexe 1 2 3 4 5 Parker (Mell Name and Indexe 1 2 3 4 5 Parker (Mell Name and Indexe 1 2 3 4 5 Parker (Mell Name and Indexe 1 2 3 4 5 Parker (Mell Name and Indexe 1 2 3 4 5 Parker (Mell Name and Indexe 1 2 3 4 5 Parker (Mell Name and Indexe 1 2 3 4 <td>Ranks</td> <td>Distant and an address of the set</td> <td>1998</td> <td></td> <td>1</td> <td></td> <td></td>	Ranks	Distant and an address of the set	1998		1		
Colfice Shape, Bene detections with theme: 1 2 3 4 5 Parties Bene detections with theme: 1 2 3 4 5 Parties Bene detections with theme: 1 2 3 4 5 Parties Bene detections with theme: 1 2 3 4 5 Statistics Bene detections with theme: 1 2 3 4 5 Statistics Bene detections with theme: 1 2 3 4 5 Statistics Bene detections with theme: 1 2 3 4 5 Statistics Bene detections with theme: 1 2 3 4 5 Statistics Bene detections with theme: 1 2 3 4 3 Statistics Bene detections with them: 1 2 3 4 3 Statistics Bene detections with them: 1 2 3 4 3	Rotarati	De litre after de yes suit dans?					
Important one with starter barrow (Starter, Strategy, Starter, Starter	Cotting Shops	The size do not will done?	× 1	-	-		
March and State and Advances and Advances 1 2 3 4 Athena Construction and Advances 1 2 3	Parks	D Her stords on side days					
Internet store well kalow, i 1 2 3 4 5 Internet store well kalow, i 1 2 3 4 5 Internet store well kalow, i 1 2 3 4 5 Affer systemating proof. Internet store well kalow, i 1 2 3 4 5 Affer systemating proof. Internet store well kalow, i 1 2 3 4 5 Affer systemating proof. Internet store well kalow, i 1 2 3 4 5 Affer systemating proof. Internet store well kalow, i 1 2 3 4 5 Affer systemating proof. Internet store well kalow, i 1 2 3 4 5 Affer systemating proof. Internet store well kalow, i 1 2 3 4 5 Affer systemating roof. Internet store well kalow, i 1 2 3 4 5 Affer systemating roof. Internet store well kalow. 1 2 3	Aust Chilling	The start is set and the of	2.14				
Interest (Feld Nations' or and Antisy) 1 2 3 4 5 and c existencing pools Interestination of the set of the s	-	Contractor do you will done'		10			
Annu Jacobis Ministry pools	beaters (playhouses or	"They adore do you wall theye"			3.1	- 4	3
Affer versioning pool I 2 3 4 5 sterbler or places of resplay in places of resplay in places of resplay in places of resplay in places of resplay in places of resplay in places of resplay in places of	and a second second	The line also do see and they?	ST	2	2	4	
action: 1 2 3 4 3 include any places of indegram and a set provide a structure of the set of th	able withining pools	Co Brade do mademati		-2	3.1	4	5
Institution Image: Control of Contro	number or places of		1	2	3	. 4	.5
Allow after data data wait how* 1 2 3 4 5 for of your Allow after data wait how* 1 2 3 4 5 for protect Allow after data wait how* 1 2 3 4 5 for protect Differentiation wait how? 1 2 3 4 5 end main Differentiation wait how? 1 2 3 4 5	and an an and an and	Commentation and states.	1	-2	3	14	
And the providence of the second street of the seco	(ka)	Ane attends one walk down"	1		31-	4	1 28
and Control (please first)	playment	D fire also de yes suit dure?	1	2		4	.9
	ine powers (please list	Chine advention on well there !	-1	- 2	-	-	

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

	Destinations	Walking Tri		
Results		Destination within 0.4 mile walking distance	Destination <i>not</i> within 0.4 mile walking distances	P *
Valking trips	Grocery	Men=26.45	Men=19.01	.0014
	Stores	Women=26.07	Women=19.45	.0013
orrolated with	P-Patches	Men=29.58	Men=21.50	.0087
orrelated with		Women=31.88	Women=20.72	.0002
umber of lestinations in	Libraries	Men=26.42	Men=22.10	.1882
		Women=29.45	Women=21.10	.0047
valking	Banks	Men=30.21	Men=20.35	.0003
listance - 329 p- 01)		Women=28.72	Women=20.69	.0023
	Restaurants	Men=24.61	Men=19.10	.0262
=.329, p=.01).		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 (r² = .16, p < .0001 (model); t-test on regression coefficient for walking trips p = .0003)
- Sense of Community (r² = .15, p < .0001 (model); t-test on regression coefficient for walking trips p < .0001)
- Importance of destinations (r² = .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



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