### Purdue University Purdue e-Pubs

#### **GIS** Day

GIS, Geoinformatics, and Remote Sensing at Purdue

11-14-2007

# Using Accelerometry and Wearable GPS Units to Measure Trail Users' Physical Activity: Preliminary Findings

Philip J. Troped *Purdue University*, ptroped@purdue.edu

Charles E. Matthews Vanderbilt University

Ellen K. Cromley Institute of Community Research

Steven J. Melly *Harvard University* 

Marcelo S. Oliveira GeoStats (Atlanta, GA)

See next page for additional authors

Follow this and additional works at: http://docs.lib.purdue.edu/gisday

Troped, Philip J.; Matthews, Charles E.; Cromley, Ellen K.; Melly, Steven J.; Oliveira, Marcelo S.; and Wolf, Jean, "Using Accelerometry and Wearable GPS Units to Measure Trail Users' Physical Activity: Preliminary Findings" (2007). *GIS Day.* Paper 4. http://docs.lib.purdue.edu/gisday/4

This document has been made available through Purdue e-Pubs, a service of the Purdue University Libraries. Please contact epubs@purdue.edu for additional information.

#### Authors

Philip J. Troped, Charles E. Matthews, Ellen K. Cromley, Steven J. Melly, Marcelo S. Oliveira, and Jean Wolf



### Using Accelerometry and Wearable GPS Units to Measure Trail Users' Physical Activity: **Preliminary Findings**

Philip J. Troped<sup>1</sup>, Charles E. Matthews<sup>2</sup>, Ellen K. Cromley<sup>3</sup>, Steven J. Melly<sup>4</sup>, Marcelo S. Oliveira<sup>5</sup>, Jean Wolf<sup>5</sup> Purdue University, Department of Health & Kinesiology<sup>1</sup>, W. Lafayette, IN; Vanderbilt University<sup>2</sup>, Nashville, TN; Institute of Community Research<sup>3</sup>, Hartford, CT; Harvard School of Public Health<sup>4</sup>, Boston, MA; GeoStats<sup>5</sup>, Atlanta, GA

### Background

In recent years, there has been a growing body of public health research examining the role of community trails and paths in the promotion and maintenance of physical activity. However, little is known about how much activity occurs on trails, the impact of community trails on overall physical activity levels or about the relationships between specific trail characteristics and utilization. The integration of activity measurements technologies, specifically accelerometers and wearable global positioning system (GPS) units that can track spatial patterns of activity, provide a unique opportunity to study some of these issues. The current transdisciplinary study builds on a previous Active Living Research project that developed and evaluated objective geographic information system (GIS) measures of trail characteristics. This will be accomplished by objectively measuring activity of users with two devices and linking activity data to detailed environmental data on trails.

### **Study Aims**

Aim 1: To determine the amount and proportion of moderate and vigorous physical activity (PA) conducted on trails among adult users.\*

#### Research questions

- · What is the contribution of different types of trails to objectively measured PA among adult users?
- · Does the proportion (and absolute amount) of PA conducted on trails differ across six study sites located in urban, suburban and rural communities?
- If so, can these differences be explained either by the physical characteristics of the trails/paths or differences in neighborhood contextual variables, such as adjacent land use mix?

Aim 2: To examine associations between objectively measured physical characteristics of trails and levels of use.

#### Research questions

- · Do certain segments of trails have higher use?
- · Are these differential patterns of use associated with certain physical characteristics of trail segments and/or contextual neighborhood factors?

\*Focus of this poster presentation.

### Originally presented at Active Living Research Annual Conference San Diego, CA - February 17-18, 2006

### Study Setting – 5 Trails





1.6 mile unpayed loop within suburban conservation land

#### Nashua River Rail Trail Aver to Dunstable, MA 1.3 mile paved rural rail-trail

### **Methods**

#### Study Participants

· Adults, 18 years and older, walking, running, cycling, in-line skating at 5 trails/paths in Massachusetts

#### Data Collection

- · Conducted brief intercept trail surveys with 1194 adults during fall 2004 & spring/summer, 2005 Recruited sub-sample of 178 "regular" (≥ 4x/month) users to
- wear Actigraph accelerometer & portable GPS unit for 4 days (2 WD, 2WE)
- · Participants also completed International Physical Activity Questionnaire (IPAQ)

Data Processing

- · Merging minute-by-minute Actigraph & GPS data Linking accelerometer & GPS data to GIS database for trail
- segments

#### Preliminary Outcomes

Portable GPS Unit

 Mean min/day moderate & vigorous-intensity activity overall & on the trail

#### Statistical Analyses

· Descriptive statistics to quantify the amount & proportion of PA "on trail" vs. other locations (Aim 1)

#### GPS Unit Specifications

- Garmin GPS receiver/antenna and GeoStats GPS Data Logger Passive longer has no user interface and requires no user input.
- Weighs approximately one pound. Battery lasts for up to five days of continuous logging before recharge

Actigraph Activity Monitor



### Preliminary Results: Surveys

Survey Respondent Demographics SEX: 53.9% female; 46.0% male AGE: 13.1% 18-29 years; 50.7% 30-49; 31.1% 50-65; 5.1% 66 and older

RACE/ETHNICITY: 81.8% white; 13.7% black; 1.9% Asian; 1.7% Hispanic/Latino

	Cutler	FP	MB	Nashua	SW
	% (n)	% (n)	% (n)	% (n)	% (n)
First Time Using Tra	il				
Today	7.5 (17)	2.1 (4)	4.5 (11)	9.5 (31)	7.2 (15)
<1- 11 Months	16.0 (36)	9.7 (18)	6.9 (17)	12.9 (42)	13.1 (27)
1-3 Years	29.1 (66)	11.8 (22)	17.1 (42)	42.0 (137)	24.6 (51)
>3 Years	47.5 (108)	76.3 (142)	71.5 (176)	35.6 (116)	55.0 (114)
Origin When Using T	rail				
Home	70.5 (160)	80.1 (149)	90.2 (223)	95.7 (312)	73.9 (153)
Work	23.4 (53)	10.8 (20)	2.8 (7)	2.2 (7)	2.4 (5)
Home & Work	4.4 (10)	8.6 (16)	2.8 (7)	1.8 (6)	14.5 (30)
Other	1.7 (4)	0.5 (1)	4.0 (10)	0.3 (1)	9.1 (19)
Travel Time From Ho	ome to Trail				
<15 minutes	79.4 (135)	81.8 (135)	80.0 (184)	46.5 (148)	93.4 (171)
15-29 minutes	16.4 (28)	14.6 (24)	11.7 (27)	30.8 (98)	5.7 (10)
30-44 minutes	2.4 (4)	3.0 (5)	5.7 (13)	18.2 (58)	0.6 (1)
45-59 minutes	1.1 (2)	0.6 (1)	.9 (2)	2.2 (7)	0.6 (1)
1-2 hours	0.6 (1)	0.0 (0)	1.7 (4)	2.2 (7)	0.0 (0)
Usual Reason For Us	sing Trail				
Exercise/ Recreation	100.0 (224)	96.8 (180)	74.5 (184)	98.5 (321)	27.5 (57)
Transportation	0.0 (0)	0.5 (1)	8.5 (21)	1.2 (4)	51.7 (107)
Both	0.0 (0)	2.7 (5)	17.0 (42)	0.3 (1)	20.8 (43)
Frequency of Use: P	ast 7 days For F	ecreation			
1	51.8 (117)	30.8 (57)	36.7 (83)	52.8 (170)	29.0 (29)
2-3	31.4 (71)	24.3 (45)	32.7 (74)	34.8 (112)	29.0 (29)
4-7	16.8 (38)	44.7 (83)	30.5 (69)	12.4 (40)	42.0 (42)
Frequency of Use: P	ast 7 days For T	ransportation			
1	0.0 (0)	0.0 (0)	30.2 (19)	80.0 (4)	20.7 (31)
2-3	0.0 (0)	50.0 (3)	15.9 (10)	0.0 (0)	24.7 (37)

0.0 (0)
20.0 (1) 50.0 (3) 54.0 (34) 54,7 (82) 0.0 (0) Most common activities on trails: walking (45.3%), bicycling (43.1%), jogging/running (7.7%) & in-line skating (3.8%)

#### Accelerometry – GPS Sample

Home Addresses of Trail Users



1.8 (1.3)

1.5 (1.1)

94 (143

7.9 (13.0)

9.2 (7.5)

2.9 (4.9) 7.1 (6.3)

3 3 (5 3)

0.9 (1.4)

0.8 (1.3)

letworl

Distance

Straight

Line

## **Accelerometry - GPS** Activity Tracing of Participant at Franklin Park



**Preliminary Results:** 

Table 3 Mean daily minutes of moderate and vigorous activity for trail users and mean daily minutes of moderate-vigorous activity on trail (n = 625 person-days)

	Cutler	FP	MB	Nashua	SW			
Moderate PA [mean minutes (SD)]								
		120.9	134.2		144.4			
All	135.5 (49.3)	(69.2)	(65.6)	124.6 (59.5)	(65.2)			
		128.7	135.1		139.5			
Men	132.2 (52.5)	(79.0)	(67.3)	134.4 (60.3)	(72.3)			
		117.0	133.5		150.0			
Women	139.5 (45.9)	(63.7)	(64.6)	109.9 (55.7)	(56.0)			
Vigorous PA [mean minutes (SD)]								
All	6.9 (12.8)	6.0 (14.3)	9.2 (22.4)	4.6 (12.3)	4.2 (9.7)			
			13.2					
Men	8.0 (13.8)	7.2 (15.8)	(27.6)	4.5 (13.8)	4.4 (10.7)			
Women	5.7 (11.5)	5.5 (13.5)	5.6 (15.9)	4.7 (9.9)	3.9 (8.5)			
Mod-Vig PA on Trail [mean minutes (SD)]								
		25.4	13.0					
All	7.2 (16.0)	(35.8)	(23.8)	9.8 (20.3)	8.3 (11.6)			
		25.0	12.2					
Men	7.0 (16.1)	(34.8)	(19.5)	4.0 (10.0)	7.9 (12.5)			
		25.7	13.8					
Women	7.4 (16.1)	(36.5)	(28.0)	13.6 (24.2)	8.7 (10.6)			

Cutout for Adults. Medicine & Science in Sports & Exercise 200 17/11)-\$512.\$52 Cut-points for vigorous PA (counts ≿ 5725): Freedson, PS, et al. Calibration of the Computer Science and Applications, Inc. Medicine & Science in Sports & Exercise

#### **Conclusions & Next Steps**

Patterns of trail use varied across sites in urban, suburban & rural locations

GPS monitoring allowed us to objectively quantify on-trail physical activity - although this needs further refinement

Further processing to identify valid monitoring days, use GPS to quantify on trail activities such as cycling, etc.

Further analyses to examine associations with trail characteristics

Funded by The Robert Wood Johnson Foundation, Active Living Research Program

![](_page_2_Picture_62.jpeg)

![](_page_2_Picture_63.jpeg)