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

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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
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San Diego, CA - February 17-18, 2006

Study Setting – 5 Trails

Southwest Corridor *Boston, MA*
3.9 mile asphalt trail in urban linear park with adjacent facilities

Franklin Park *Boston, MA*
2.1 mile mostly paved loop trail within 500 acre urban park

Minuteman Bikeway *Arlington to Bedford, MA*
10.0 mile paved suburban rail-trail

Cutler Reservation *Needham, MA*
1.6 mile unpaved loop within suburban conservation land

Nashua River Rail Trail *Ayer to Dunstable, MA*
11.3 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
- 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)

Portable GPS Unit

GPS Unit Specifications
- Garmin GPS receiver/antenna and GeoStats GPS Data Logger.
- Passive logger 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 is required.

Actigraph Activity Monitor (model 7164)
Actigraphs initialized to collect data at 1-minute epochs.

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

Table 1. Patterns of trail use at 5 facilities in Massachusetts

	Cutler % (n)	FP % (n)	MB % (n)	Nashua % (n)	SW % (n)
First Time Using Trail					
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 Trail					
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 Home 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 Using 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: Past 7 days For Recreation					
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: Past 7 days For Transportation					
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)
4-7	0.0 (0)	50.0 (3)	54.0 (34)	20.0 (1)	54.7 (82)

Most common activities on trails: walking (45.3%), bicycling (43.1%), jogging/running (7.7%) & in-line skating (3.8%)

Accelerometry – GPS Sample

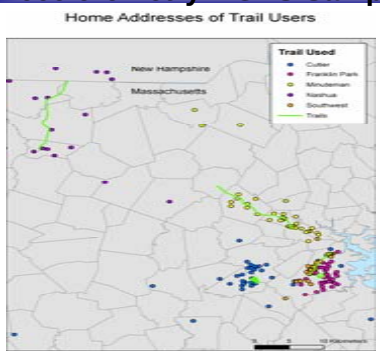

Table 2. Mean (SD) Distance in Kilometers from Home to Trail (n=174)

	Cutler	FP	MB	Nashua	SW
Network Distance	9.4 (14.3)	1.8 (1.3)	3.3 (5.3)	9.2 (7.5)	0.9 (1.4)
Straight Line	7.9 (13.0)	1.5 (1.1)	2.9 (4.9)	7.1 (6.3)	0.8 (1.3)

Preliminary Results: Accelerometry - GPS

Activity Tracing of Participant at Franklin Park

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)]					
All	135.5 (49.3)	120.9 (69.2)	134.2 (65.6)	124.6 (59.5)	144.4 (65.2)
Men	132.2 (52.5)	128.7 (79.0)	135.1 (67.3)	134.4 (60.3)	139.5 (72.3)
Women	139.5 (45.9)	117.0 (63.7)	133.5 (64.6)	109.9 (55.7)	150.0 (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)
Men	8.0 (13.8)	7.2 (15.8)	13.2 (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)]					
All	7.2 (16.0)	25.4 (35.8)	13.0 (23.8)	9.8 (20.3)	8.3 (11.6)
Men	7.0 (16.1)	25.0 (34.8)	12.2 (19.5)	4.0 (10.0)	7.9 (12.5)
Women	7.4 (16.1)	25.7 (36.5)	13.8 (28.0)	13.6 (24.2)	8.7 (10.6)

Cut-points for moderate PA (counts = 760-5724): Matthews CE. Calibration of Accelerometer Output for Adults. Medicine & Science in Sports & Exercise 2005; 37(11):S512-S522.
Cut-points for vigorous PA (counts ≥ 5725): Freedson, PS, et al. Calibration of the Computer Science and Applications, Inc. Medicine & Science in Sports & Exercise. 1998;30(5):777-81.

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*

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