



Measuring Activity and Participation Among Wheeled Mobility Users

Stephen Sprigle, Fran Harris, Sharon
Sonnenblum

Center for Assistive Technology &
Environmental Access

Georgia Institute of Technology

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The Significance of Participation

Increased participation for people with disabilities is a goal of the Americans with Disabilities Act (ADA) and the New Freedom Initiative.

Recently revised International Classification of Functioning and Disability (ICF) recognizes participation and activity as one of its four key components.

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Some Factors Impacting Participation and Activity among Wheelchair Users

- *Health* Conditions
- *Environmental* barriers in society (e.g., lack of curb cuts, reliable and accessible transportation, and social attitudes & policies)
- *Personal* factors (e.g., gender, lifestyle)

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International Classification of Functioning, Disability, & Health (ICF) Definitions of Participation and Activity

- *Activity* is defined as the “execution of a task or action by an individual.”
- *Participation* is defined as “involvement in a life situation.”

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Capacity and Performance

ICF recommends 2 qualifiers to measure activity and participation:

- *Capacity* is the individual's ability to execute a task or action in standardized environment (e.g., a clinical measurement of reach).
- *Performance* is what an individual does in his/her current environment.

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Self-Report Measures are most common method to measure activity/participation

Problems with using self-reports among wheelchair users:

- 1. Inconsistent scoring of AT.**
- 2. Only one targets mobility disabilities specifically (CPPRS).**
- 3. Question format, context, and rating scales may result in inconsistent responses across subjects.**

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Power Wheelchair Study

Measure health, activity and participation of people who use power wheelchairs.



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Wheelchair Activity Monitoring Instrument (WhAMI)

A new methodology to measure activity and participation among wheelchair users. It combines activity monitoring instruments (such as occupancy monitor, wheel revolution counter, seat position sensor, GPS) with a prompted recall interview and self-report measures.

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Activity Monitoring Technology

- **Data logger**
- **Occupancy monitor**
- **Wheel revolution counter**
- **Seat position sensor**
- **GPS**

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Self-Reports

1. **Community Participation and Perceived Receptivity Survey (CPPRS)***
2. **Home Accessibility Survey (HAS) (a study-specific survey that captures in-home wheelchair use and accessibility).**

***For information contact: David B. Gray, Ph.D., Washington University
School of Medicine, Program in Occupational Therapy, 4444 Forest
Park Blvd., Campus Box 8505, St. Louis , MO 63108
voice: (314) 286-1658, email: grayda@wustl.edu**

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Assumptions in the measurement of activity and participation among wheeled mobility users

Activity and participation:

- 1. need to be assessed in the context of wheelchair use.**
- 2. need to include measurement of both in-home and community activities.**

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Research Question: How did subjects use their wheelchairs?

Measurements included:

- 1. Distance wheeled**
- 2. Time spent wheeling**
- 3. Number of bouts***
- 4. Time spent in chair**

***A mobility bout was defined as a bout of movement initiated when a subject travels a minimum of 2 feet within 4 seconds and continues until the subjects travels less than 2.5 feet over 14 seconds.**

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Wheelchair Usage Results

- 19 subjects (11 male, 6 female)
- Age range 22-69 (median 53 years)
- Diagnoses (SCI, MS, CP, MD, CVA)
- Total of 264 days of data (on 115 days subjects did not leave their homes)

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Complexity of Wheelchair Use

Simple averages of 3 basic mobility measurements do not accurately represent complexity of wheelchair use : there is no single “normal” behavior for subjects.

Average Daily Wheelchair Use Over All Subjects				
Variable	Mean	Stdev	Median	Range
Distance Wheeled (miles)	1.0	1.4	0.66	0.2-6.6
Number of Bouts	117	60	107	36-244
Time Spent Wheeling (min)	62	39	55	16-173

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3 Sample Subjects

Subject	Days of Data	Miles Wheeled Total	Miles Wheeled In the Home	% Distance Wheeled In the Home
A	13	19.5	6.5	33%
B	27	5.2	4.0	77%
C	13	6.3	3.1	49%

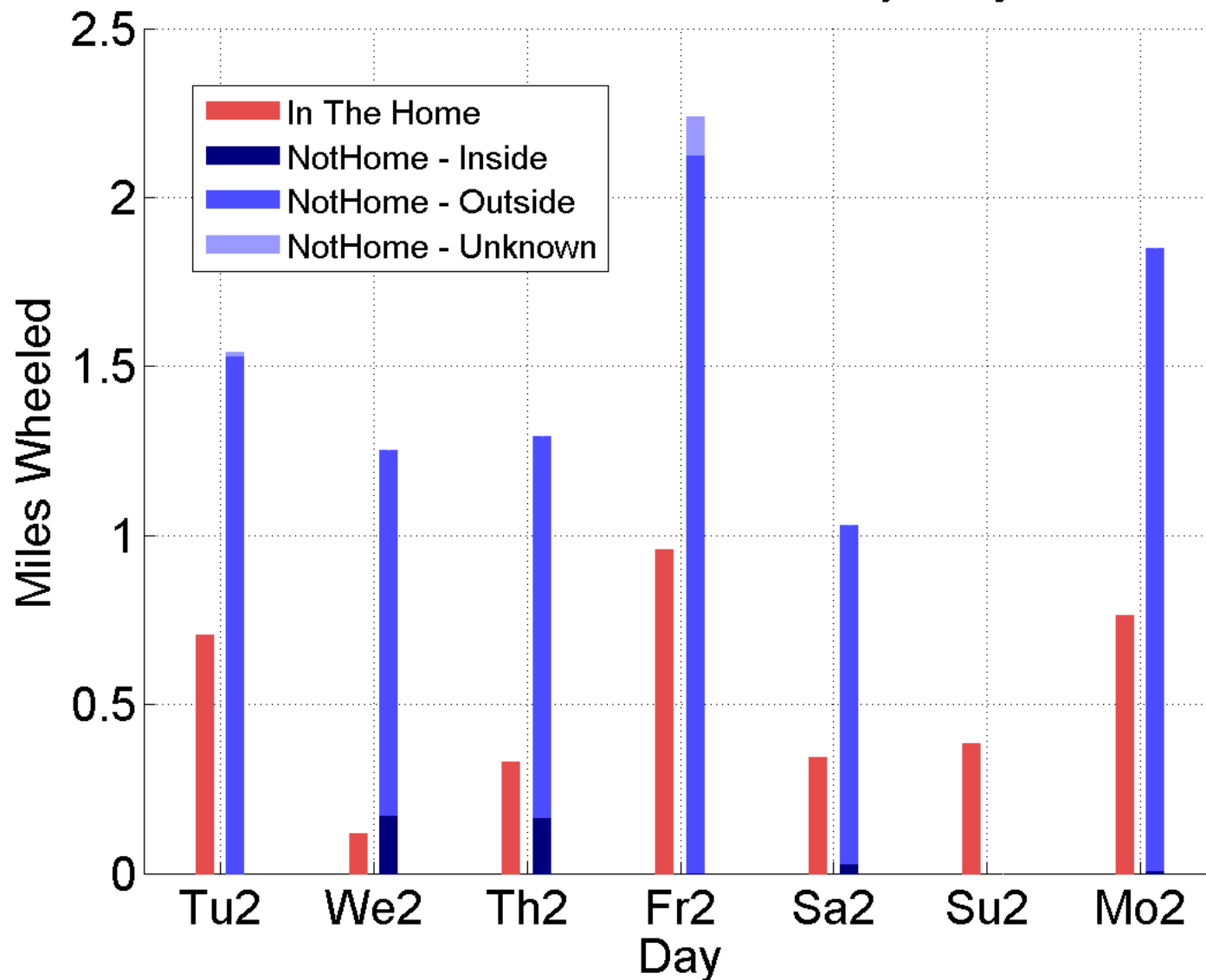
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Subject Descriptions

- **Subject A:** 42 year old African-American male, SCI, unemployed. Lives alone in an accessible apartment within a pedestrian-friendly neighborhood within Atlanta (Oakhurst). Spends most of his time wheeling around immediate neighborhood, visiting friends and hanging out in local restaurants and shops.
- **Subject B:** 24 year old white male, CP, unemployed. Lives with parents in an accessible home in a suburban, neighborhood outside Atlanta. Depends on parents for transportation. Home activities include computer, TV, and radio.
- **Subject C:** 36 year old white female, Juvenile Parkinson's and Dystonia. She is a physician who works part time in research. Lives alone in an accessible apartment in Atlanta. Most non-work activities are visits to her personal physicians and restaurants. Drives her own car.

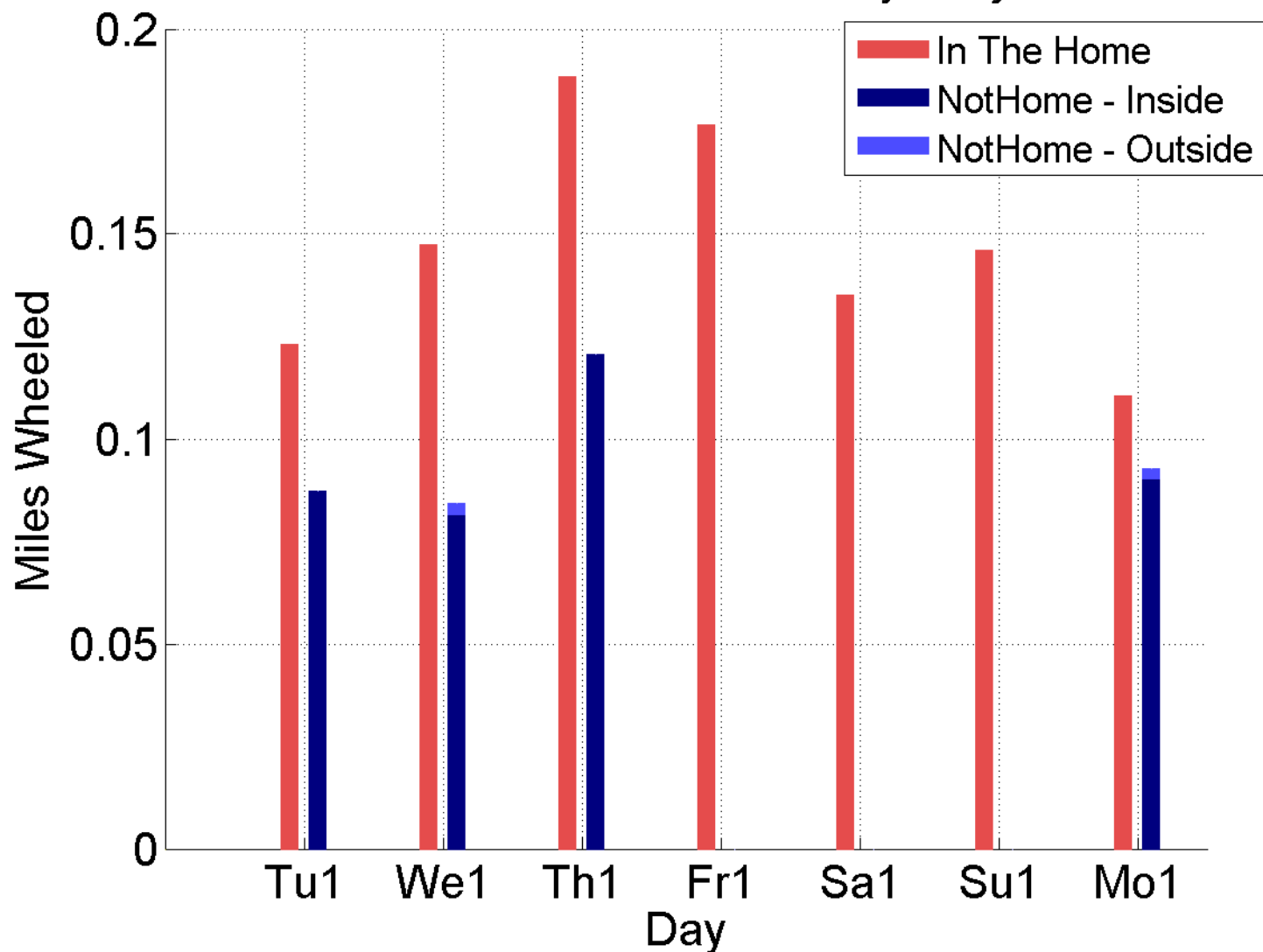
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Subset of Distance Wheeled by Subject A



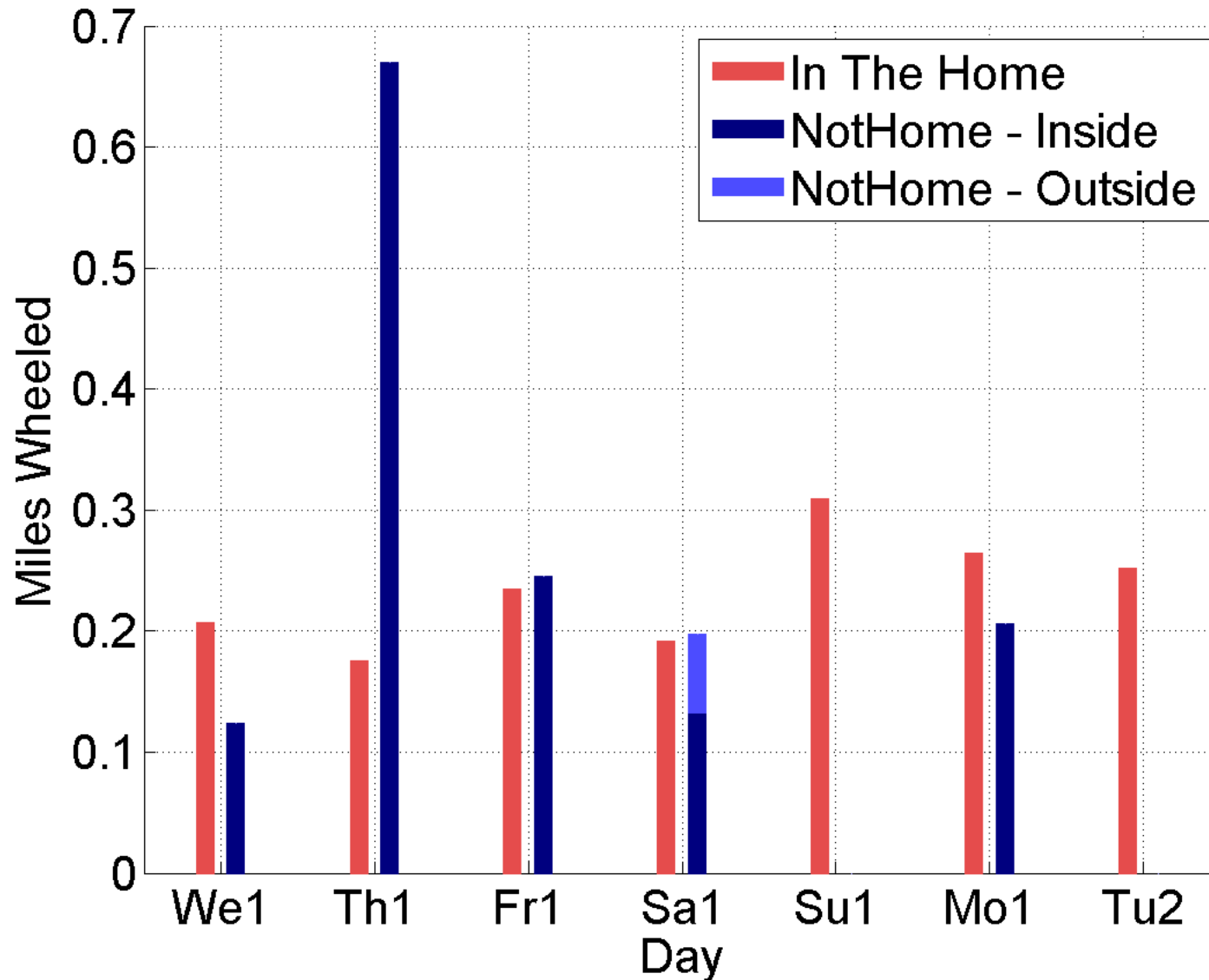
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Subset of Distance Wheeled by Subject B



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Subset of Distance Wheeled by Subject C



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What different measurements tell us . . .

- **2 wheelchair behaviors appear prevalent:**
 - **Inside home (>50%) of subjects wheeled small distances in short, transient bouts that included more starts, stops and turns.**
 - **Outside home (<50%) wheeling distances were greater overall with fewer bouts.**

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Question: What were the nature of trips taken outside the home?

For example:

- **How many destinations did subjects visit per day?**
- **What kinds of activities did subjects engage in?**
- **What was the average time spent wheeling while engaged in different activities?**

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Measurements included:

- 1. GPS data (sampling rate every 2 seconds)**
- 2. Prompted recall interview (administered within 48 hours after GPS data were processed)**
- 3. CPPRS (administered within 5 days of the PRI)**
- 4. Wheel count data**

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PRI Interface: Single Trip

Subject ID TS63: Trip 11
GPS Trip 11

[Return to Table Display](#)

[Logout](#)

[Previous Day](#)

Saturday 12/10/2005

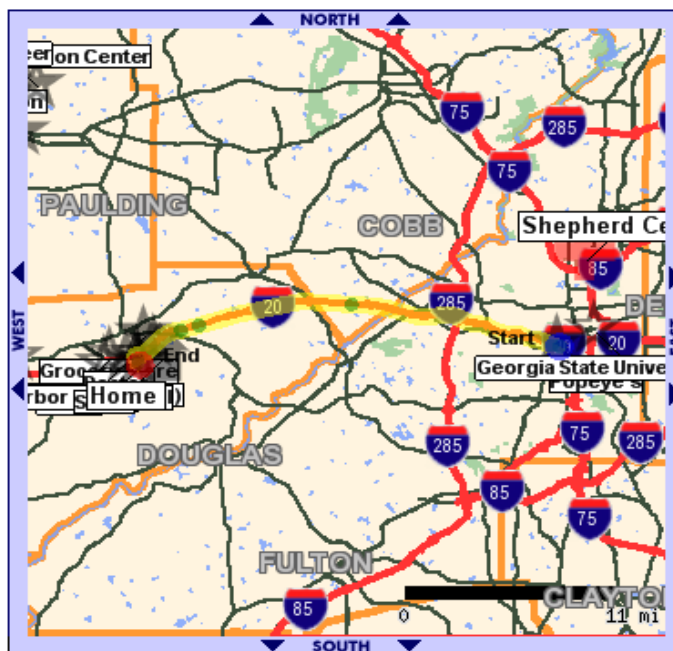
[Next Day](#)

[Previous Trip](#)

Distance from previous trip end:
0.00 mi

[Next Trip](#)

Map Views: [All](#) [Origin](#) [Destination](#)



Map Click Mode

- ☒ Zoom In
 ☐ Zoom Out
 ☐ Recenter
 ☐ Split Trip
☒ Label Destinations

Trip Attributes*

Field	P	Value	N
Start	P	12/10/2005 3:58:59 PM	N
End	P	12/10/2005 4:26:35 PM	N
Distance (mi)	P	20.60	N
How	P	Personal Vehicle	N
Why	P	Daily Living Task	N
Destination	P	Target	N
Indoors/Outdoors	P	indoor	N

Destination not listed?
(The new location will use the coordinates of the end of this trip)

Travel Companions

Companion not listed?

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GPS, wheel revolution & prompted recall data for 13 days – outside the home

Subject	Activity Type	# Visits to Destinations with Activity Type	Dist. Wheeled (miles)	# Mobility Bouts	Time Wheeling (min)
A	Work / School	0	0	0	0
	Daily Living Task	2	0.8	27	27
	Entertainment	1 (+22 NODEST)	6.7	130	184
	Social	11	0.5	76	27
	Unknown	0	0	0	0
	Travel	n/a	4.2	66	105
	Total	14 (+22 NODEST)	12.2	299	343
C	Work / School	1	0.2	6	10
	Daily Living Task	15	2.7	202	150
	Entertainment	1	0.1	53	29
	Social	1	0	0	0
	Unknown	1	0	0	0
	Travel	n/a	0.1	6	5
	Total	19	3.1	267	194

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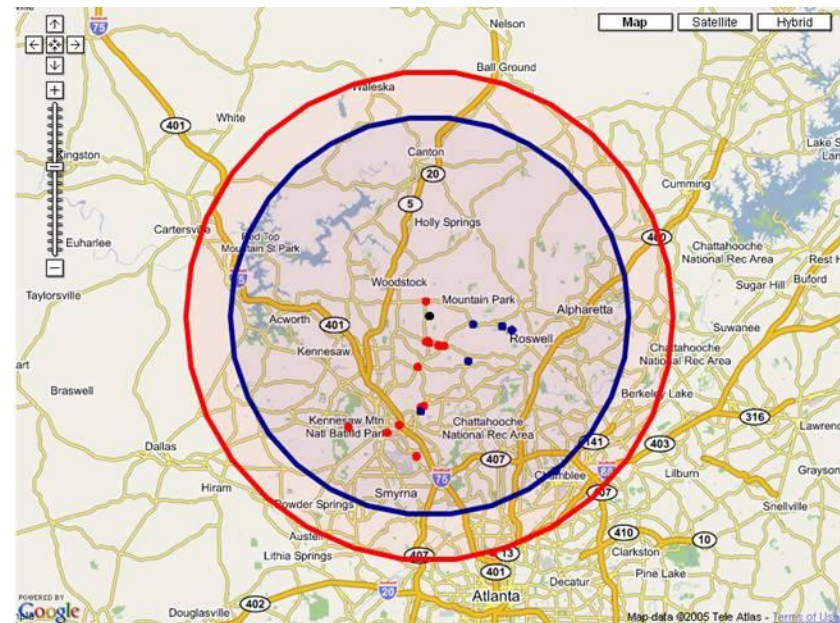
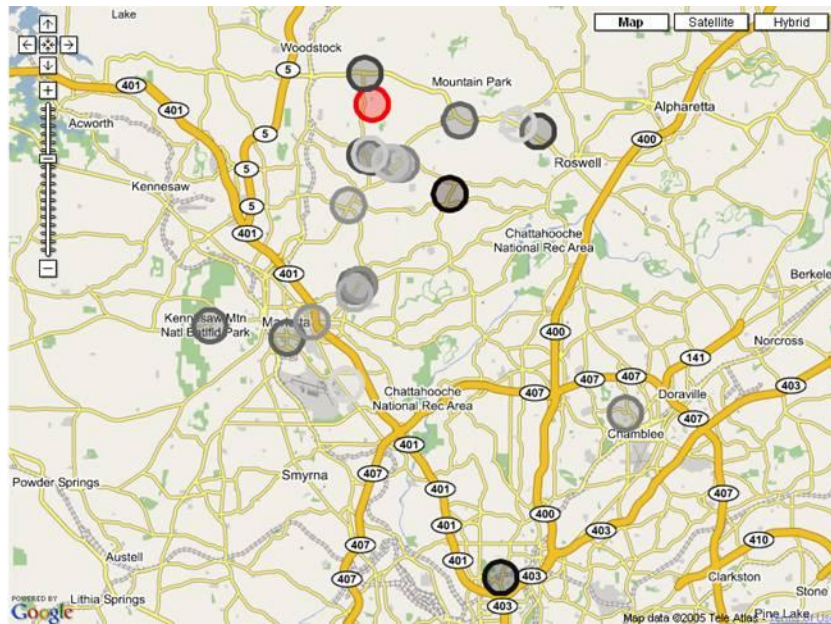
Activity patterns represented geographically

LEFT: Colored by the time spent at each destination.

(**red=home**, black = short time → white = long time)

RIGHT: Colored by activity type.

- black=home, **red = daily living tasks**, **blue = entertainment**
- radius of large circle = farthest distance traveled for that purpose



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One question: how do data results from PRI compare with those from the CPPRS?

As an example, CPPRS and PRI data derived from a 2 week period were compared in Subject D.

Subject is a 57 year old, SCI, African-American male. He lives with his wife and son in a fully accessible suburban home about 22 miles outside Atlanta.

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Summary of PRI and CPPRS Data in Subject D

GPS/PRI Destination	# Trips in past 2 wks	CPPRS Self-Reported Destinations	# of est. trips in past mo/ year
Shepherd Center (rehab hospital)	6	Doctors' offices	4/year
Church	4	Religious Institutions	5/month
Gwinnett Sports Arena	1	Sports arenas	1/year
Grocery Store	1	Grocery Store	2/month
Arbor Pl. Shop. Mall	1	Shopping malls	10/year
Target (large store)	1	Large Stores	1/month
Restaurant	1	Restaurant	0/month
Gas Station	2	Gas Station	0/month
Volunteer (Youth Ctr)	1	Work/Volunteer	Not a volunteer

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WhAMI is a flexible and versatile research tool.

- 1. Objective measurements and self-report instruments supplement each other.**
- 2. Measuring activity “performance” in a real-world environment helps in assessment of unmet mobility needs or the functional outcome of an intervention.**
- 3. WhAMI can link multiple mobility aid use as it impacts the performance of activities.**

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