Wheelchair use in everyday life

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Why understand wheelchair use in everyday environments?

- Clinicians and users
  - Relating a clients use (or anticipated use) relative to others may better inform decisions about models and configurations.
- Manufacturers and Suppliers
  - Better information about how products are used can inform design of their products and compare products.
- Payers
  - Any data that relates mobility to health or independence or secondary complications should inform policy. We can and should learn more about use to better distinguish users, and therefore coverage.

Characterizing Manual Wheelchair Use-Study 1

- 6 manual wheelchair users
- Inpatients of rehab facility in UK
- Activity monitor mounted to wheel

Wilson SKM, Haslet PM, Granat MH. Objective assessment of mobility of the spinal cord injured in a free-living environment. Spinal Cord (2008) 46, 352-357

7-day total & daily averages

Subj #	Time moving (hr)	Distance (km)	Speed (m/sec)	Daily covariance (%)
2	13.2	34.9	0.73	34
3	4.5	8.4	0.52	55
4	6.2	12.5	0.56	14
5	9.4	17.0	0.50	57
6	10.0	15.6	0.43	20
7	4.1	7.4	0.50	29

Subj #	Avg Time moving/day (hr)	Avg distance/day (km)
2	1.89	4.98
3	0.64	1.2
4	0.88	1.78
5	1.34	2.43
6	1.43	2.23
7	0.58	1.06

Characterizing Manual Wheelchair Use-Study 2

- 52 Athletes from VA Games
- 2.457 Km (sd= 1.20 km) over 47.9 min (sd=21.4)
- Employed subjects
  - 3.4 km

Tolerico, M, et., al ; Assessing mobility characteristics and activity levels of manual wheelchair users. JRRD 2007

Characterizing Manual Wheelchair Use-Study 3

- 6 full time users living in the community
- Seat occupancy switch
- Accelerometer-based data logger on wheel

Distance, time moving & bouts of mobility

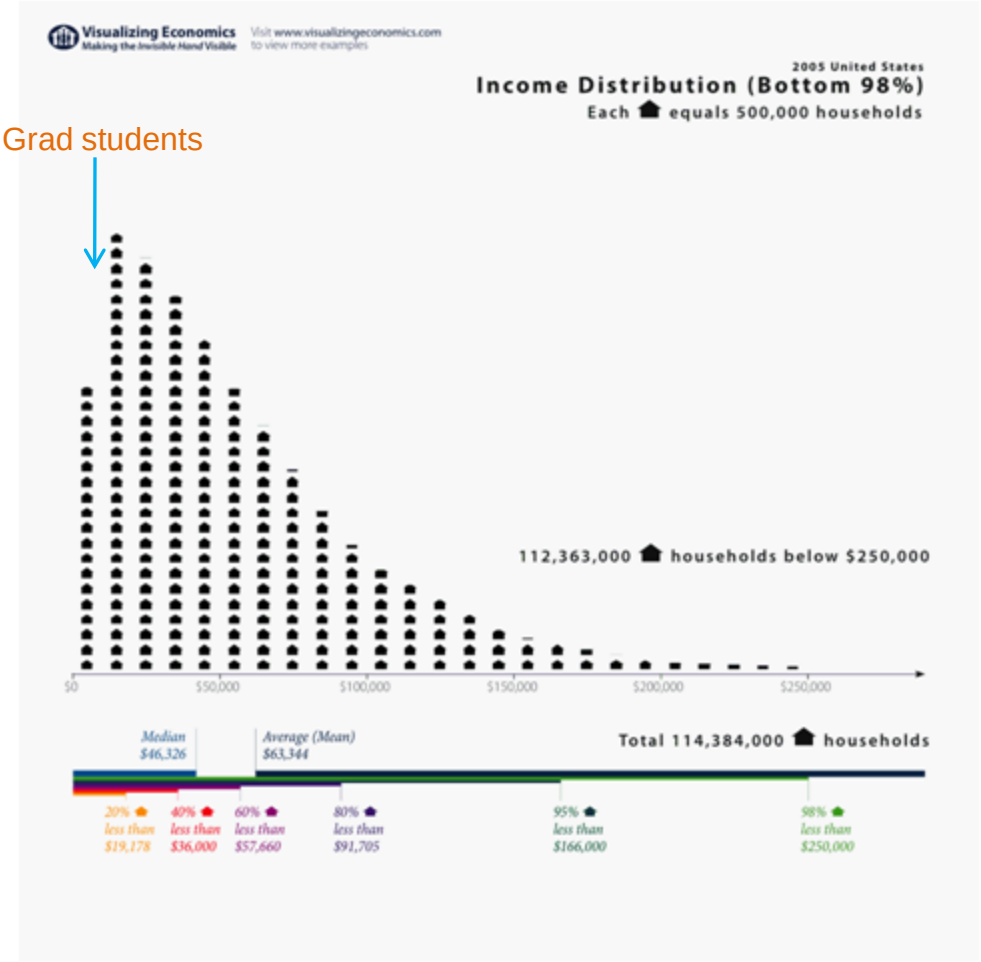
- Three constructs, 2 are commonly described
- Bouts of movement
  - Represent transitions between activities
  - Technical definition
    - Movement that is < 5 ft in < 5 sec
- Distance and time are very highly correlated
- Bouts are least correlated to the others in MWC and PWC data
- Data varies widely within and across subjects

Mean vs median

- Why look at median versus mean?
- Example: Income in the US
  - Normal or skewed?
  - What is the mean? median?

Median= 46,300
Mean= 63,300

20% < $29,200
40% < $36,000
60% < $57,700
80% < $91,700
95% < $166,000
98% < $250,000



Median and ranges of movement

Subject	Distance (m)		Time (min)		Number Bouts	
A	2295	(1710 - 3062)	95	(80 - 133)	113	(88 - 151)
B	1153	(523 - 2605)	61	(42 - 75)	81	(63 - 93)
C	1167	(875 - 1233)	87	(84 - 88)	119	(118 - 133)
D	676	(103 - 1150)	35	(7 - 46)	46	(14 - 60)
E	1375	(700 - 1731)	71	(39 - 91)	92	(58 - 112)
F	3596	(1577 - 4694)	134	(82 - 153)	136	(114 - 178)

* Subjects A, E & F are employed

Characterization of Power Wheelchair Use in the Home and Community

- 25 full-time power users
- Monitored for 2 weeks
  - Seat occupancy
  - Wheel movement
  - GPS
- Prompted recall used to add context & detail

Sonenblum SE, Sprigle S, Harris FH, Maurer CL, "Characterization of Power Wheelchair Use in the Home and Community," Archives of Physical Medicine and Rehabilitation **89(3),** 486-91, 2008.

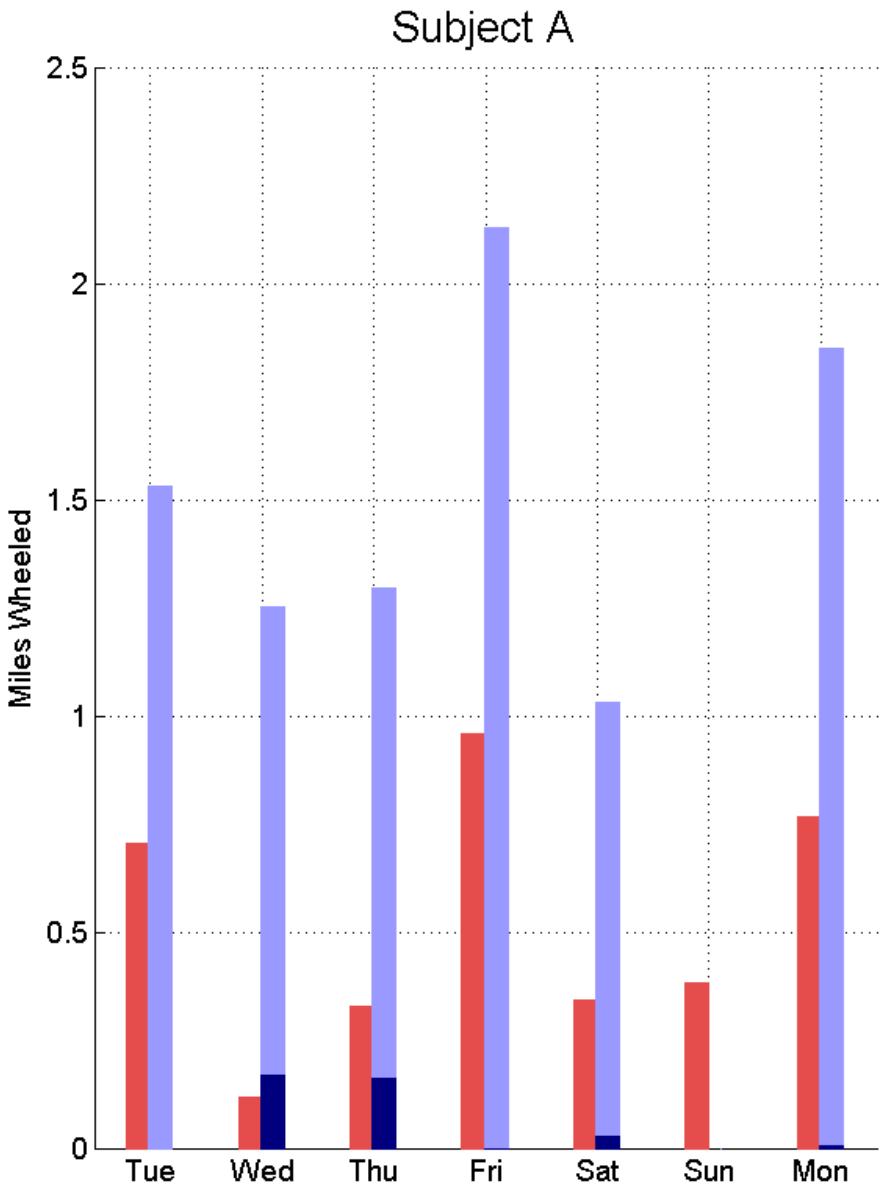
Environment	Variable	Median	Mean	SD
Home	% Distance	59	57	30
	% # Bouts	75	71	23
	% Time	64	63	27
Not Home Indoors	% Distance	13	22	18
	% # Bouts	13	19	17
	% Time	11	20	17
Not Home Outdoors	% Distance	2	19	29
	% # Bouts	2	8	12
	% Time	2	15	22

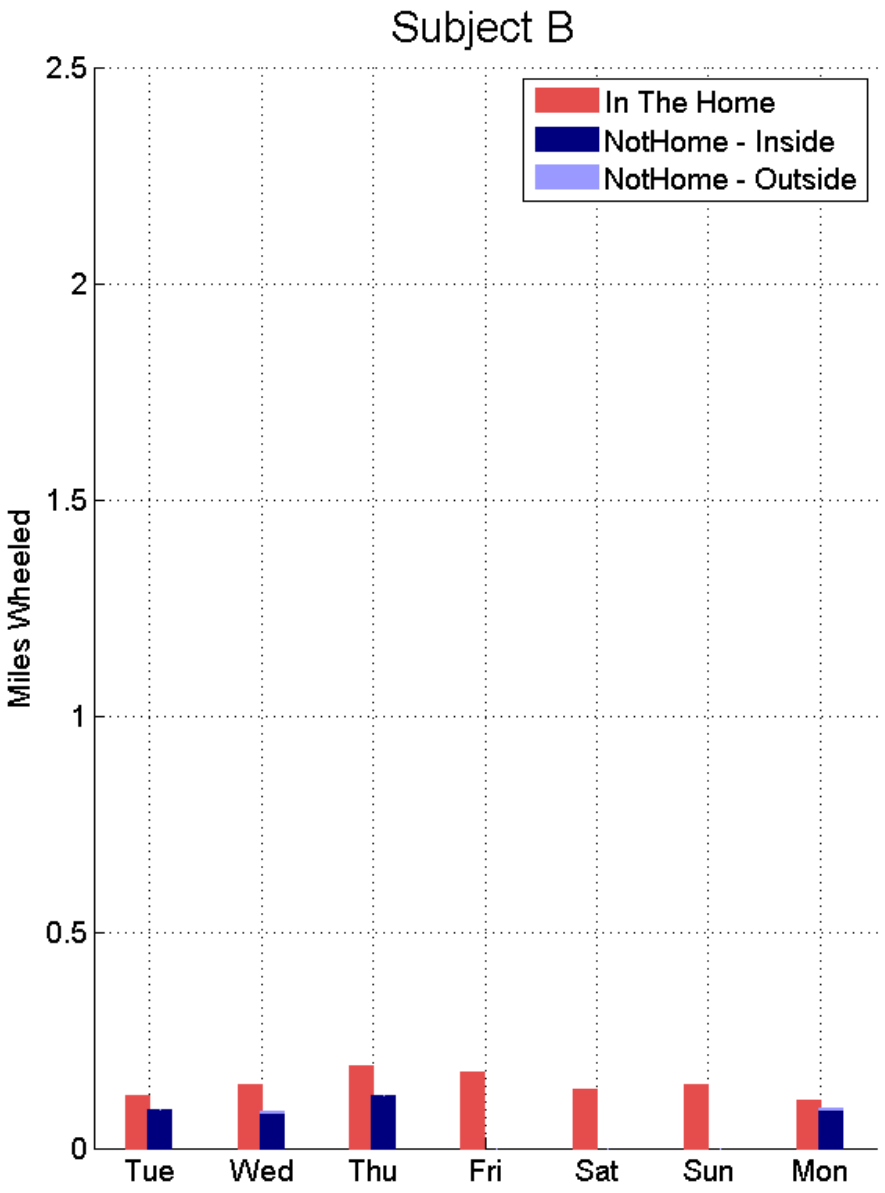
Median bout characteristics differ based on environment.

	Distance (m)	Duration (sec)	Speed (km/hr)
Home	3.7	18	0.8
Not Home Indoors	4.2	18	1.0
Not Home Outdoors	11.3	34	1.6

Bouts: transitions between activities

Comparing two users





10 vs 14” wheels

Can and should we try to discuss this?

Comparing usage

- PWC study- the *median* user
  - spent 10.6 hours in his/her wheelchair daily
  - wheeled 1.085 km over 58 minutes
  - 110 bouts
- MWC study- the *median* inpatient
  - Wheeled 2.0 km over 67 minutes
- MWC study- *mean* of Veterans Games participants
  - 2.457 Km over 47.9 min
- MWC study- the *median* community user
  - 1.33 km over 77 min
  - 101 bouts

Why might PWC users wheel < MWC users?

Why we should care

- Daily use varies widely within a person
- Use varies widely across people
- Movement is characterized by short bouts of movement
  - For PWC, this indicates need for maneuverability more than top speed
  - For MWC, this indicates that starts, stops and turns dominate propulsion
- Repair and replacement frequency is impacted by wheelchair usage

Why we should care- Power

- Can disparity of use inform prescription?
  - i.e., 10” wheel vs 14”
    - Considering only the ‘in-the-home’ restriction?
    - Considering idiosyncratic usage?




Why we should care- Manual

- Research has not defined a dose-response relationship between time of MWC use and UE overuse injury
  - The disparity in propulsion might have masked this relationship
  - Documenting bouts of mobility and time moving might be a better measure

Why we should care- Manual

- Can comparing average speed data to our clients' speeds inform prescription?
  - A client unable to reach the average speed necessary for 'everyday mobility' may form basis for different MWC or need for PWC
- Should research into propulsion reflect speeds used in everyday mobility?
- Endurance – total time propelling leads to 2 considerations
  - Enough 'umph' at end of the day
  - Able to get to point B from Point A (longest trek)

Let’s toss ambulation into the mix

How far do people walk?

- The role of free-living daily walking in human weight-gain and obesity. Levine, JA, et. al; Diabetes. 2008
  - 22 people over 10 days
  - **On average, people walked about 11.25 km/day (7 miles)**
- Measurement of daily walking distance-questionnaire versus pedometer , Bassett D, Cureton A, Ainsworth B; Med & Sci in Sports & Exercise, 2000.
  - 96 people over 7 days
  - **Average: 4.17 +/- 1.61 km**
- How Many Steps/Day Are Enough?: Preliminary Pedometer Indices for Public Health. Tudor-Locke C, Bassett Jr D - Sports Medicine, 2004
  - **<5000 steps: sedentary (3.3 to 4 km)**
  - **5000-7500: typical (3.3-6 km)**

How do people walk?

- How humans walk: Bout duration, steps per bout, and rest duration; Orendurff MS, Schoen, JA, et. al; 2008
  - 10 subjects measured over 14 days
  - **90% of walking bouts <100 steps**
  - **40% of bouts <= 12 steps**
  - **<1% of walking bouts lasted 2 minutes**
- The role of free-living daily walking in human weight-gain and obesity. Levine, JA, et. al; Diabetes. 2008
  - 22 subjects over 10 days
  - **"walking comprises many short-duration, low-velocity walking bouts"**
  - **On average, a participant took 47 (range 46-62) walks per day: 85% were <15 min in duration, and 88% occurred at <2 mph;**
  - **On average, people walked about 11.25 km/day (7 miles)**

Amputee daily activity

- 3063± 1893 steps per day
  - 77 amputees, at least 6 mo post sx (Australia)
    - Stepien, Cavenett, Taylor; *Archives of PM&R*, 2007
- 3079 ± 1515 steps/day weekdays & 2386 ± 1225 steps/day on weekends
  - 12 Transtibial amputees
    - Klute, Berge, Orendurff; Arch Phys Med Rehabil, 2006

Approx 2- 2.4 km/day

Comparing wheelchair use to walking

- Studies of both produce disparate results
- Wheelchair movement is quite low, comparatively
- Can we infer walking data reflects typical ADL needs?
- Can we use this comparison to
  - judge ‘mobility limitation’?
  - make an argument that mobility devices should facilitate equal movement ?

Done