INTEGRATION OF DATA FROM ACTIGRAPH AND ACTIVPAL MONITORS: CRITERION VALIDITY OF THE SIP METHOD

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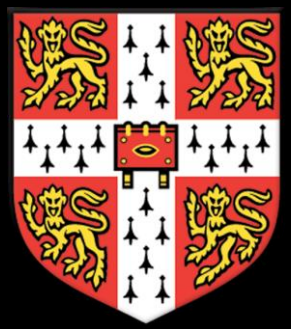


Ellingson, et al., *MSSE*, epub ahead of print

ACCURATE MEASUREMENT OF PHYSICAL ACTIVITY IS CHALLENGING AND IMPORTANT

- Choice of measurement strategy impacts:
  - *Accuracy* and *precision* of knowledge regarding influence of physical activity and sedentary behaviors on health
  - Ability to assess *change over time*
- Currently researchers are faced with multiple options:
  - Type of monitor
  - Wear location
  - Processing Strategy

OVERVIEW OF SOJOURNS METHOD

(LYDEN ET AL., 2014, MSSE)

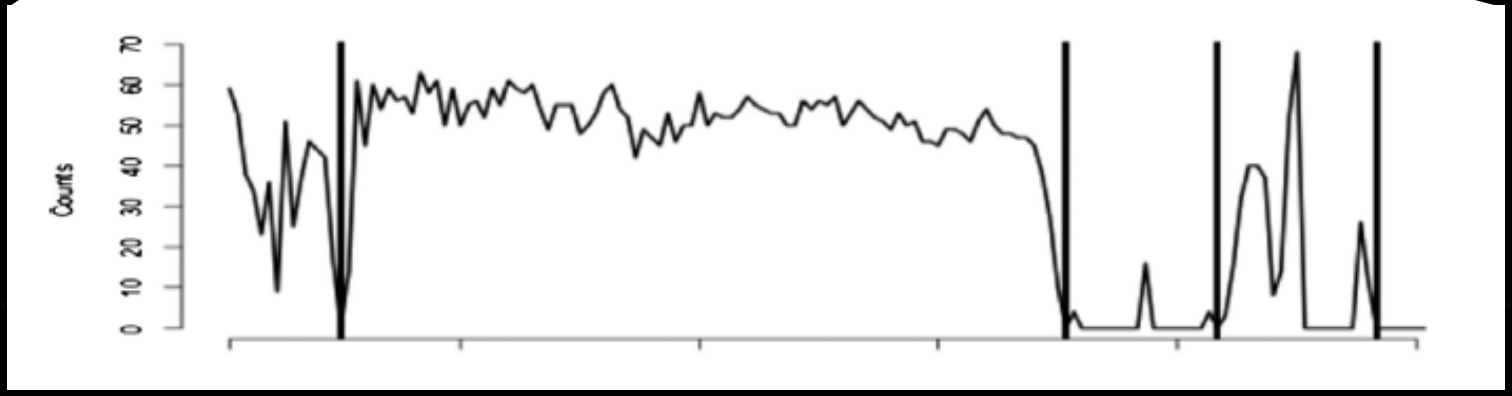
"counts" data from 3 axes in 1-sec. epochs

Looks for periods of rapid acceleration or deceleration to identify bout boundaries

Decision Tree: Sedentary or not

Assigns MET Value from 1-1.5

Estimates METS with Neural Net



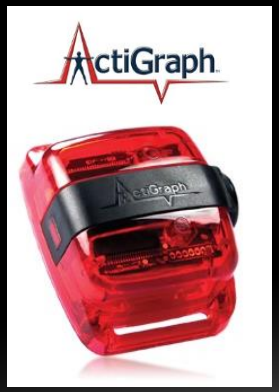
SOJOURNS METHOD

(LYDEN ET AL., 2014)

- Benefits:
  - Provides a more accurate estimate of physical activity and sedentary behavior
    - Uses all 3 axes to estimate METs
    - Data-determined epoch lengths
    - Machine-learning methods to estimate METs
  - Freely available program in *R* (www.math.umass.edu/~jstauden/SojournCode.zip)
- Areas for improvement
  - Cannot reliably distinguish posture (misclassifies light intensity as sedentary)
  - Problems identifying bout boundaries when changes in activity intensity (acceleration/deceleration) are not rapid enough

THE SIP METHOD
(SOJOURNS INCLUDING POSTURE)

- Integrates additional information from activPAL to:
  - Corrects for mistakes in sedentary vs. light categorization
  - Adds additional candidate bout boundaries in order to refine the estimates of energy expenditure, improving estimates of moderate and vigorous intensity activities



METHODS FOR SIP VALIDATION

- Participants: 49 healthy, young adults (63% female; 23.9 ± 5.3 year old)
- Procedures: 15 activities, 5 minutes each, 1 minute intervals
  - Sedentary: Supine, Resting; Sitting, Reading; Sitting, Typing; Sitting, Fidgeting
  - Light: Standing, Reading; Standing, Typing; Standing, Fidgeting; Throwing/Catching a Ball; Treadmill Walking, 2 mph
  - Moderate: Climbing Stairs; Stationary Biking; Treadmill Walking, 3 mph; Treadmill Walking while typing, 3 mph
  - Vigorous: Treadmill Running, 4.5 mph; Treadmill Running, 5.5 mph

MEASURES

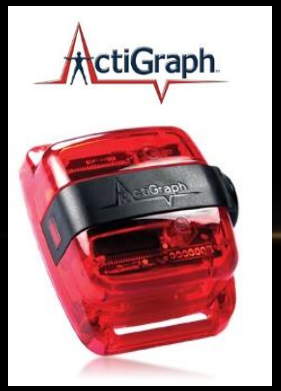
Criterion Measures: Oxycon-Mobile and Compendium

Compendium of Physical Activities

TABLE 2. New codes in Version 2 of the Compendium of Physical Activities.

Major Heading	Code Number	METs	Example
Bicycling	01015	8.0	Bicycling, general
Conditioning Exercises	02101	2.5	Mild stretching
Dancing	03016	8.5	Aerobic, step, with 6–8 inch step
	03017	10.0	Aerobic, step, with 10–12 inch step
	03031	4.5	Disco, folk, square, line dancing, Irish step dancing, polka, contra, and country dancing.
	03050	5.5	Anishinaabe Jingle Dancing or other traditional American Indian dancing
Home Activities	05021	3.5	Mopping
	05025	2.5	Multiple household tasks all at once, light effort
	05026	3.5	Multiple household tasks all at once, moderate effort
	05027	4.0	Multiple household tasks all at once, vigorous effort
	05043	3.5	Vacuuming
	05045	6.0	Butchering animals
	05053	2.5	Feeding animals
	05148	2.5	Watering plants
	05149	2.5	Building a fire inside
	05181	3.0	Carrying small children
	05187	4.0	Elder care, disabled adults, only active periods
	05188	1.5	Reclining with baby
	05190	2.5	Sitting, playing with animals, light, only active periods
	05191	2.8	Standing, playing with animals, light, only active periods
	05192	2.8	Walk/run, playing with animals, light, only active periods
	05193	4.0	Walk/run, playing with animals, moderate, only active periods
	05194	5.0	Walk/run, playing with animals, vigorous, only active periods
	05195	3.5	Standing–bathing dog
Lawn and Garden	06165	4.5	Painting (Taylor Code 630)
Inactivity	07011	1.0	Lying quietly, done nothing, lying in bed awake, listening to music (not talking or reading)
	07021	1.0	Sitting quietly, sitting smoking, listening to music (not talking or reading), watching a movie in a theater
Lawn and Garden	08125	4.5	Mowing lawn, power mower (Taylor Code 590)
	08165	4.0	Raking lawn (Taylor Code 600)
	04246	3.0	Picking fruit off trees, picking fruits/vegetables, moderate effort

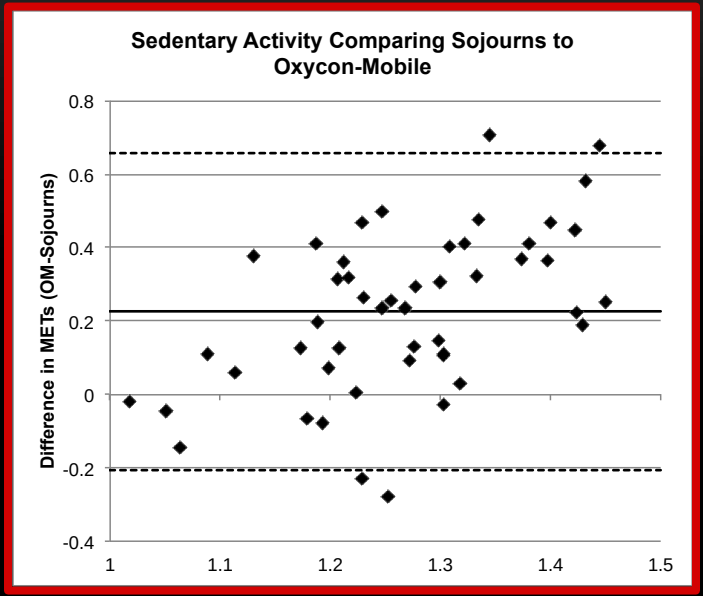
Research Measures: ActiGraph, activPAL, Sensewear Armband

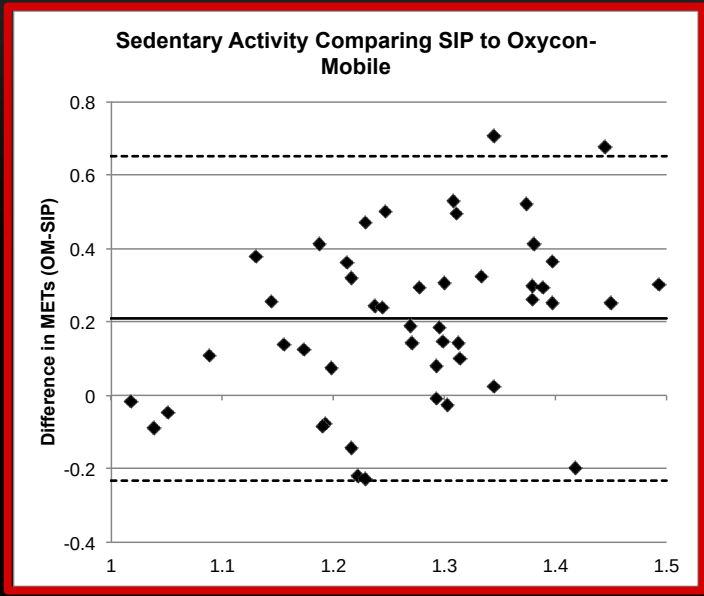


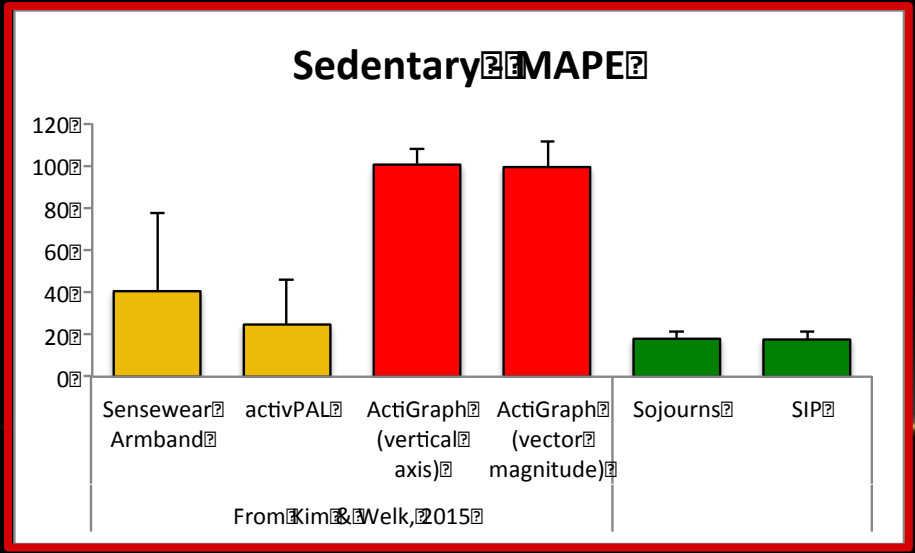
Criterion – Indirect Calorimetry

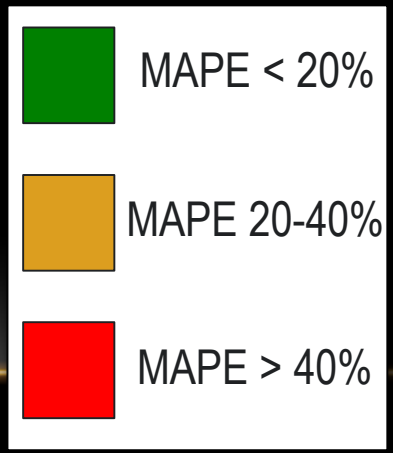
RESULTS – MET ESTIMATES

MET COMPARISONS - SEDENTARY TIME



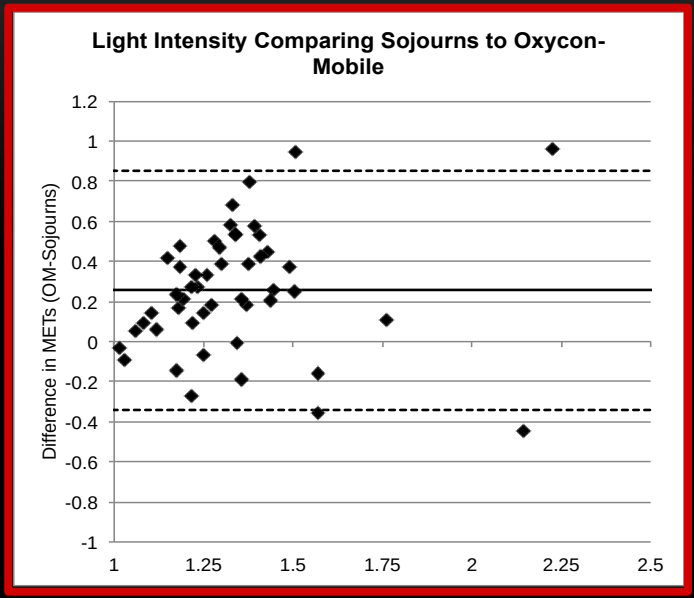


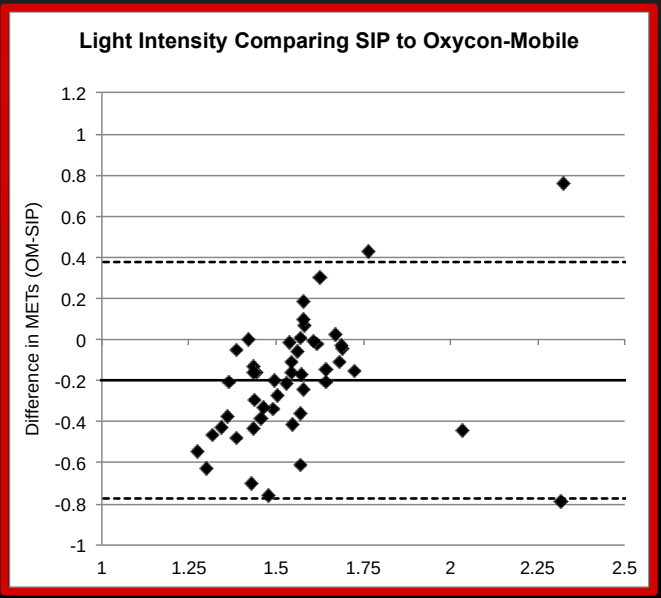


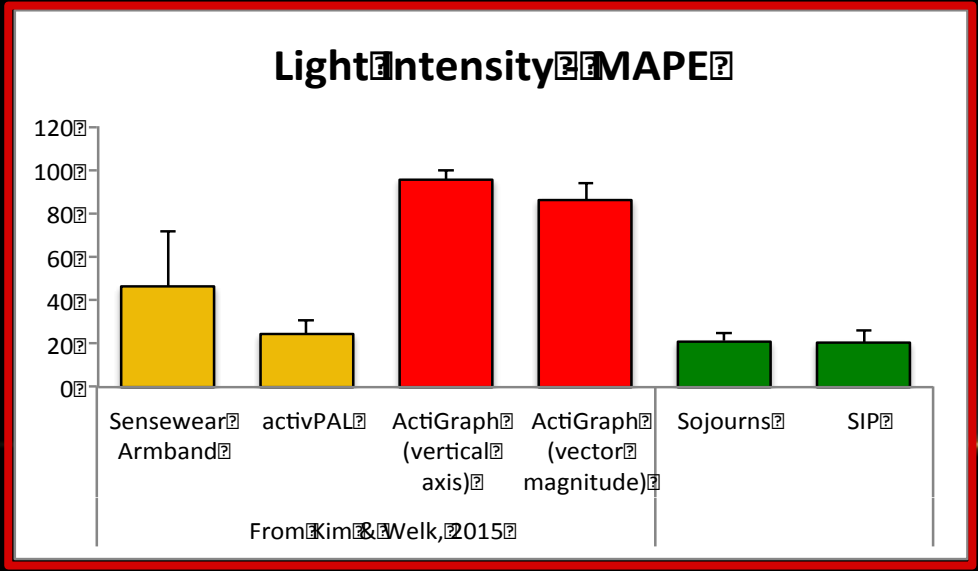


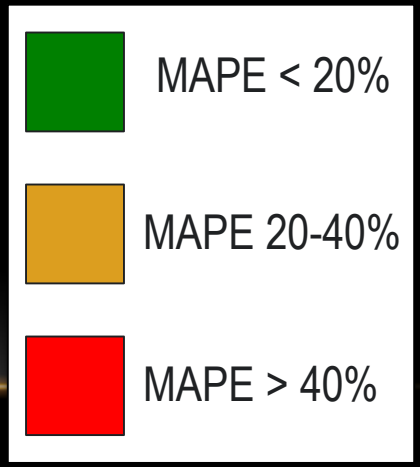
MAPE = Mean Absolute Percent Error

MET COMPARISONS – LIGHT INTENSITY



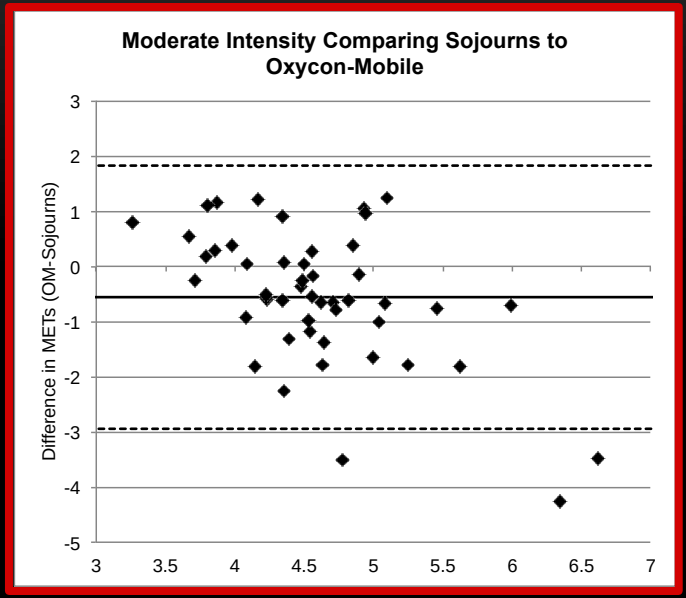


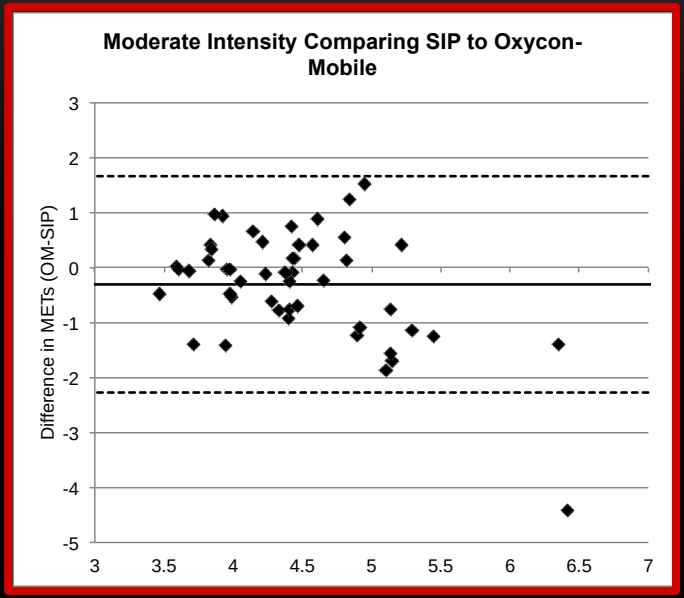


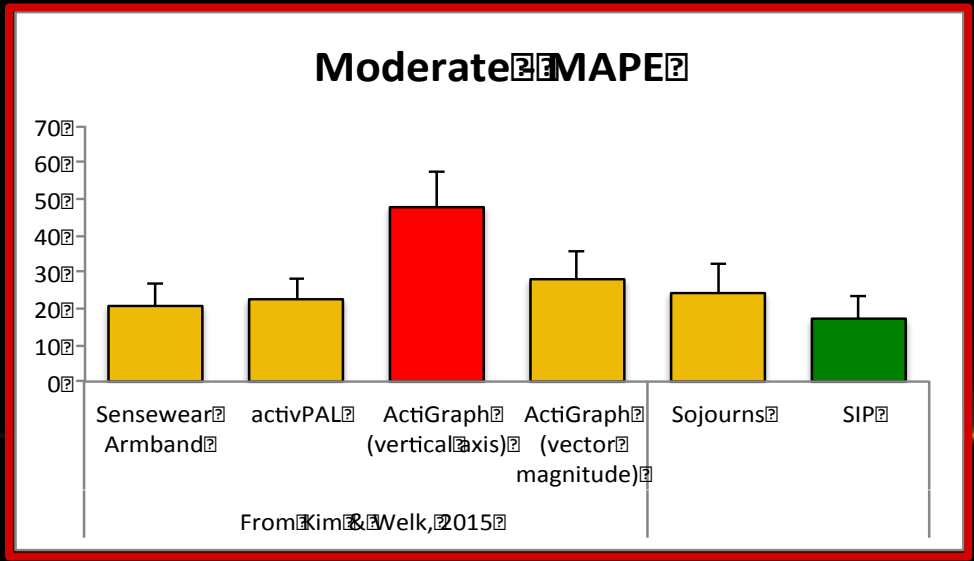


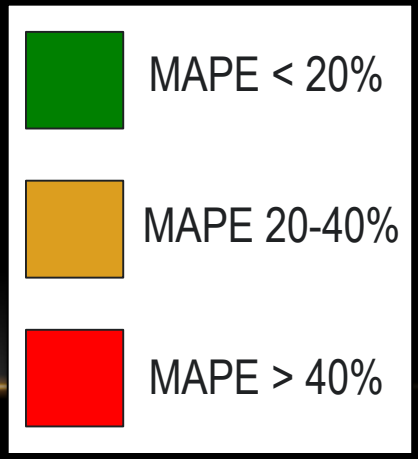
MAPE = Mean Absolute Percent Error

MET COMPARISONS – MODERATE INTENSITY



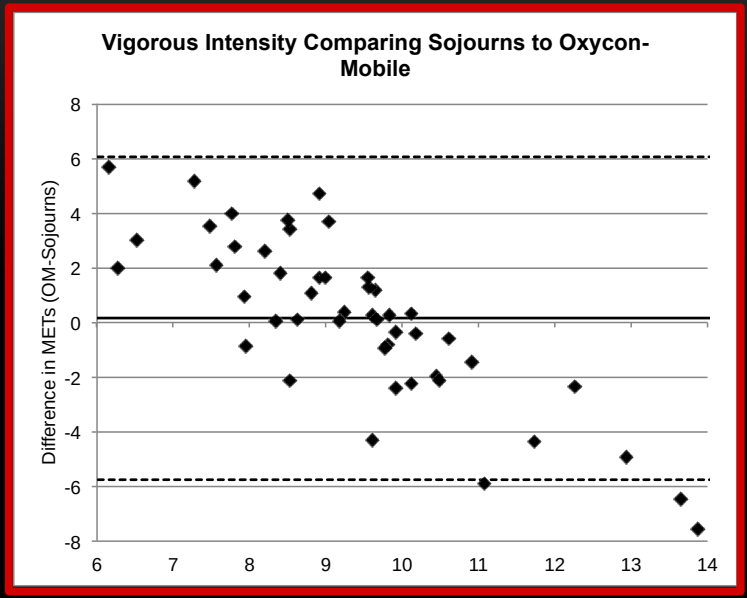


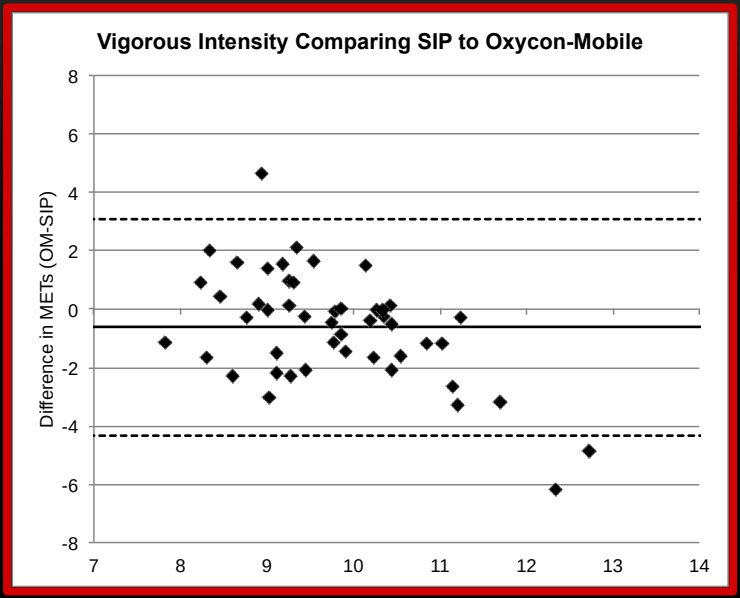


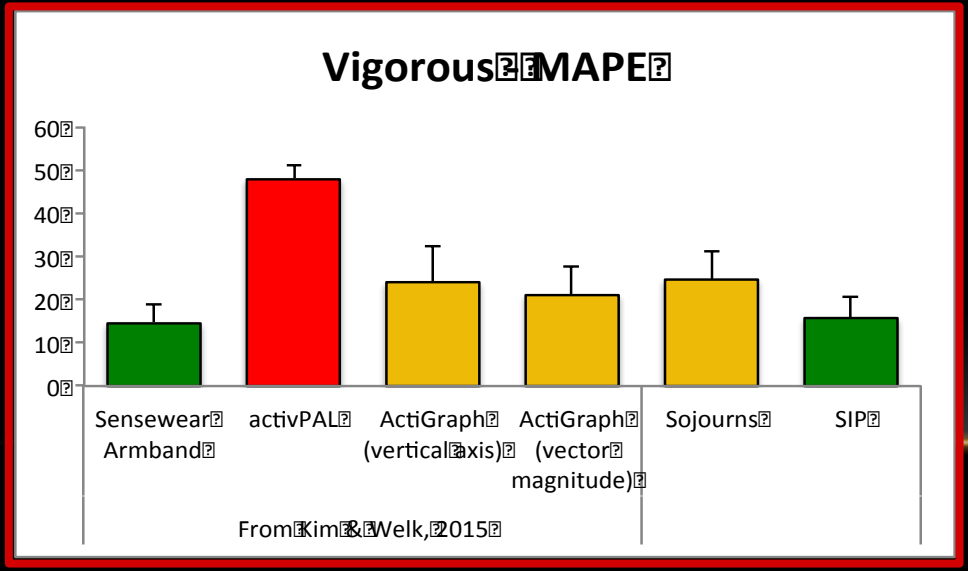


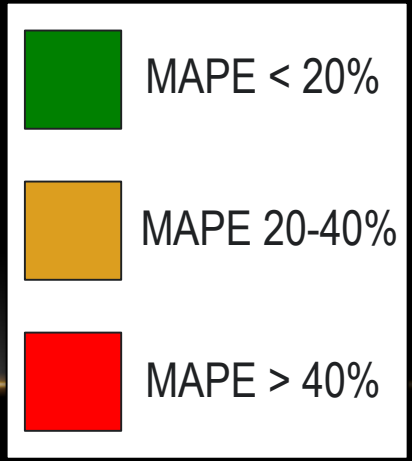
MAPE = Mean Absolute Percent Error

MET COMPARISONS – VIGOROUS INTENSITY







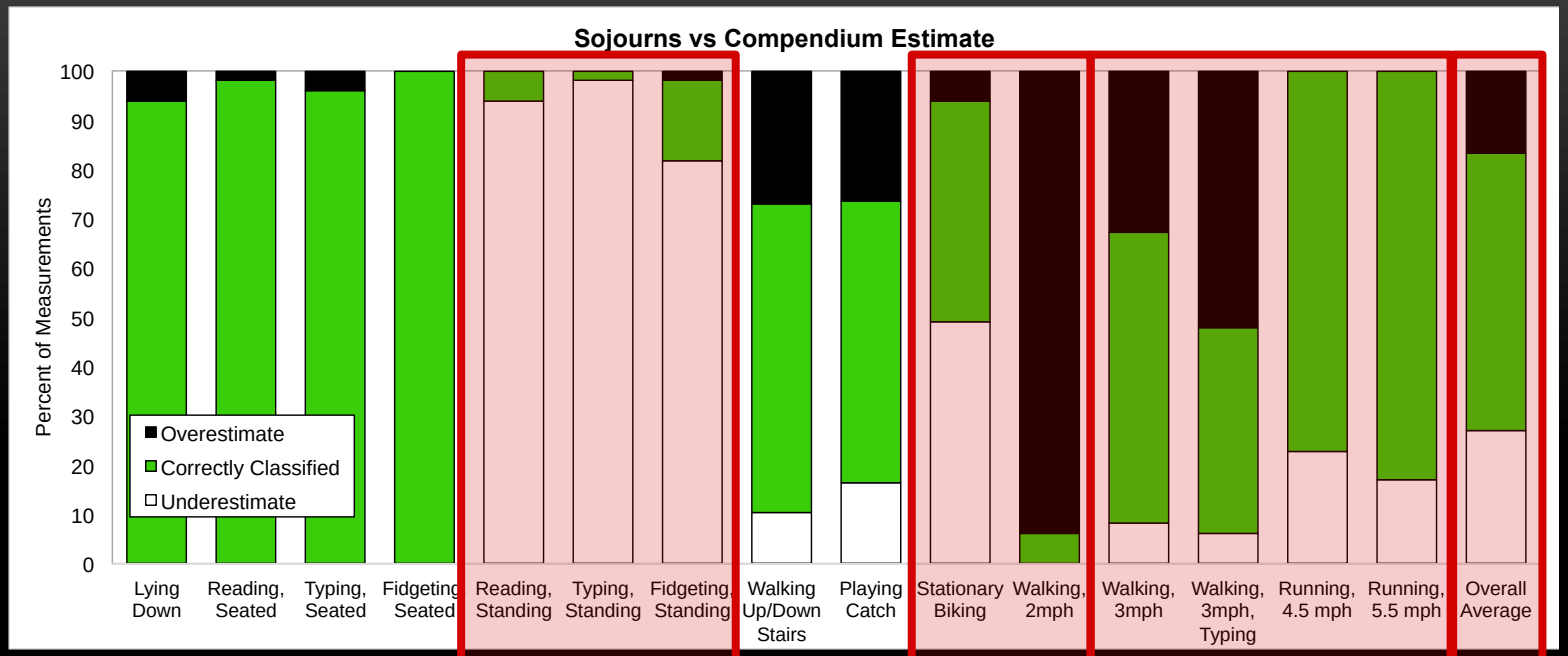


MAPE = Mean Absolute Percent Error

Criterion – Compendium Classification

RESULTS – ACCURACY OF INTENSITY CLASSIFICATION

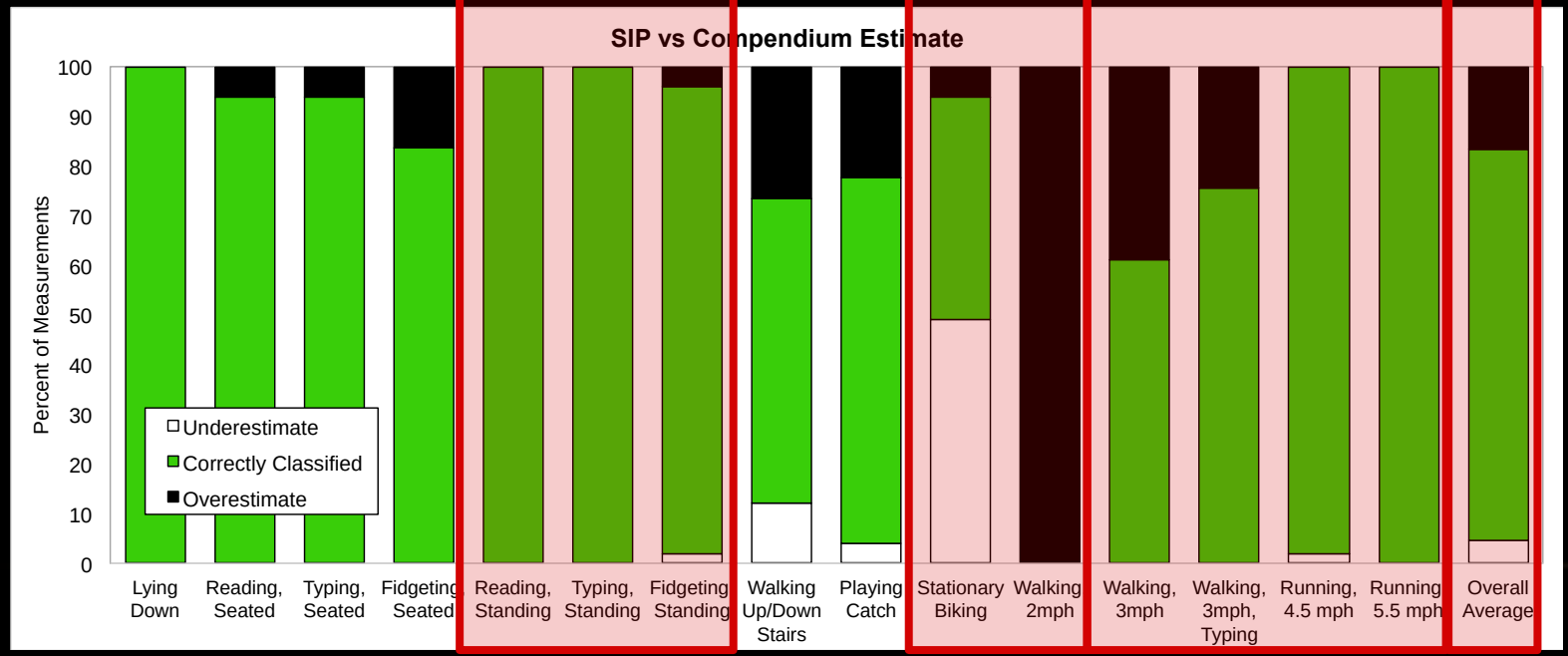
SOJOURNS



Overall Accuracy: 56%

Kappa: 0.41

SIP



Overall Accuracy: 79%

Kappa: 0.71

% of measurements that were correctly classified using The Compendium as the criterion

LIMITATIONS

- SIP method requires 2 monitors – potential for compliance issues
- Additional validation under free-living conditions and with more diverse populations is needed.

CONCLUSIONS

- Both SOJ and SIP methods are superior to established processing methods using the ActiGraph.
- SIP provides a more accurate measure of behavior overall and is recommended for studies where differentiating sedentary and light intensities is of interest.

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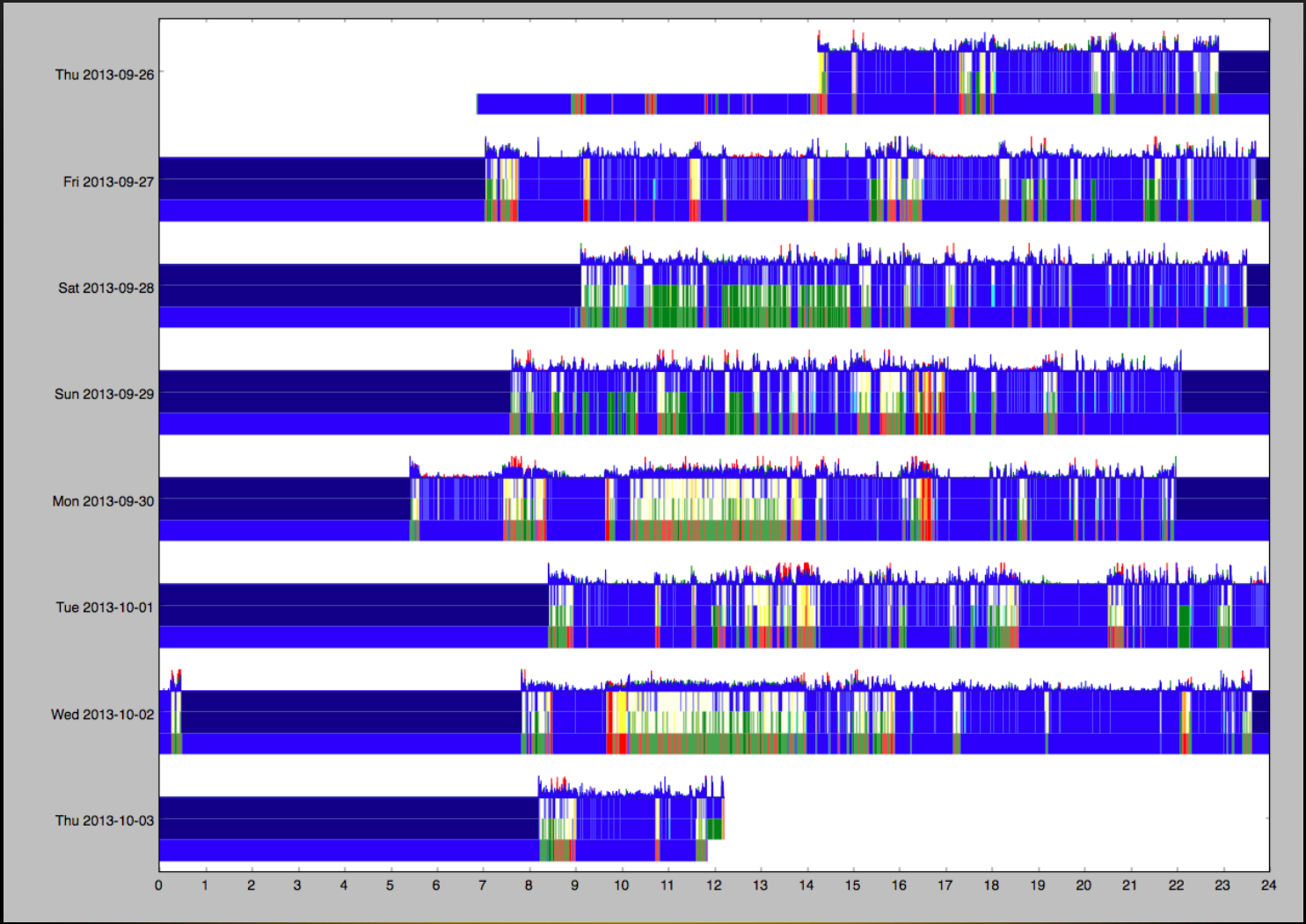
  - Paul Hibbing, BS
  - Rachel Devick, BS

TO LEARN MORE:

- Publication of the SIP method is available (Ellingson et al., MSSE, *epub ahead of print*)
- SIP Software is freely available for download from Github: https://www.github.com/ischwabacher/SIP
  - Implemented in R
  - Two additional scripts in python to get a multitude of output variables and to graphically display the data

Questions?

GRAPHICAL OUTPUT OF DATA FROM SOJOURNS & SIP FOR A FULL WEEK OF DATA



Top row is ActiGraph x, y, z axes;
Second row is Sojourns output from ActiGraph only;
Third row is Sojourns with ActiGraph & activPAL
Bottom row is ActivPAL

red=vigorous; orange=high moderate; yellow=low mod; light yellow=light; green=standing still; light blue=active sitting; dark blue=sedentary

Data processed using Sojourns and SIP methods