Using Accelerometers in Active Living Research: Practical Issues in Collecting and Managing Data (Beginner Level)

> Kelli Cain Carrie Geremia San Diego State University

NIH Studies

Study	Aims	PI	Population	Ν	Mode of delivery	Actigraph model
NQLS 2001-2007	Walkability & PA	Jim Sallis	Adults, 20-65	2000	Mail	7164 and 71256
NQLS-S 2004-2009	Walkability & PA, Physical Functioning	Abby King	Seniors, 66+	900	Mail	7164 and 71256
NIK 2005-2010	Walkability/ Rec/Food Environment & BMI, PA, Diet	Brian Saelens	Children, 5-11	800	In-person & mail	GT1M
TEAN 2007-2011	Walkability, Rec/Food Env & PA, Diet	Jim Sallis	Teens, 12-16	850	Mail	7164, 71256, GT1M & GT3X
IPEN 2009-2013	Walkability & PA in numerous countries	Jim Sallis	Adults, 18-65	3000+	In-person & mail	7164, 71256, GT1M & GT3X

Format of workshop

Presentation

A. Pre-data Collection
B. Boosting Compliance
C. Data Screening & MeterPlus
D. Decisions about Cleaning, Compliance & Cutpoints

Goals:

- 1. ask more in-depth questions
- 2. learn from others experience & approaches
- 3. try MeterPlus with your own files

Learning Objectives

A. Pre-data Collection

- 1. How to plan and budget for data collection
- 2. Benefits of having a good tracking database

B. Boosting Compliance

- 1. Tips for in-person & mail delivery & retrieval
- 2. Tips to increase compliance
- 3. Prompting protocols how to get devices back

Learning Objectives

C. Data Screening & MeterPlus

- 1. Why it's important to screen data
- 2. What 'valid' vs 'invalid' data look like
- 3. MeterPlus demonstration

D. Decisions about Cleaning, Compliance & <u>Cutpoints</u>

- 1. What cleaning & compliance decisions need to be made
- 2. What cutpoints are out there and will this choice affect my outcomes

Pre-data Collection

Carrie Geremia



7164



GT1M/GT3X

Data Decisions

- I. How long will you ask participants to wear the Actigraph?
- 2. When will you ask them to wear the Actigraph (e.g., waking time only, only when in town, all day and night)?
- 3. Will you ask participants to complete a log of when they put the unit on and take it off? Any other daily assignments?
- 4. Will you ask participants to re-wear the Actigraph if not enough good data are collected the first time?
- 5. What will be enough wearing time to be considered compliant and therefore not asked to do a re-wear?

Data Decisions, cont.

- 6. How will you define a valid hour?
- 7. How will you define a valid day?
- 8. Will you have different valid wear time criteria for weekday vs. weekend?
- 9. What software will you use to screen and score your Actigraph data?
- 10. Will you collect any additional data streams (e.g., step counts)? How will you process it/use it?

11. What epoch will you use?

- Activity in kids is intermittent so shorter epoch length will capture short bursts of activity and categorize them appropriately
- Longer epoch dilutes vigorous activity
- In use: 2, 5, 10, 15, 30, 60 seconds
- Enough memory in new models to use short epochs

How much memory?

15 second epoch	Days of data collection with Activity- only	Days of data collection with Activity+Steps (or 2 selections in GT3X)	Days of data collection with Activity+Dual+ Steps (or 3 selections in GT3X)	Days of data collection with 4 selections in GT3X
GT1M	85	42	28	NA
GT3X	358	179	119	89

- Battery runs out before memory.
- GT1M has about 14 days and GT3X has about 20 days (15 in tri-axial mode)

Budgeting for Data Collection

Staff	Part time equipment manager (at least 20 hours/week), for 30-50 meters/week; additional recruitment/participant management staff
Actigraphs	# days of data collection/ [return time + in-office time] = X X * [loss rate] = Y X-Y = the number of time the unit can go out in one year (Z) Number of participants to measure/Z = desired inventory to meet your measurement goals

Example: Assuming a 1 year data collection period, 30-day average return time, 5 day in-office time, 4% loss rate with a target of 100 participants to measure, it would be determined that 10 Actigraphs are needed.

Equipment

ActigraphsLabelInventory

Belts, clips
Where to purchase
Different sizes

TEAN Study 3900 Fifth Ave Ste 310 San Diego, CA 92103 If found please call **1-877-440-4832**

Calibrator *older models only*





Delivery

Online USPS

Priority Mail http://www.usps.com/shipping/prioritymail.htm

Tracking

Cost

Materials



Reply 🖓 Reply to all 🍣 Forward 🛃 🕵	🖄 😤 🗙 🔺 🧇 🛞 Неір	
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Cc: Subject: Click-N-Ship(R) Notificatio	20	
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Dear TEAN STUDY,		
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Tracking

- Access database
- Each wearing is a record
- Track by serial number and participant
- Queries
 - Length of time out
 - Problem units
 - Compliance
 - Outstanding units

Access Database

TEAN GPS and Meters

articipant ID#	E
Sity	
Stage	
Recruiter	
PS Round #	
feter Round #	
PS Serial #	
>harger Serial #	
1eter Serial #	
leter Model	
leter Battery Life	
ast Day for Meter	
GPS Intervals	
ast Day for GPS	
leter Log Dated?	

Outgoing

Date GPS Sent Date Meter Sent Date Meter Activated Charts GPS for repair

1/28/2010
1/28/2010
1/30/2010
0

GPS

Meter for repair

Incoming

Date GPS Received Date Meter Received Date GPS Downloaded Date Meter Downloaded Valid GPS Days

2006) 1	- 23
2	2
4	7
3	3
3	3
086	644
018	584
2003	3816
GT	1 M
2/13/	/2010
3	0
2/16/	2010
- 1	Ê.

Data Problems	Meter Needs 🗖 Repair
Bad GPS data	
Bad Meter data	
GPS Not Downloaded	
Meter Not Downloaded	
GPS Never Worn	
Meter Never Worn	
Memory Address Error	
Repeat Data	
ID of Repeat Data File	
Notes about Repeat Data F	ile
Scoring status repeat file	
Other GPS Data Problems	
Other Meter Data Problem	ns
Comments	
Meter	

Meter Log	Meter Log
DAY 1	
Day	Date
Time on:	Time off:
Meter	Meter
GPS	GPS Home all day
Time removed	
Valid hours	Reason for invalid day
GPS valid day	GPS turned on 0
DAY 2	
Day	Date
Time on:	Time off:
Meter	Meter
GPS	GPS Home all day
Time removed	
Valid hours	Reason for invalid day
GPS valid day	GPS turned on 0
Comments	
Day	Date
Time on:	Time off:
Meter	Meter
GPS	GPS Home all day
Time removed	
Valid hours	Reason for invalid day



Boosting Compliance

Rates

Study	Valid Wearing Time Guidelines	Compliance	Return Time (median)	Equipment Loss Rate
Seniors	5 valid days, <45 minutes of consecutive "0" counts per hour	90%	20 days	0.7%
Adults	5 valid days, <30 minutes	88%	20 days	2.6%
Teens	5 valid days (1 weekend), <30 minutes	71%	23 days	1.8%
Children	6 valid days (1 weekend), <20 minutes	74%	19 days	1.6%

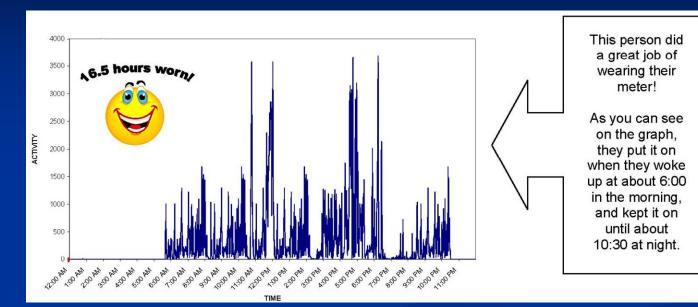
Wearing Instructions

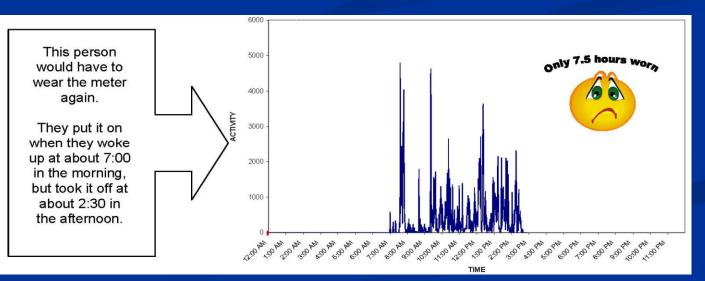
• Delivery one day early, preferably near the weekend

•Show how to wear

• Stress how long to wear (see charts)

• Will ask to re-wear





Meter Instructions

- How to wear meter
- Increase valid wearing time expectations
- Providing an end date



How to Wear the Activity Meter

This small activity meter records general movement and allows us to get a better idea of your overall activity level. We will **not** be able to tell what kind of specific activity is happening. At first, the belt may feel slightly awkward, but after a few hours, you will probably get used to it and not notice it as much. It is **extremely** important for our study that you wear the meter properly. If it is not worn properly, we may have to send it back for you to wear again. Please follow these instructions carefully:

- Wear the meter attached to the belt around your waist, just above your <u>right</u> hipbone.
 You can wear it either underneath or on top of your clothing.
- Wear the meter so that the star sticker is facing **up**.



- Wear the meter snug against your body. If you have to, you can adjust the belt by pulling the end of the strap to make it tighter. Or, to loosen the belt, push more of the strap through the loop. Wear the belt tight enough so that the meter does not move when you are being active.
- Please put it on first thing in the morning -- either just after you get out of bed or just after you shower or take a bath in the morning.
- O not submerge the meter in water (swimming, bathing, etc.)
- Keep the activity meter on all day (unless swimming or in the water).
- At night, take it off right before you go to bed. You should be wearing the meter for *at least* 12 hours each day.
- O not let anyone else wear it.
- O The meter has a very short battery life.

The last full day that it will work is	If you
cannot begin wearing it by	, please call

1-877-440-4832 as soon as possible!

There is <u>no</u> "ON" or "OFF" switch that you need to worry about turning on or off every day. The activity meter runs on a battery and is programmed to run continuously without you needing to turn it on. Please do not try to open the activity meter.

Log/Journal



Meter and GPS Log

Wear the movement meter and GPS for seven (7) days in a row, including weekends. In the spaces below, write down the dates, days and times which you wear them. If you take the devices off for <u>more</u> <u>than 30 minutes</u>, such as for swimming, record when they were removed and for what reason. If you are unable to wear the meter for *at least* 12 hours one day, please wear it one extra day. Thank you!

Please start wearing your meter <u>on or before</u> ______ The last full day that your meter will work is _____

Day 1								
(Circle Day)	Mon	Tues	Wed	Thurs Fri	Sat	Sun	Date	

<u>Time Meter Put On:</u> <u>Time Meter Taken Off: :</u>	am / pm am / pm	Time Left Home with GPS:		am / pm <i>or</i> Home All Day
Time removed during the day (e.g. Why removed (e.g.			_	

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Duy	-

(Circle Day) Mon Tues Wed Thurs Fri Sat Sun Date_

<u>Time Meter Put On:</u> <u>Time Meter Taken Off: :</u>	am / pm am / pm	<u>Time Left Home with GPS:</u>	am / pm <i>or</i> Home All Day
Time removed during the day Why removed	(e.g. 10:30-11am): (e.g. swimming):		

Day 3 (Circle Day) Mon Tues Wed Thurs Fri Sat Sun Date_

<u>Time Meter Put On:</u> <u>Time Meter Taken Off: :</u>	am / pm am / pm	Time Left Home with GPS:		am / pm or Home All Day
Time removed during the day (e.g. Why removed (e.g.			_	

 Day 4

 (Circle Day) Mon Tues Wed Thurs Fri Sat Sun Date_____

 Time Meter Put On:
 am / pm
 Time Left Home with GPS:
 am / pm
 or

Prompting Material Return

Phone calls

• First calls at the beginning of wearing: to remind of criteria, proper wearing

• Prompt calls weekly

Emails/Text Messages

• Use in combination with phone calls, most effective with adults and teens Mailings

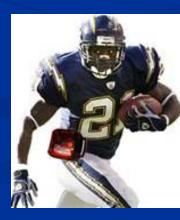
• Last resort: if phone calls are not successful, begin mailing return materials, reward letter or home visit

DON'T GIVE UP!

Action (MC=meter check-in call; MR=meter reminder call; PC=prompt call)	Length of time before next contact
Make your MC call the day you expect your participant to receive the meter.	Schedule next call for 3 days later.
Make your MR call to check in again and make sure the participant started wearing the meter.	Schedule next call for 5 days later.
Make your PC1 call (first prompt call).	Schedule your next call for 1 week later.
Make your PC2 call.	Schedule your next call for 1 week later. If local, offer a home pickup.
Make your PC3 call and send an email if possible.	Schedule your next call for 1 week later.
Make your PC4 call and mail a return envelope (#1).	Schedule your next call for 1 week later.
Make your PC5 call.	Schedule your next call for 1 week later.
Make your PC6 call and send an email if possible.	Schedule your next call for 1 week later.
Make your PC7 call.	Schedule your next call for 1 week later.
Make your PC8 call and mail another return envelope (#2).	Schedule your next call for 2 weeks later.
Make your PC9 call.	Schedule your next call for 2 weeks later.
Make your PC10 call and send an email if possible.	Schedule your next call for 2 weeks later.
Make your PC11 call.	Schedule your next call for 2 weeks later.
Make your PC12 call and mail another return envelope.	Schedule your next call for 2 weeks later and continue calling until at least 6 months have passed.
At this point, the meter has been out for at least 6 months and 3 envelopes have been sent. Consult a supervisor about the next steps.	Continue calling if you have had contact with participant and think continued attempts will help. A reward letter is an option but only if nothing else helps. The reward is usually comparable to the incentive they would have received for completing the study.

Charts/graphs Instruction sheets with dates Logs/Journals Calls/Emails/Texts/ Mailings Letter to schools and coaches Stickers

Compliance Elements







MeterPlus & Data Screening

Kelli Cain

MeterPlus

- Anyone can use it, <u>no programming skills required</u>
- Windows-based, with user-friendly interface for data screening
 <u>Beforeatch-process</u> your files <u>After</u>
 - Visual screen for consecutive zeros of ActiGraph and and are for consecutive zeros

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5 Cycle Period (hh:mm:ss) 00:01:00	
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	Enter the name of the file that you would like to save your scoring file as:
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21 11/16/2005 1440 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
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2 11/11/2005 1438 1 0 0 5897 N/A 6.84 11/12/2005 1440 0 0 0 0 N/A	
filters and more	



1. Convert

2. Screen

Screen data files

individually for

enough valid

Useful when

checking for

compliance.

wear time.

Convert DAT files to CSV files with a oneclick utility.

Eliminate
 non-wearing
 time and
 save days of
 data you
 really want
 to keep as
 MPD files.

3. Clean

4. Score

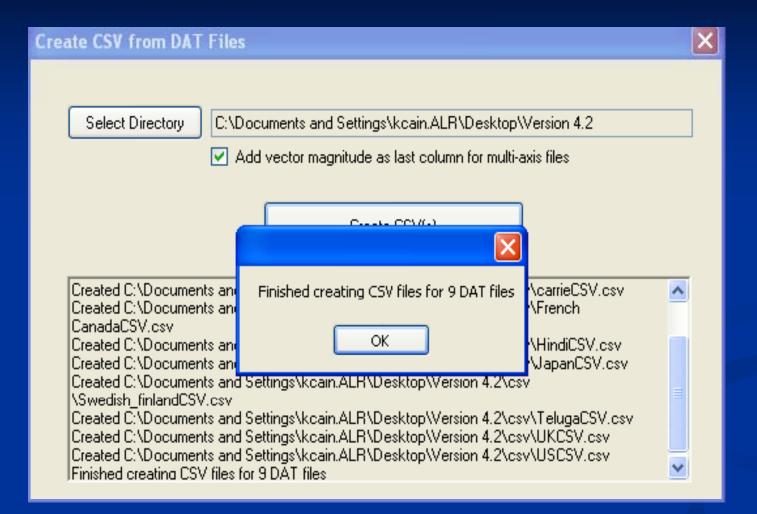
V

5. Analyze

Batch score your files and create one comma-delimited file containing variables for your entire sample.

Import the commadelimited file into statistical software and analyze.

Step 1. Convert DAT to CSV





- Screen data right away
 - Compliance with first wearing only 70-75% in children & teens. About 95% with additional wearing.
- Looking for valid wear time & malfunctionDecide if re-wear is needed
- MeterPlus makes this easy

Screening data

🏓 MeterPlus Options 🛛 🔀	
View Data Score Data Categories Variables Bouts kCals Filters	
Hours required for a valid day:	Valid hours
Number of zeros in a row to make an hour invalid: 30	Non-wearing time
Meter Start Time for Participant's Time Zone	
0 + HH (actual meter start hour in 24 hour time; start minutes are read from the file header)	Time zone or
Same Day Next Day Previous Day	start time adjustments

Screening Actigraph files

	🏘 MeterPlus - default.mpo		📕 MeterPlus - kelli.mpo							
	File Tools Reports Help			le Tools Reports Help						
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			ñ ñ ñ	ñ ñ ñ	n n 🗡					
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Wear time
Mail days that may look like wear time
Malfunction/Invalid data
Repeat data (older models)

Wear time – typical pattern

Daily Info for Thursday, August 22, 2002

Number of Data Points each Hour: 60

Numbe	Number of Data Points each Hour: 60													
0	0	0	0	0	0	0	0	0	0	0	0	0	0	<u> </u>
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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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198	164	344	148	311	108	207	76	14	86	25	68	127	260	95
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87	2	0	195	315	0	11	15	20	19	13	71	49	4	6
5	0	253	1131	951	182	251	6	1480	831	90	11	0	162	269 🗏
83	0	280	76	86	194	138	28	150	426	12	513	173	246	39
202	15	195	132	223	382	196	45	101	782	1239	757	1213	3832	704
0	0	0	0	0	0	0	12 90	423	469	1133	488	392	197	816
894 469	1063 873	900 1338	386 1963	760 2133	208 1079	537 684	1093	160 1347	265 2070	1079 662	558 334	1332 531	1090 846	862 1231
768	159	385	1634	1898	2009	539	2076	2167	2070	310	321	3136	2675	616
525	772	639	132	149	125	33	49	99	98	490	638	261	126	34
544	1022	319	239	310	0	15	õ	1	26	83	38	õ	43	7
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Mail days

🔄 MeterPlus - Kids_3 METS-30 epoch.mpo

File Tools Reports Help

S:\CSA Data\Actigraph Training\B_mail time\Mail_60s.DAT

Date	Valid Hours	Valid Day?	Day Of Week	Parameter
8/15/2002	11	Yes	Thursday	Activity
8/16/2002	0	No	Friday	Activity
8/17/2002	0	No	Saturday	Activity
8/18/2002	12	Yes	Sunday	Activity
8/19/2002	17	Yes	Monday	Activity
8/20/2002	13	Yes	Tuesday	Activity
8/21/2002	15	Yes	Wednesday	Activity
8/22/2002	17	Yes	Thursday	Activity
8/23/2002	12	Yes	Friday	Activity
8/24/2002	2	No	Saturday	Activity
8/25/2002	10	Yes	Sunday	Activity
8/26/2002	6	No	Monday	Activity
8/27/2002	10	Yes	Tuesday	Activity
8/28/2002	5	No	Wednesday	Activity

Daily Info for Tuesday, August 27, 2002 Number of Data Points each Hour: 60 ^ ō ō n 0 0 0 0 n õ ō ō õ ō ō õ õ ō õ õ Ō õ õ Ō Ō Ō Ō 0 0 0 Ō O 6 13 16 35 0 0 0 0 1 9 0 32 0 0 20 8 13 27 0 2295 6 0 62 0 7 0 n. ō ō ō ō Ō ō Π Π Π In. n n n. Ω <

Save Change

Close

Change Valid Value

🐼 Validi

🔿 Invalid

Malfunction – invalid data

Counts >16,000, don't have to fill the entire day.

U	Paily In	fo for M	onday, S	Septemb	er 01, i	2003									
	Number	of Data P	oints each	Hour: 60											
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 🔨
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 💳
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	24820	25188	24811	25180	25064	25142	24962	25120	24846	24675	24605	24918	24801	24808	2496
	24000	24000	24000	23980	23952	23814	23428	23384	22268	21604	21600	21600	21450	21006	2135
	20400	20400 20959	20400 20844	20412 20885	20437 20606	20400 20797	20400 20914	20400 20985	20528 20938	20401 20997	20408 20978	20400 20922	20400 20950	20400 20996	2041 2091
	20800	20303	20844	20005	20606	20737	20314	20305	20538	20557	20378	20522	20300	20336	2031
	21600	21559	21600	21600	21600	21600	21203	21608	21606	21600	21600	21600	21610	21600	2164
	25559	25223	25203	25200	25194	25197	25200	25186	25196	25200	25200	25200	25200	25200	2520
	25801	25812	25803	25800	25800	25843	25946	26041	26049	25817	26105	26295	26386	26400	2640
	26333	26400	26400	26400	26400	26400	26400	26400	26400	26400	26400	26400	26400	26400	2640
	26720	26672	26522	26469	26660	26850	26871	26784	26991	27000	26999	26922	26987	26996	2700
	27282	27456	27293	27240	27545	27597	27595	27599	27600	27600	27483	27594	27600	27600	2756
	28047	28138	28042	28193	28200	28200	28200	28200	28357	28800	29261	29805	30127	29226	2803
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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ate	Valid Hours	s Valid Day?			Day Of W	eek	Parameter									
/30/1899	24	Yes			Saturday		Activity									
/31/1899	24	Yes			Sunday		Activity									
/1900	24	Yes			Monday		Activity									
/1900	24 🧧				* •		1.11.12									
/1900	24	Daily Inf	io for Th	hursday	, Januar	y 11, 1	900									
1900	24		(D													
/1900	24	Number	of Data Po	oints each	Hour: 60											
/1900	24	<u>n</u>	14080	16	16	20704	15616	4320	16128	31966	16384	1706	16896	21690	17152	27326
/1900	24	17734	65	16963	17477	17991	18432	0	770	3	768	772	2	1280	520	2
/1900	24	0	9802	19	1024	4386	4	31572	26729	29472	26995	8289	8277	16722	21536	29810
/1900	24	5892	17	13532	0	0	272	0	0	0	528	0	0	0	769	7900
0/1900	24	23699	16936	29160	12306	3299	12306	214	12306	6371	3602	3959	7766	1536	3679	16016
1/1900	24	1810	1554	2066	2322	2578	2834	3346	3998	6184	3616	7580	1024	1024	4904	2336
2/1900	24	15140	16272	8446	12332	3656	2121	2378	2635	2883	16208	2	12324	16272	8446	8492
3/1900	24	12097	3935	12257	16304	128	22820	16099	7763	16205	3960	2127	16205	3961	2383	12109
4/1900	24	544 1060	8531 6227	15932 2403	2207 2659	29999 2915	14144 3144	6 N	2888 3145	2115 512	1887 3146	2136 1024	2409 3147	2666 1536	2923 15681	3007 15169
5/1900	24	579	6227 18947	2403	2659	3971	2852	U 8067	3145	512 8067	3146 6948	1024	3147 13348	8067	21796	8067
6/1900	24	18435	16963	22019	7231	14992	2002 6144	800	21059	22019	5695	17043	22019	1060	15072	16384
7/1900	24	572	17043	22275	4900	8002	18435	20042	20446	14339	16963	22275	8002	18435	8019	591
8/1900	24	8067	8740	12163	8996	8067	110433	8067	14116	14396	12944	10496	20995	808	12306	5334
9/1900	24	12866	19971	572	12866	19971	12946	19971	548	23619	316	19523	14913	12353	8579	12306
20/1900	24	26684	4803	21507	8002	21507	16368	31231	12243	591	21507	12994	21507	13040	32766	21507
1/1900	19	13010	21507	13040	32766	21507	10044	4819	21507	8002	21507	16368	31231	12243	591	21507
2/1900	0	828	13008	2	21507	7491	3137	12306	10962	16787	0	548	24131	316	20035	24243
3/1900	0	8146	28675	3987	1056	12867	28163	12867	28675	11587	15424	9475	12306	10962	15680	768
4/1900	0	2322	1554	1810	1042	1298	12674	1612	1357	3141	3395	12306	16606	6726	17920	2650
5/1900	0	7759	1024	8015	1536	12306	27868	2124	2381	2638	2895	7750	17920	3678	3678	3678
6/1900	0	7503	512	7759	1024	8015	1536	12306	27868	332	0	333	512	334	1024	335
7/1900	0	6977	1536	12306	5341	332	0	333	512	334	1024	335	1536	5971	18239	8006
8/1900	0	28385	3219	3108	11329	7489	512	7745	1024	8001	1536	12306	9924	12306	25788	2876
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/1900 /1900								_								

Constant, repeating, often "32767"

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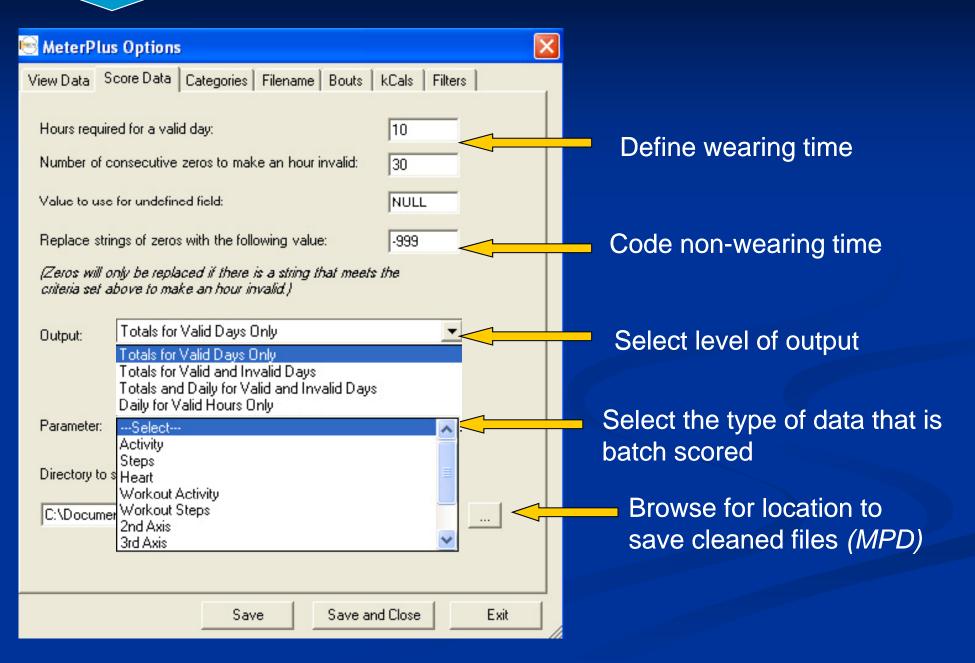
Constant, repeating

Daily Info for Saturday, June 01, 2002

Number of Data Points each Hour: 60														
128	128	128	128	128	128	128	128	128	128	128	128	128	128	128 👗
128	128	128	128	128	128	128	128	128	128	128	128	128	128	128 🔤
128	128	128	128	128	128	128	128	128	128	128	128	128	128	128
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128	128	128	128	128	128	128	128	128	128	128	128	128	128	128
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128	128	128	128	128	128	128	128	128	128	128	128	128	128	128
128	128	120	128	128	128	128	128	128	128	128	128	128	128	128
120	120	120	128	128	128	128	128	128	128	128	128	128	120	128
<	.70	10			.711	.70				.70	.70			>



3. Clean



Saving wear time

Select the days to be scored. Days without enough valid wearing time can be excluded from this process so they are not included in the final data set.

😸 MeterPlus -	kelli.mpo					
File Tools Repo	rts Help					MeterPlus 🛛 🔀
C:\Documents ar	nd Settings\k	cain.ALR\Desktop\Ver	sion 4.2\GT1M_MODI	E=5CSV.csv	Mode = 5	24 days were successfully saved to C:\Documents and Settings\kcain.ALR\Desktop\Version 4.2\version 4203\GT1M MODE=5CSV_Activity(1).mpd
Date \	Valid Hours	Valid Day?	Day Of Week	Parameter		ОК
10/11/2008 2	2	No	Saturday	Activity		
10/12/2008 1	1	No	Sunday	Activity		MeterPlus 🛛
10/13/2008 2	2	No	Monday	Activity		
10/14/2008 0	0	No	Tuesday	Activity		24 days were successfully saved to
10/15/2008 1	1	No	Wednesday	Activity		C:\Documents and Settings\kcain.ALR\Desktop\Version 4.2\version 4203\GT1M MODE=5C5V_Steps(1).mpd
	0	No	Thursday	Activity		
	2	No	Friday	Activity		OK
	0	No	Saturday	Activity	_	
10/11/2008 4	4	No	Saturday	Steps		MeterPlus
	5	No	Sunday	Steps		15 days were successfully saved to
10/10/2000	3	No	Monday	Steps		C:\Documents and Settings\kcain.ALR\Desktop\Version 4.2\version 4203\Actitrainer MODE=3_2nd Axis.mpd
	0	No	Tuesday	Steps		
10/15/2008 2	2	No	Wednesday	Steps		OK
10/16/2008 2	2	No	Thursday	Steps		
10/11/2000 1	2	No	Friday	Steps		
	0	No	Saturday	Steps		
	0	No	Saturday	2nd Axis		
	0	No	Sunday	2nd Axis		
1011016000	2	No	Monday	2nd Axis		
	0	No	Tuesday	2nd Axis		
	0	No	Wednesday	2nd Axis		
	0	No	Thursday	2nd Axis		
	2	No	Friday	2nd Axis		
10/18/2008 0	0	No	Saturday	2nd Axis		
Get Total Valid	Hours	Epoch Period (hh:mm:	ss) 00:00:05	Save All	Save Selected Days	

Variables: Date, Valid Hours, Valid Day, Day of Week & Parameter



Scoring Data

- There are a few things to configure in MeterPlus before batch-scoring your files
 - Cut-points
 - Filename variables
 - Energy Expenditure
 - Bouts
 - Time Filters

Programming cut-points

🗣 MeterPlus Options		X
View Data Score Data Categories V	ariables Bo	uts kCals Filters
Group/Category Name	Min Value	MaxValue
<pre> Addit (age 10 to 04) not_wearing sedentary light moderate hard very_hard + Senior (age 65 to 100)</pre>	-999 0 101 1953 5725 9499	-999 100 1952 5724 9498 100000
Add Group Add Category	Edit	Delete

Create Groups

Name: Child Age from 9 + to 10 + OK Cancel	🖳 Edit Category Form							
	Name:	Child						
OK Cancel	Age from	9 <u>+</u> to	ho 🗧					
		ОК	Cancel					

Add/Edit Cut-points

CutPointForm
Name: moderate
Meter values from 1953 to 5724
OK Cancel

Variables Created

•Total, Daily and Hourly: time spent in each activity category (not wearing, sedentary, light, moderate, vigorous). All days and/or Valid Days Only

Filename variables

MeterPlus Options	
View Data Score Data Categories Variables Bouts kCals Filters	
 Parse data file name into variables Begin parsing for variables after the last character. Map source data file name to: Filename 	
Sample file name: 12345 <mark>6789</mark> .dat	Enter sample file name
Variables: Add Variable for 59	Designate character positions
Variable Character Position City 0-1 Neighborhood 1-3 Variable 2.4	
Walkability 3-4 Group 4-5 ID 5-9	Name your variables
SaveCancel	

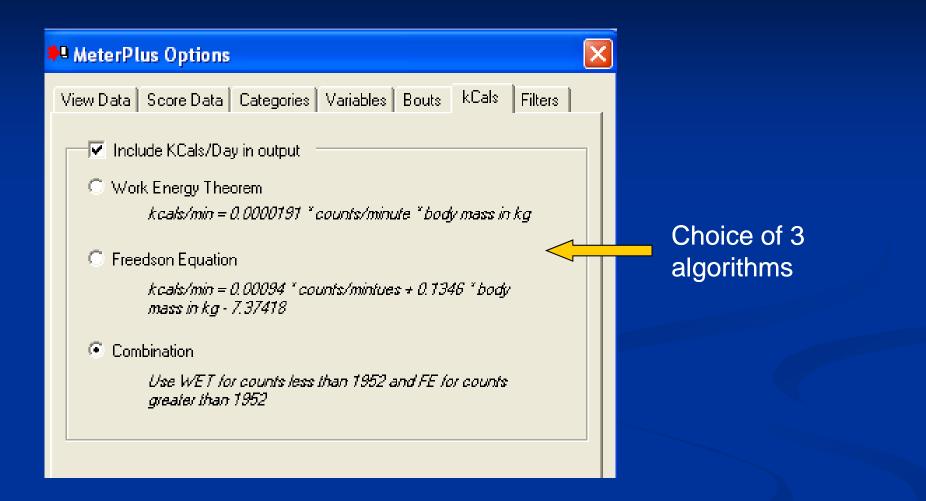
Settings for bouts (sustained levels of activity)

MeterPlus Options		\mathbf{X}	
MeterPlus Options View Data Score Data Catego Include Bouts in output Bout length (minutes) Lower limit (activity count) Upper limit (activity count) Tolerance (minutes)	ries Filename Bouts kCals F 10 1953 20000 2 -		Minimum length ntensity Allowable interruption
	Save Save and Close	Exit	

Variables Created

- Number, total length and average length of bouts
- Start and end times of each bout
- Total, Daily and Hourly

Energy expenditure



Variables Created

- Total, mean and peak energy expenditure
- Energy expenditure in each activity category
- Total, Daily and Hourly

Time filters

	9 0	MeterPlu	s Options		-			
	Vi	iew Data	Score Data	Categories	Filename	Bouts	kCals	Filters
	Г	Crea	te Time Filt	er Output File				
		Start Tim	e	End Time		Apply to [Days	
		08:00 AM		12:00 PM		Weekend	ds Only	
		03:00 PM		07:00 PM		Weekday	/s Only	
🗚 Sum data within these time periods 🛛 💷 🛋								
Start Time 09:00 AM								
End Time 05:00 PM								
Apply to Days								
C All Days								
C Weekdays Only								
C Weekends Only								
Save Sun Mon Tue Wed Thu Fri Sat			1			-	1	I
		Add Fil	ter			Edit		Delete
10 11 12 13 14 15 6 17 18 19 20 21 22 23								
24 25 26 27 28 29 30								
31 1 2 3 4 5 6								

Variables Created

- Date and day of week
- Start and end times of each filter
- Time spent in each activity category during each defined time period.

Age and weight scoring

Particpant Age Data for Scoring

Participant Age Data Age file for participants: Leave blank if you don't have an age file. If a participant's age is unknown, use the following category group or specify an age: Category Group: Adult (age 18 to 64) NIK (age 18 to 64) NIK (age 12 to 16) Senior (age 65 to 100)	Participant Weight Data You have specified to include Kcals in the output so you need to provide the participant's weight for scoring. Weight file for participants: Leave blank if you don't have a weight file. If a participant's weight is unknown, use the following weigh: Weight: 100 (in Kg)
--	--

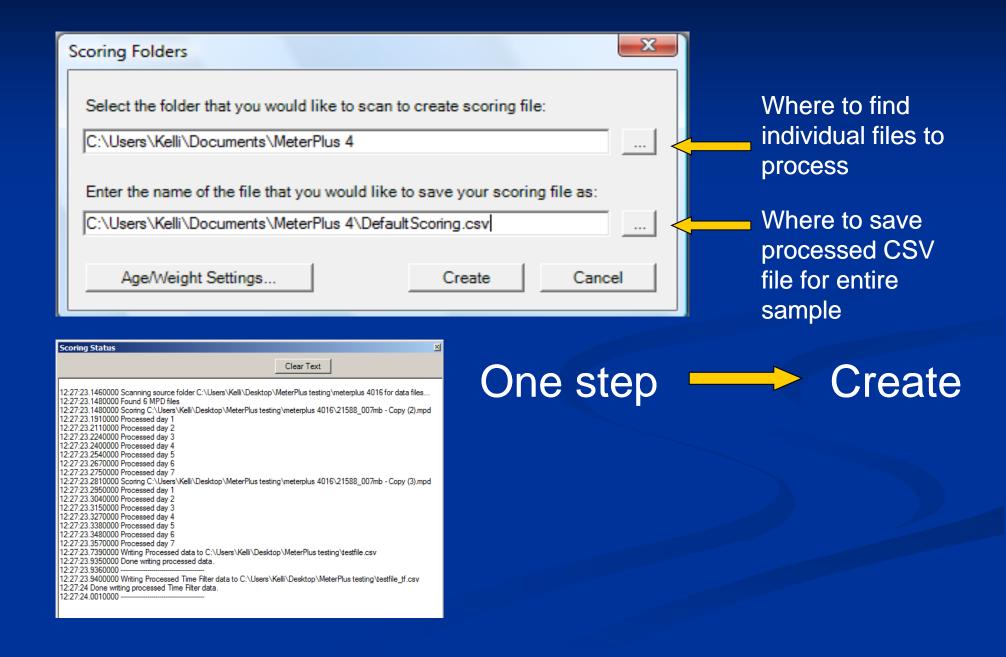
Use subject age to apply different cutpoints within the same batch

Select a group of cutpoints to use for your entire sample

Use subject body weight for energy expenditure calculations

Select a weight to be used for your entire sample

Batch scoring





File type	Description
CSV	Comma-delimited file containing the results of the batch scoring including activity counts, step counts, bouts and energy expenditure.
TF.CSV	Comma-delimited file containing the time-filtered activity variables only
SPS	SPSS syntax file that will import data into SPSS

MeterPlus

Where to get more information

 www.meterplussoftware.com

 Demonstration at breakout session
 ALR grantee discount



Data Decisions

- No consensus, big differences across studies
- •Cut-points and METs
 - Differences in outcomes depending on cutpoints and MET value used to define MVPA threshold
 - •"Brisk walk"=3 METs for adults and 4+ METs for children
- •Data cleaning and compliance
 - •What are some of the decisions to make?
 - •What are people using?

Calibration Studies

-	MVPA cutpoint (60s equiv)	METs	Age	Validation/Criterion measure	Activity
Freedson, 1997	<u>10 yr:</u> 1017 <u>10 yr:</u> 1910	3 4	6-18	VO2 consumption	Treadmill [60s]
Pate, 2006	1680	20 mL/kg/min (equiv to brisk walk)	3-5	Cosmed	Walk, run, lifestyle [15s]
Ekelund , 2004	2000	3	9-10	Used previous research to establish	Treadmill
Evenson, 2008	2296	ROC curve analysis	5-8	Cosmed	Lifestyle and treadmill [15s]
Treuth, 2004	3000	4.6	13-14 girls	Cosmed & heart rate	Lifestyle [30s]
Puyau, 2002	3200	AEE: .05 kcal/kg/mn (hrt rate 130)	6-16	room respiration, microwave detector & heart rate	Lifestyle and treadmill [60s]
Sirard, 2005	<u>3 yr old:</u> 2460 <u>5 yr old:</u> 3564	ROC curve analysis	3-5	Observation	Walk, run, sit, play [15s]
Mattocks, 2007	3582	4	12	Cosmed	Lifestyle

Differences in sedentary and MVPA in same sample (*n*=72; 4-7 yr olds; *p*<.01)

	MVPA cutpoint	Mean minutes MVPA/day	Sedentary cutpoint	Mean minutes sedentary/day
Puyau	3200	28	800	488
Treuth	3000	41	650	180
Freedson	630	266	NA	$N\!A$
Reilly	NA	$N\!A$	1100	501

Reilly, Penpraze, Hislop, Davies, Grant & Paton (2008). Objective measurement of physical activity and sedentary behaviour: review with new data. Arch. Dis. Child, 93, 614-619.

Cleaning and compliance decisions

- Reliable data processing staff
- Number of valid days & valid hours
- How many minutes of consecutive zero counts to define non-wearing

Reliability between data cleaners

- Ideally, same person would clean data for entire sample
- Detailed protocols with thorough training
- Inter-rater reliability

Same data, different cleaning parameters 7 wearing days

10 minutes of zeros

🖲 MeterPlus - ALR(1).mpo

File Tools Reports Help

C:\Documents and Settings\kcain.ALR\Desktop\Test data\Wearing Time test\Mail_60s.DAT

Date	Valid Hours	Valid Day?	Day Of Week	Parameter
8/15/2002	2	No	Thursday	Activity
8/16/2002	0	No	Friday	Activity
8/17/2002	0	No	Saturday	Activity
8/18/2002	8	No	Sunday	Activity
8/19/2002	11	Yes	Monday	Activity
8/20/2002	12	Yes	Tuesday	Activity
8/21/2002	13	Yes	Wednesday	Activity
8/22/2002	14	Yes	Thursday	Activity
8/23/2002	11	Yes	Friday	Activity
8/24/2002	0	No	Saturday	Activity
8/25/2002	7	No	Sunday	Activity
8/26/2002	1	No	Monday	Activity
8/27/2002	4	No	Tuesday	Activity
8/28/2002	0	No	Wednesday	Activity
	5 v	alid days		

30 minutes of zeros

🔄 MeterPlus - default.mpo

File Tools Reports Help

S:\CSA Data\Actigraph Training\B_mail time\Mail_60s.DAT

Date	Valid Hours	Valid Day?	Day Of Week	Parameter
8/15/2002	11	Yes	Thursday	Activity
8/16/2002	0	No	Friday	Activity
8/17/2002	0	No	Saturday	Activity
8/18/2002	12	Yes	Sunday	Activity
8/19/2002	17	Yes	Monday	Activity
8/20/2002	13	Yes	Tuesday	Activity
8/21/2002	15	Yes	Wednesday	Activity
8/22/2002	17	Yes	Thursday	Activity
8/23/2002	12	Yes	Friday	Activity
8/24/2002	2	No	Saturday	Activity
8/25/2002	10	Yes	Sunday	Activity
8/26/2002	6	No	Monday	Activity
8/27/2002	10	Yes	Tuesday	Activity
8/28/2002	5	No	Wednesday	Activity

9 valid days

20 minutes of zeros

😁 MeterPlus - default.mpo

File Tools Reports Help

S:\CSA Data\Actigraph Training\B_mail time\Mail_60s.DAT

Date	Valid Hours	Valid Day?	Day Of Week	Parameter
8/15/2002	5	No	Thursday	Activity
8/16/2002	0	No	Friday	Activity
8/17/2002	0	No	Saturday	Activity
8/18/2002	11	Yes	Sunday	Activity
8/19/2002	13	Yes	Monday	Activity
8/20/2002	13	Yes	Tuesday	Activity
8/21/2002	15	Yes	Wednesday	Activity
8/22/2002	16	Yes	Thursday	Activity
8/23/2002	11	Yes	Friday	Activity
8/24/2002	2	No	Saturday	Activity
8/25/2002	8	No	Sunday	Activity
8/26/2002	5	No	Monday	Activity
8/27/2002	5	No	Tuesday	Activity
8/28/2002	1	No	Wednesday	Activity
	6 v	alid days		

60 minutes of zeros

🖳 MeterPlus - default.mpo

File Tools Reports Help

S:\CSA Data\Actigraph Training\B_mail time\Mail_60s.DAT

		1	1	1
Date	Valid Hours	Valid Day?	Day Of Week	Parameter
8/15/2002	16	Yes	Thursday	Activity
8/16/2002	0	No	Friday	Activity
8/17/2002	0	No	Saturday	Activity
8/18/2002	13	Yes	Sunday	Activity
8/19/2002	20	Yes	Monday	Activity
8/20/2002	14	Yes	Tuesday	Activity
8/21/2002	17	Yes	Wednesday	Activity
8/22/2002	17	Yes	Thursday	Activity
8/23/2002	14	Yes	Friday	Activity
8/24/2002	4	No	Saturday	Activity
8/25/2002	12	Yes	Sunday	Activity
8/26/2002	9	No	Monday	Activity
8/27/2002	17	Yes	Tuesday	Activity
8/28/2002	15	Yes	Wednesday	Activity
	10 va	lid days		

Differences in sedentary & non-wear time

Zeros	Valid Days	Minutes of "Not wearing" time in same 7 wearing days	Minutes of "Sedentary" time in same 7 wearing day
10	5	4680	2861
20	6	4505	3036
30	9	4396	3145
60	10	4278	3263

- No differences in MVPA
- Difference between 2861 (10 zeros) & 3263 (60 zeros) = 402 min
- Almost one hour per day difference on average

Protocols – select studies

	Minimum wearing days	Minimum valid hours	# consecutive minutes of zero counts for non- wear time	Cutpoints	METs
NHANES, US	4	10	60+ (with allowance of a few low counts)	Freedson	4
TAAG, US	1	80% standard day is non- missing	20+	Treuth	4.6
EYHS, 4 European	3	10	10+	Freedson	3
ALSPAC, UK	3	10	10+	Mattocks	4
Kolle 2009, Norway	2	8	10+	Ekelund	3

What about activities that are missed by accelerometer?

- Under-estimates certain activities (biking, swimming, etc.)
- Use diary or log to identify time, duration and type of activity
- Get MET value for activity from Compendium of Physical Activities
- Using a regression equation, get corresponding count value
- Insert or replace values with new count value
- Labor intensive and didn't make a difference in one of our studies

Esliger, D.W., Copeland, J.L., Barnes, J.D. & Tremblay, M.S. (2005). Standardizing and optimizing the use of accelerometer date for free-living physical activity monitoring. Journal of Physical Activity and Health, 3, 366-383.



• MeterPlus can help manage and score your data but each investigator has many decisions to make

• Need more research to reach consensus...any takers?

The end...

- Questions, Comments?
- Come try out MeterPlus and discuss other topics
- References and other materials to take
- Roundtable in the morning