

# Youth Physical Activity Data Collection in Low Resource Community Settings using Accelerometers

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# Acknowledgements



Active Living  
**RESEARCH**



The North Carolina **Public Health**  
*Foundation*

# Workshop Objectives

## Participants will be able to...

- ✓ Select validated self-report physical activity measures for youth subjects
- ✓ Understand time and equipment specifications related to the use of accelerometers in field based research
- ✓ Identify groups or individuals with whom they might partner in order to facilitate large-scale accelerometer data collection on a limited budget
- ✓ Conceptualize barriers to accelerometer data collection given the nature of their specific low resource population, as well as identify strategies to address some of these barriers

# Our Study: Project Aims & Measures

**Aim 1: Determine efficacy of target grant funding**

- Youth physical activity measured via accelerometry

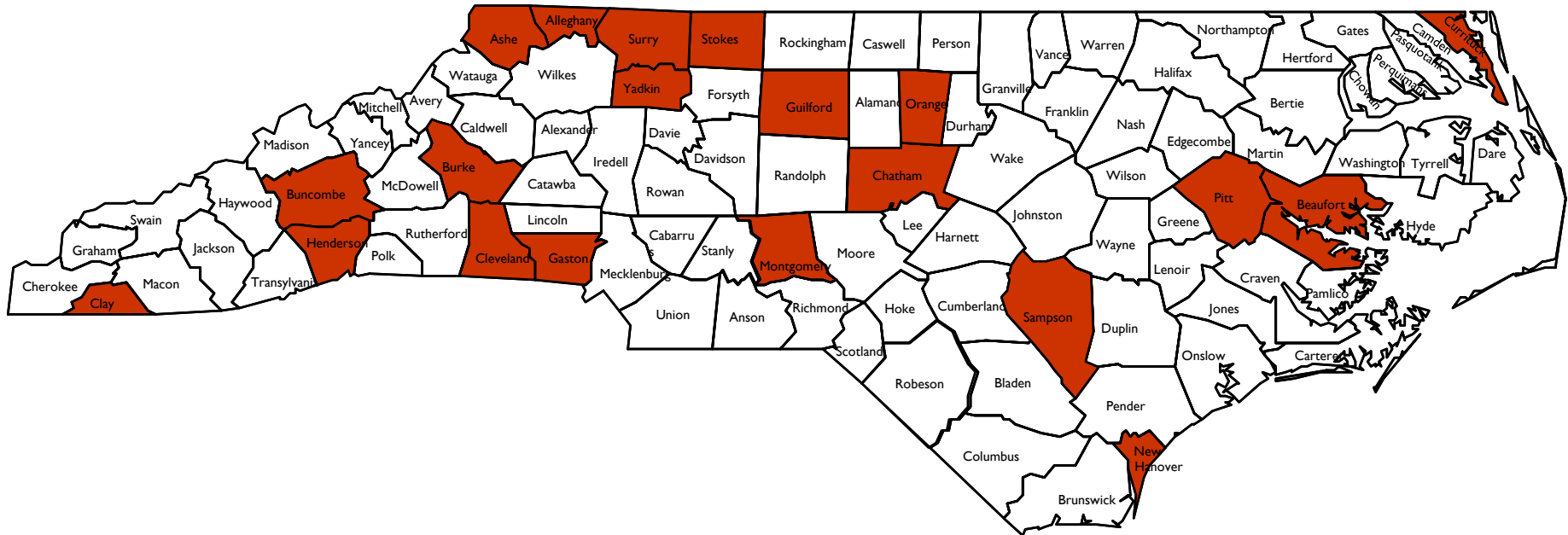
**Aim 2: Identify effective interventions for increasing physical activity in youth**

- Youth physical activity as measured via accelerometry
- Reporting by grantees on process and outcomes

**Aim 3: Identify characteristics of community partnerships that positively impact interventions**

- Qualitative assessment of grant coordinators and community partners
- Reporting by grantees on project process and outcomes

# Accelerometer Distribution Sites



# Our Study: Youth Data Collection Process

## Pre-data collection

- Obtain consent from parents
- Charge, initialize and pre-assign accelerometers
- Prepare surveys

## Data Collection

- Obtain assent from youth
- Administer youth survey
- Distribute accelerometers

## Post-data collection

- Collect accelerometers 8 days later
- Download and store data for later processing
- Recharge, reinitialize, reassign, repeat **X 20!!**

# Our Study: Process Measures

2010	2011
1989 youth surveys administered	1825 youth surveys administered
1355 accelerometers distributed	1280 accelerometers distributed
74% of participants returned accelerometers when due	84.5% of participants returned accelerometers when due
98.1% of participants returned accelerometers eventually	97.4% of participants returned accelerometers eventually
76% of participants provided at least 4 days of usable data*	69% of participants provided at least 4 days of usable data*
95% of participants provided at least 1 day of usable data	96% of participants provided at least 1 day of usable data
55 incidences of malfunctioning accelerometers	64 incidences of malfunctioning accelerometers

\*NHANES 2003-4 reported 69-71% of 6-11 year old participants provided at least 4 days of usable data (Troiano 2008)

# Selecting Measures

- Systematic observation
- Questionnaires
  - Subjective measure of physical activity
- Wearable monitors
  - Objective measure of physical activity



# Selecting Measures: Questionnaires

- Select validated survey questions to assess subjective physical activity
  - Test/retest and alpha > 0.7
  - Resources for choosing validated instruments
    - Borowski LA, Bowles HR. Resources for Locating and Selecting Self-Report Measures for Physical Activity. *JPAH*. 2012;9(Suppl 1):S91-S92.
    - National Collaborative on Childhood Obesity Research (NCCOR) Measures Registry
    - Physical Activity Research Center for Public Health



**NCCOR  
MEASURES REGISTRY**

[Registry Home](#) | [Search the Registry](#) | [Registry Development](#) | [Measures in Development](#) | [Other Resources](#) | [Feedback](#)

## Measures Registry

### Filter options

[\[clear filter\]](#)

#### Search

Contains

#### Domain

- Individual Dietary Behavior (4)
- Food Environment (2)
- Individual Physical Activity Behavior (33)
- Physical Activity Environment (6)

#### Measure Type

- GIS (0)
- 24-hour dietary recall or food frequency (1)
- Electronic monitor (1)
- Environmental observation (0)
- Questionnaire (33)
- Record or log (0)
- Other (0)

#### Age

- 2 - 5 Years (6)
- 6 - 11 Years (33)
- 12 - 18 Years (33)
- Adults (5)

#### Context





- Metro/Urban (19)
- Small Town/Rural (3)

### Results

Showing 1-25 of 33 matching measures

[Show all](#)

[Next >](#)

Measure Name ▲	First Author	Year Published	Compare
 <a href="#">3 Day Physical Activity Recall (3DPAR) Questionnaire for 8 to 13 Year Old Girls</a>	Farr JN	2011	
 <a href="#">Bone Specific Physical Activity Questionnaire (BPAQ) for 8 to 13 Year Old Girls</a>	Farr JN	2011	
 <a href="#">Child and Adolescent Television Viewing and Ads Survey</a>	Ayala GX	2007	
<a href="#">Computer Delivered Physical Activity Questionnaire (CDPAQ)</a>	Ridley K	2001	
<a href="#">Computerized Physical Activity Recall</a>	McMurray RG	1998	
<a href="#">European Youth Heart Study Survey</a>	Ommundsen Y	2008	
<a href="#">Fels Physical Activity Questionnaire</a>	Treuth MS	2005	
 <a href="#">HABITS Questionnaire</a>	Wright ND	2011	
<a href="#">Habitual Activity Questionnaire</a>	Kimm SY	2000	
<a href="#">Health Report Card</a>	Chomitz VR	2003	
<a href="#">Home Environment Survey</a>	Gattshall ML	2008	
<a href="#">Home Physical Activity and Sedentary Equipment Survey for 5 to 18 Year Olds</a>	Rosenberg DE	2010	
<a href="#">Many Rivers Physical Activity Recall (MRPARQ) for 10 to 12 Year Olds</a>	Gwynn JD	2010	
<a href="#">Multimedia Activity Recall for Children and Adolescents (MARCA)</a>	Ridley K	2006	
<a href="#">One week Physical Activity Survey</a>	Baranowski T	1984	
<a href="#">Past Year Physical Activity Questionnaire (PYPAQ) for 8 to 13 Year Old Girls</a>	Farr JN	2011	



**Physical Activity Resource Center For Public Health**

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**Subjective Measures Search**  
Begin your search using the forms below. Make sure to select an article type before clicking, submit. [Click here](#) for detailed instructions.

## Specific Questionnaire & Population Characteristics Search

Select questionnaire characteristics to view a list of questionnaires matching the criteria specified.

OR

Select an item from the drop down list to search for articles related to a specific questionnaire.  
(To limit the number of articles returned, select population characteristics and/or enter keywords.)

Questionnaire:

Questionnaire Characteristics:

**Time Frame:**

Past Day  Past Week  Past Month  Past Year  Historical  Other

**Domain:**

Leisure or Sport and Exercise  Transportation, Household  Occupational, Other

**Administration:**

Self Administered  Interviewer Administered

**Age:**

Child  Teen  Adult  Older Adult

**Gender:**

Male  Female

**Race/Ethnicity:**

Black, non-hispanic  Asian or Pacific Islander  White, non-hispanic  
 American Indian or Alaska Native  Hispanic  Other

# Selecting Measures: Questionnaires

- Choose instruments validated on slightly younger children than those in your study population
- Choose questions based on the TYPES of conclusion statements you would like to make
- Also consider length of questionnaire and cost of questionnaire analysis

# Selecting Measures: Wearable Monitors

- Monitor selection: Accelerometers vs. other wearable monitors for objective physical activity data collection
  - Research question (volume vs. intensity of PA)
  - Reliability/validity of device type/brand

# Selecting Measures: Wearable Monitors

- Contraindications for using accelerometers with youth study populations
  - Cost
  - Tamperability
  - Compliance
  - Inability of accelerometers to detect certain types of motion

# Best Practices for Using Physical Activity Monitors in Population-Based Research

- Matthews CE, Hagstromer M, Pober DM, Bowles HR. *Med Sci Sports Exerc.* 2012;44(1 Suppl 1):S68-S76.
  - Updates and expands on previous recommendations by Trost et al. (2005)
  - Includes strengths and weaknesses of monitor measures and best practice for using monitors in studies and reporting on studies involving monitors

# Using Accelerometers

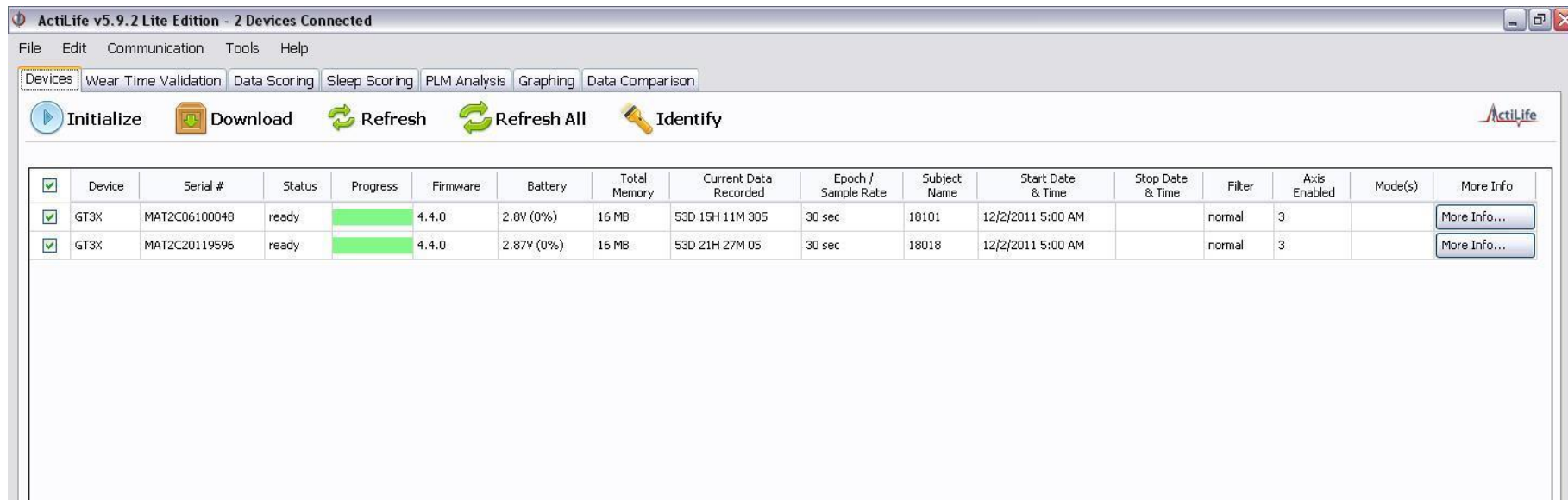
- Charging devices





# Using Accelerometers

- Initializing devices with Actilife™

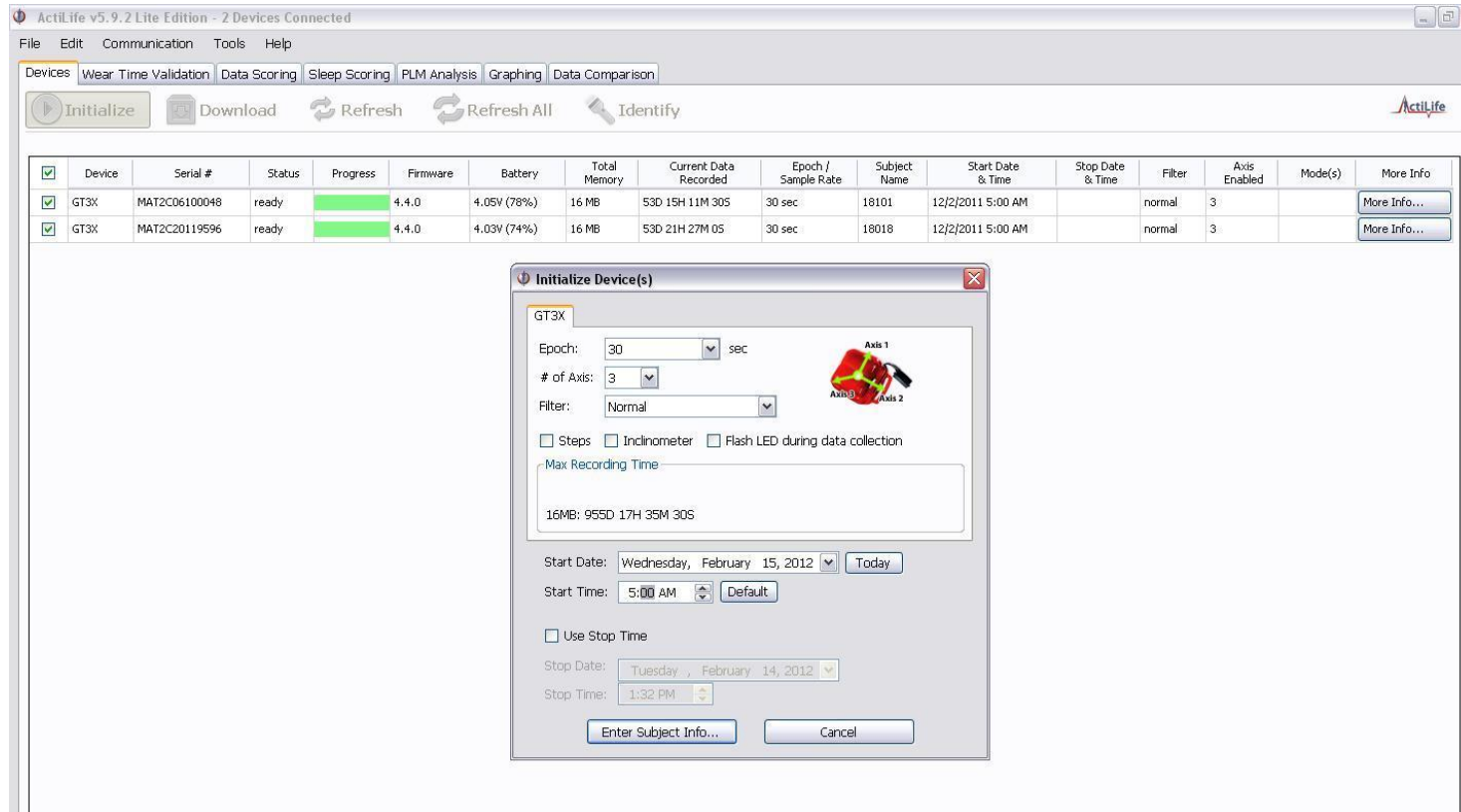


The screenshot shows the ActiLife v5.9.2 Lite Edition software interface. The window title is "ActiLife v5.9.2 Lite Edition - 2 Devices Connected". The menu bar includes File, Edit, Communication, Tools, and Help. Below the menu bar are tabs for Devices, Wear Time Validation, Data Scoring, Sleep Scoring, PLM Analysis, Graphing, and Data Comparison. The main toolbar contains buttons for Initialize, Download, Refresh, Refresh All, and Identify. The ActiLife logo is in the top right corner of the interface.

<input checked="" type="checkbox"/>	Device	Serial #	Status	Progress	Firmware	Battery	Total Memory	Current Data Recorded	Epoch / Sample Rate	Subject Name	Start Date & Time	Stop Date & Time	Filter	Axis Enabled	Mode(s)	More Info
<input checked="" type="checkbox"/>	GT3X	MAT2C06100048	ready	<div style="width: 100%; height: 10px; background-color: green;"></div>	4.4.0	2.8V (0%)	16 MB	53D 15H 11M 30S	30 sec	18101	12/2/2011 5:00 AM		normal	3		<a href="#">More Info...</a>
<input checked="" type="checkbox"/>	GT3X	MAT2C20119596	ready	<div style="width: 100%; height: 10px; background-color: green;"></div>	4.4.0	2.87V (0%)	16 MB	53D 21H 27M 0S	30 sec	18018	12/2/2011 5:00 AM		normal	3		<a href="#">More Info...</a>

# Using Accelerometers

- Initializing devices with Actilife™



The screenshot displays the ActiLife v5.9.2 Lite Edition software interface. The main window shows a table of connected devices with columns for Device, Serial #, Status, Progress, Firmware, Battery, Total Memory, Current Data Recorded, Epoch / Sample Rate, Subject Name, Start Date & Time, Stop Date & Time, Filter, Axis Enabled, Mode(s), and More Info. Two GT3X devices are listed, both with a 'ready' status and green progress bars.

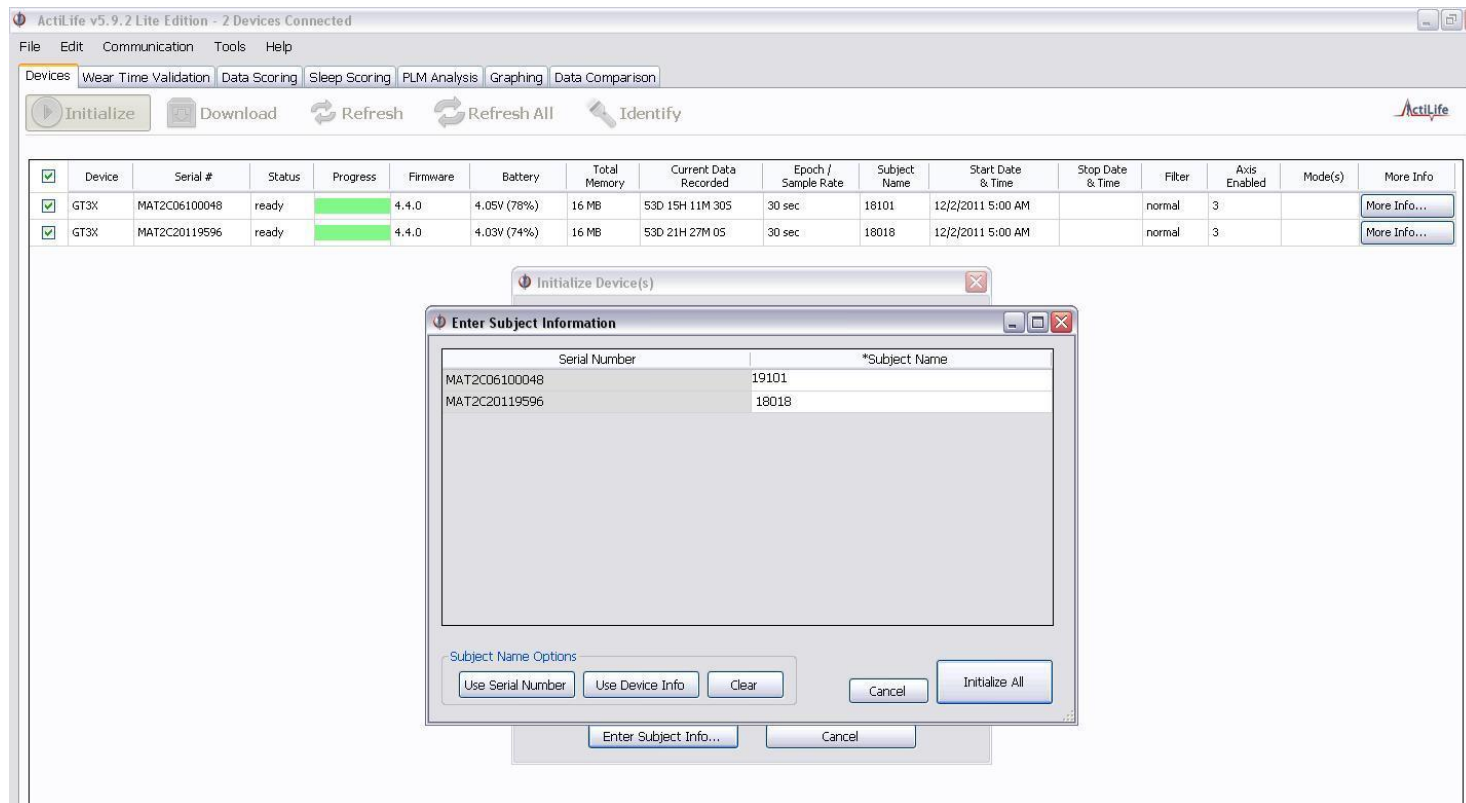
An 'Initialize Device(s)' dialog box is open, showing settings for a selected GT3X device. The settings include:

- Epoch: 30 sec
- # of Axis: 3
- Filter: Normal
- Steps  Inclinator  Flash LED during data collection
- Max Recording Time: 16MB: 955D 17H 35M 30S
- Start Date: Wednesday, February 15, 2012 (Today)
- Start Time: 5:00 AM (Default)
- Use Stop Time
- Stop Date: Tuesday, February 14, 2012
- Stop Time: 1:32 PM

Buttons for 'Enter Subject Info...' and 'Cancel' are visible at the bottom of the dialog box.

# Using Accelerometers

- Initializing devices with Actilife™



The screenshot displays the ActiLife v5.9.2 Lite Edition software interface. The main window shows a table of connected devices with columns for Device, Serial #, Status, Progress, Firmware, Battery, Total Memory, Current Data Recorded, Epoch / Sample Rate, Subject Name, Start Date & Time, Stop Date & Time, Filter, Axis Enabled, Mode(s), and More Info. Two GT3X devices are listed, both with a 'ready' status and green progress bars.

An 'Initialize Device(s)' dialog box is open, containing an 'Enter Subject Information' sub-dialog. This sub-dialog has a table with two columns: 'Serial Number' and '\*Subject Name'. The data in the table is as follows:

Serial Number	*Subject Name
MAT2C06100048	19101
MAT2C20119596	18018

Below the table, there are 'Subject Name Options' with buttons for 'Use Serial Number', 'Use Device Info', 'Clear', 'Cancel', and 'Initialize All'. At the bottom of the dialog, there are buttons for 'Enter Subject Info...' and 'Cancel'.

# Using Accelerometers

- Initializing devices with Actilife™: GT3X+



**Initialize Device(s)**

GT3X+

Sample Rate: 30 Hz



Flash LED during delay mode    Flash LED during data collection

Max Recording Time

256 MB: 21D 8H 25M 17S  
512 MB: 42D 16H 48M 0S

Start Date: Wednesday, February 29, 2012   Today

Start Time: 5:00 AM   Default

Use Stop Time

Stop Date: Wednesday, February 29, 2012

Stop Time: 12:01 PM

Enter Subject Info...   Cancel

**Enter Subject Information**

Serial Number	*Subject Name	Gender	Height Feet	Height Inches	Weight (lbs)	Date of Birth	Race	Limb	Side	Dominance
NEO1D34110269	Not Initialized									

**\* Required Information**

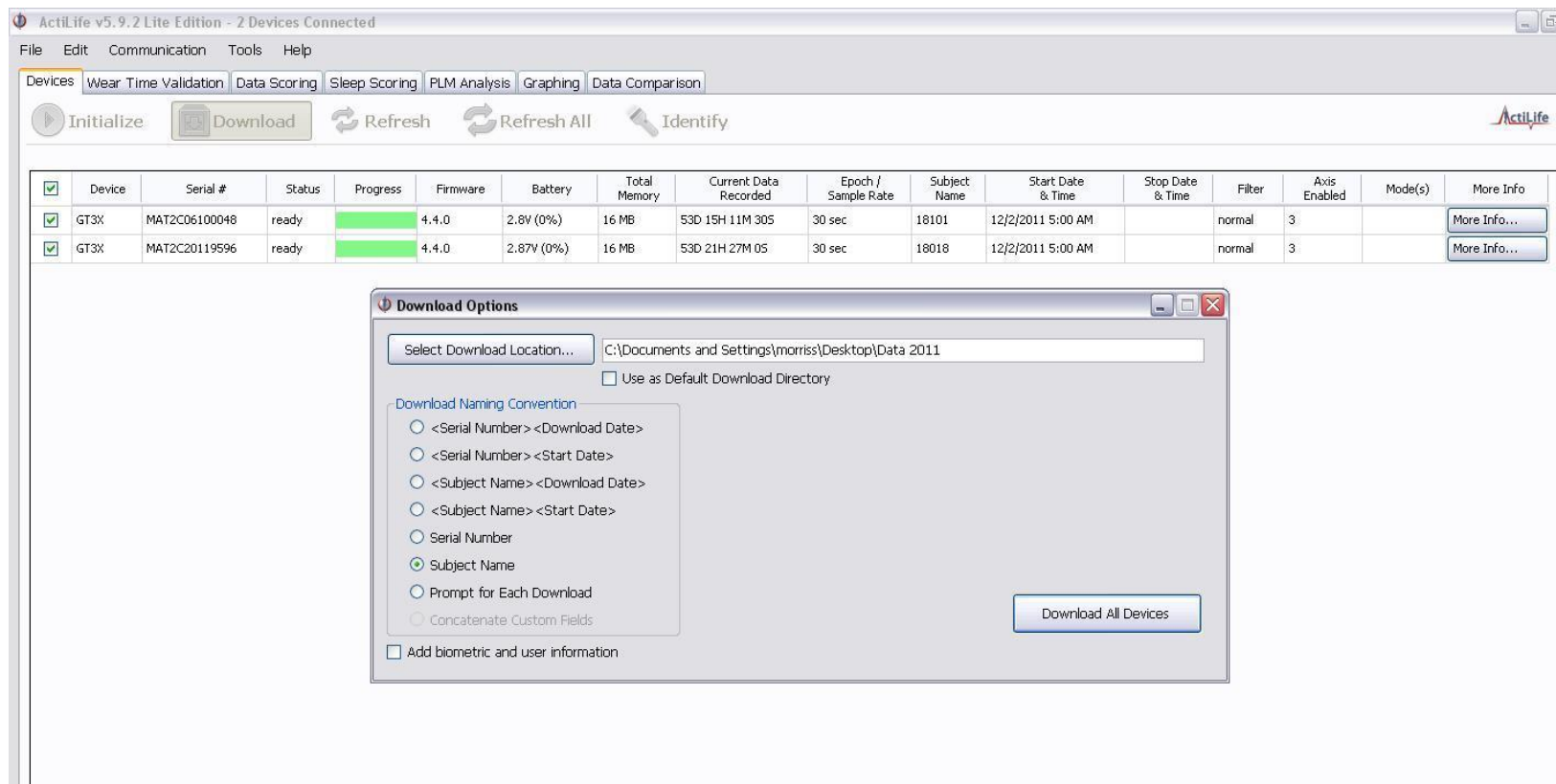
Subject Name Options

Use Serial Number   Use Device Info   Clear

Cancel   Initialize All

# Using Accelerometers

- Downloading devices with Actilife™



The screenshot shows the ActiLife v5.9.2 Lite Edition software interface. The main window displays a table of two connected GT3X accelerometers. A 'Download Options' dialog box is open, allowing the user to select a download location and naming convention.

<input checked="" type="checkbox"/>	Device	Serial #	Status	Progress	Firmware	Battery	Total Memory	Current Data Recorded	Epoch / Sample Rate	Subject Name	Start Date & Time	Stop Date & Time	Filter	Axis Enabled	Mode(s)	More Info
<input checked="" type="checkbox"/>	GT3X	MAT2C06100048	ready	<div style="width: 100%; height: 10px; background-color: green;"></div>	4.4.0	2.8V (0%)	16 MB	53D 15H 11M 30S	30 sec	18101	12/2/2011 5:00 AM		normal	3		More Info...
<input checked="" type="checkbox"/>	GT3X	MAT2C20119596	ready	<div style="width: 100%; height: 10px; background-color: green;"></div>	4.4.0	2.87V (0%)	16 MB	53D 21H 27M 0S	30 sec	18018	12/2/2011 5:00 AM		normal	3		More Info...

Download Options	
Select Download Location...	C:\Documents and Settings\morriss\Desktop\Data 2011
<input type="checkbox"/> Use as Default Download Directory	
Download Naming Convention	
<input type="radio"/> <Serial Number> <Download Date>	
<input type="radio"/> <Serial Number> <Start Date>	
<input type="radio"/> <Subject Name> <Download Date>	
<input type="radio"/> <Subject Name> <Start Date>	
<input type="radio"/> Serial Number	
<input checked="" type="radio"/> Subject Name	
<input type="radio"/> Prompt for Each Download	
<input type="radio"/> Concatenate Custom Fields	
<input type="checkbox"/> Add biometric and user information	
Download All Devices	

# Using Accelerometers

- Downloading devices with Actilife™: GT3X+ 

**Download Options**

Select Download Location... C:\Documents and Settings\morris\Desktop\Data 2011

Use as Default Download Directory

**Download Naming Convention**

<Serial Number> <Download Date>  
 <Serial Number> <Start Date>  
 <Subject Name> <Download Date>  
 <Subject Name> <Start Date>  
 Serial Number  
 Subject Name  
 Prompt for Each Download  
 Concatenate Custom Fields

Add biometric and user information


**GT3X+ Download Options**

Create AGD File

Epoch: 30 seconds

# of Axis: 3

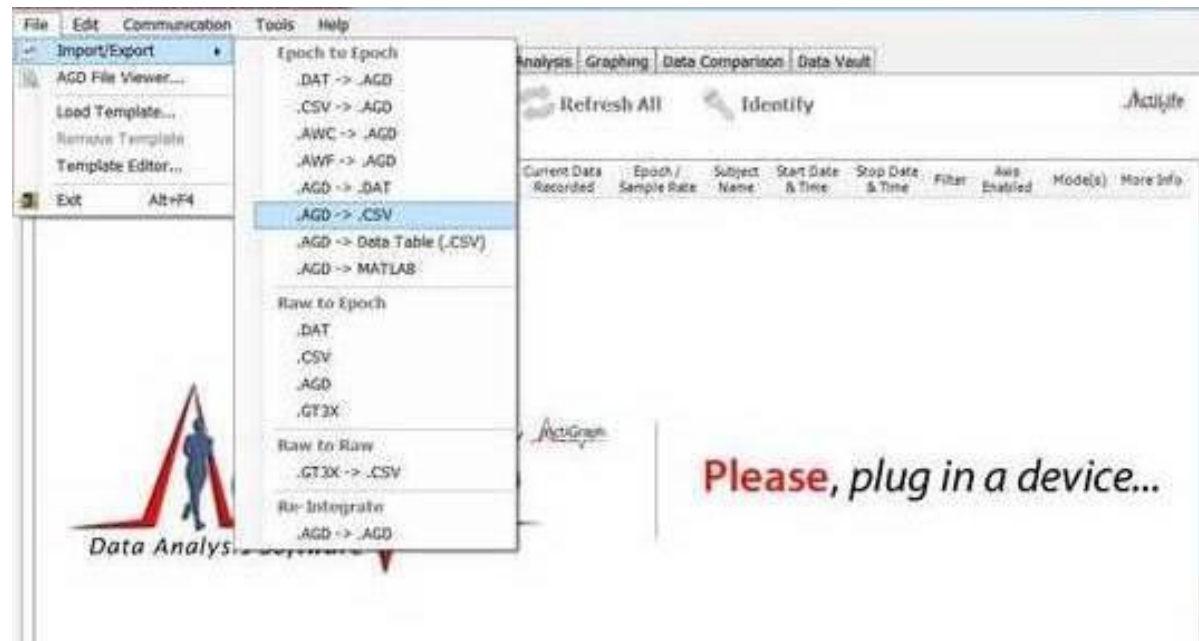
Steps  Lux  Inclinator  Low Frequency Extension



Download All Devices

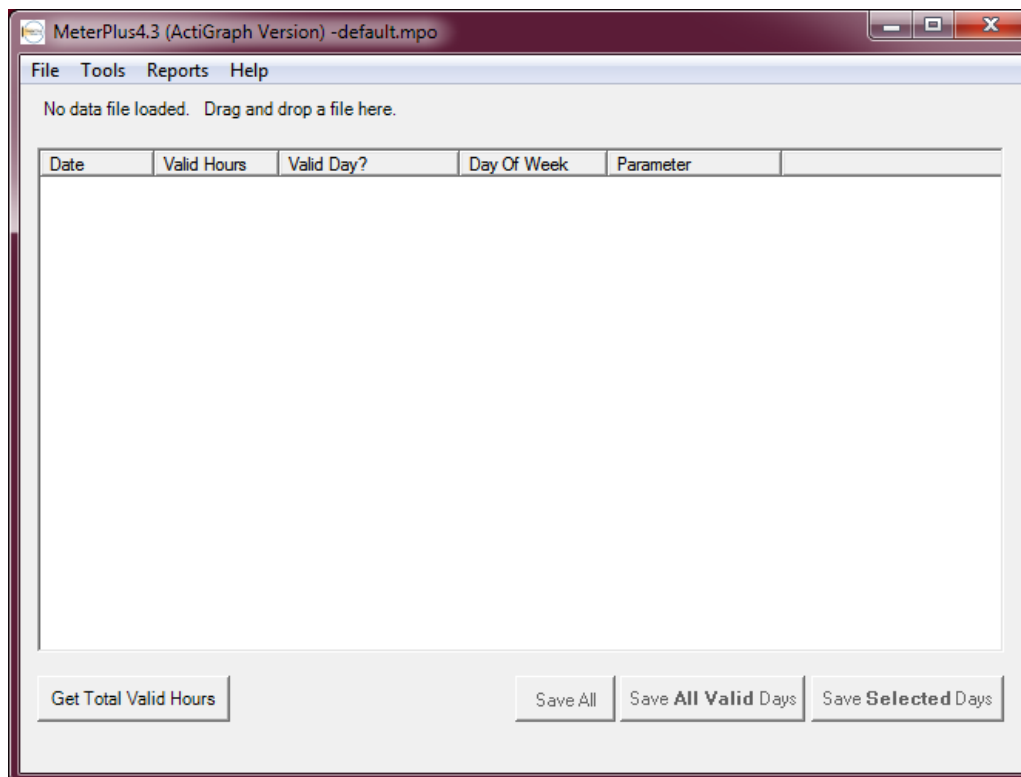
# Using Accelerometers

- Converting .agd files to .csv for processing in Meterplus™



# Using Accelerometers

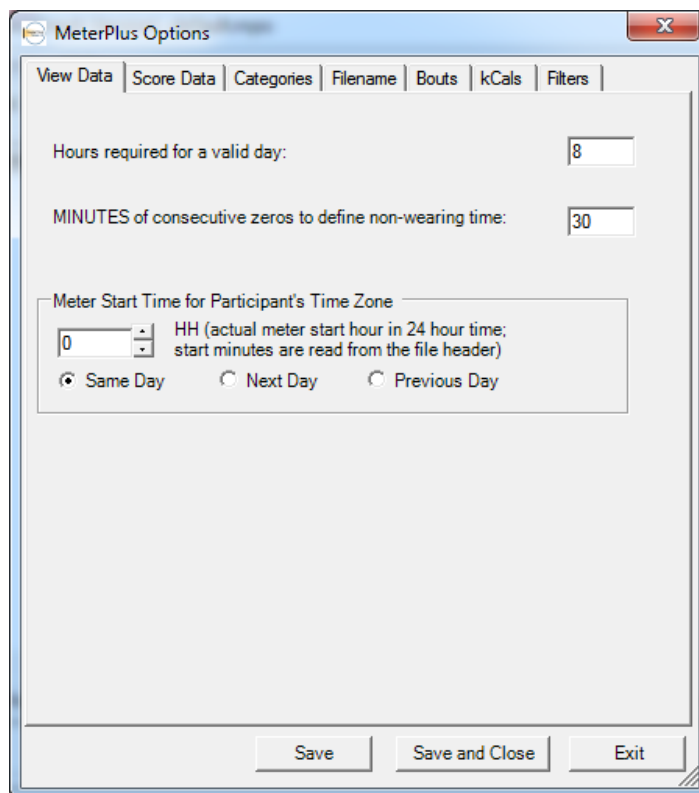
- Managing data with Meterplus™





# Using Accelerometers

- Managing data with Meterplus™: Valid day determination



MeterPlus Options

View Data | Score Data | Categories | Filename | Bouts | kCals | Filters

Hours required for a valid day:

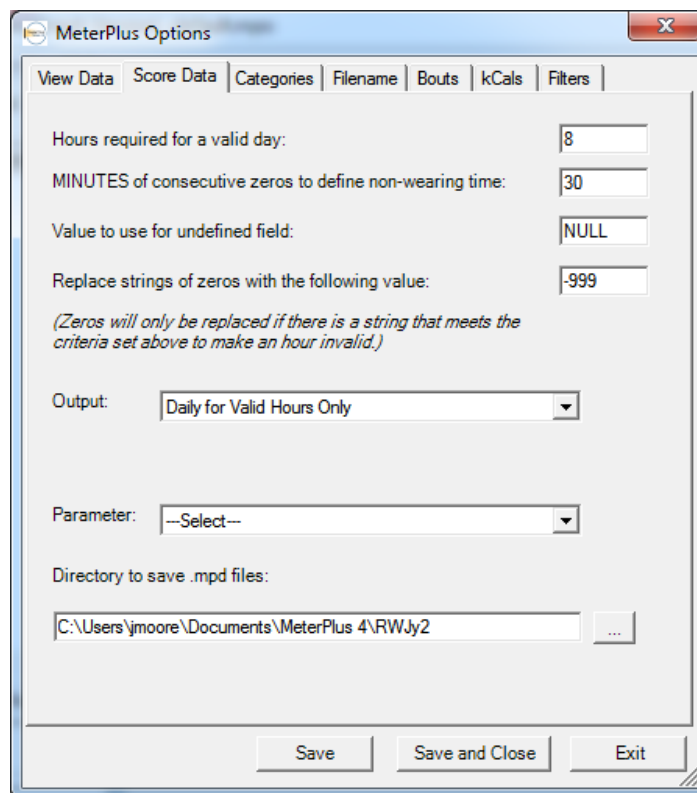
MINUTES of consecutive zeros to define non-wearing time:

Meter Start Time for Participant's Time Zone

HH (actual meter start hour in 24 hour time; start minutes are read from the file header)

Same Day  Next Day  Previous Day

Save Save and Close Exit



MeterPlus Options

View Data | Score Data | Categories | Filename | Bouts | kCals | Filters

Hours required for a valid day:

MINUTES of consecutive zeros to define non-wearing time:

Value to use for undefined field:

Replace strings of zeros with the following value:

*(Zeros will only be replaced if there is a string that meets the criteria set above to make an hour invalid.)*

Output:

Parameter:

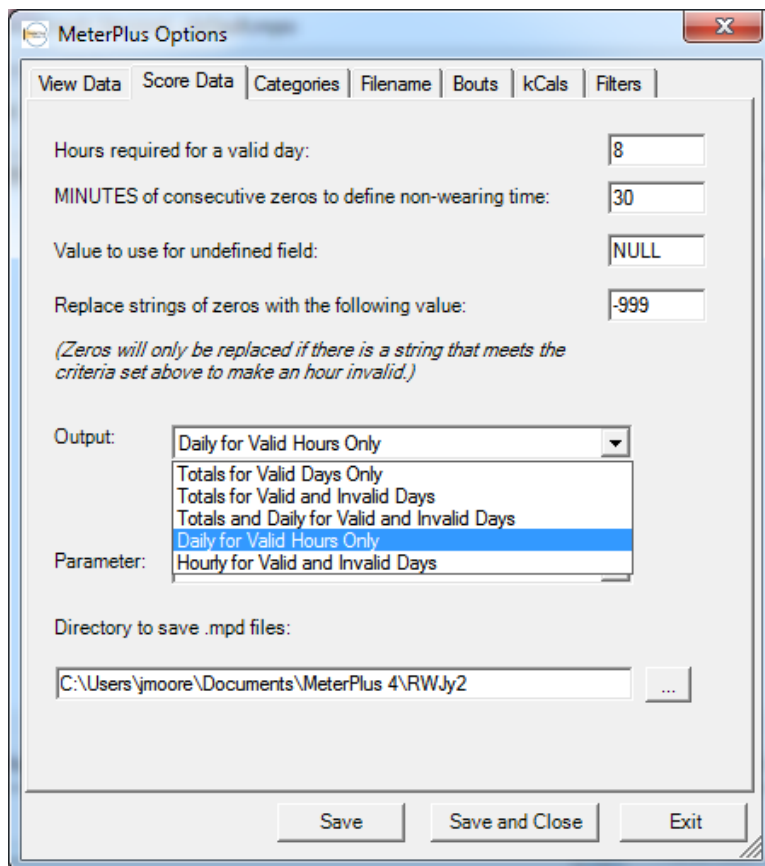
Directory to save .mpd files:

...

Save Save and Close Exit

# Using Accelerometers

- Managing data with Meterplus™: Output



MeterPlus Options

View Data | Score Data | Categories | Filename | Bouts | kCals | Filters

Hours required for a valid day:

MINUTES of consecutive zeros to define non-wearing time:

Value to use for undefined field:

Replace strings of zeros with the following value:

*(Zeros will only be replaced if there is a string that meets the criteria set above to make an hour invalid.)*

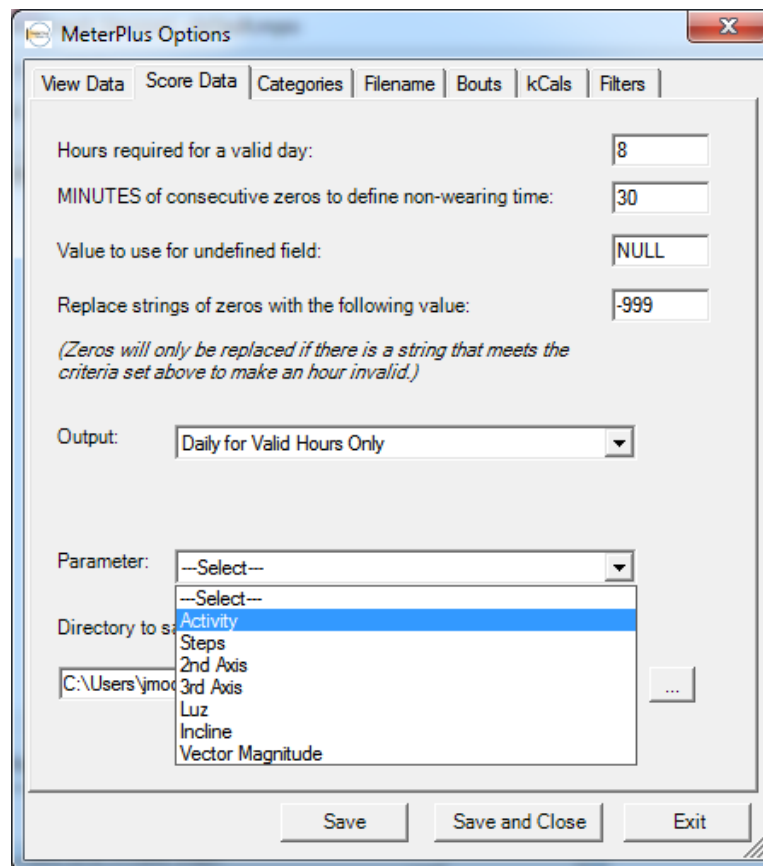
Output:

- Totals for Valid Days Only
- Totals for Valid and Invalid Days
- Totals and Daily for Valid and Invalid Days
- Daily for Valid Hours Only**
- Hourly for Valid and Invalid Days

Parameter:

Directory to save .mpd files:

Save Save and Close Exit



MeterPlus Options

View Data | Score Data | Categories | Filename | Bouts | kCals | Filters

Hours required for a valid day:

MINUTES of consecutive zeros to define non-wearing time:

Value to use for undefined field:

Replace strings of zeros with the following value:

*(Zeros will only be replaced if there is a string that meets the criteria set above to make an hour invalid.)*

Output:

Parameter:

- Select--
- Activity**
- Steps
- 2nd Axis
- 3rd Axis
- Luz
- Incline
- Vector Magnitude

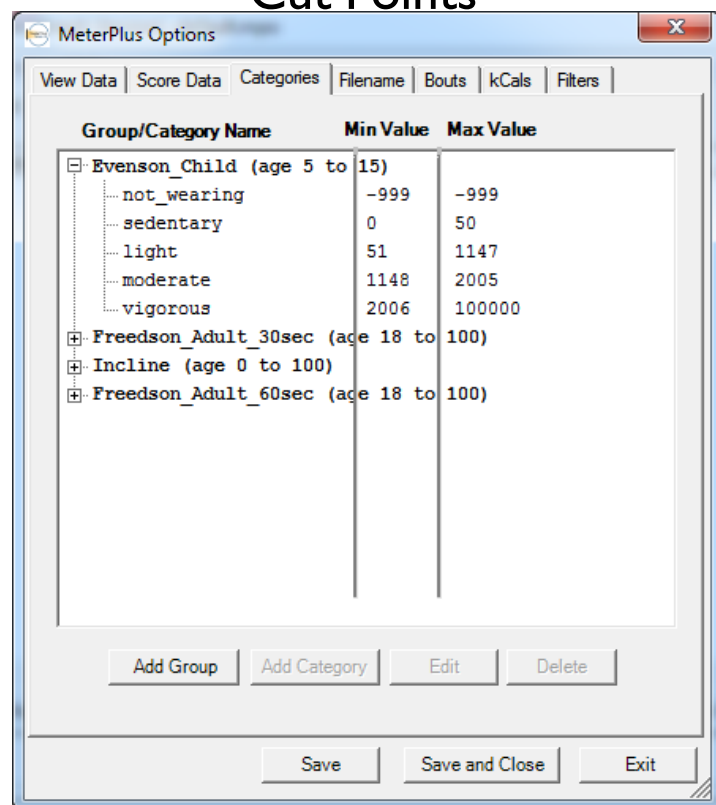
Directory to save .mpd files:

Save Save and Close Exit

# Using Accelerometers

- Managing data with Meterplus™:

Cut Points

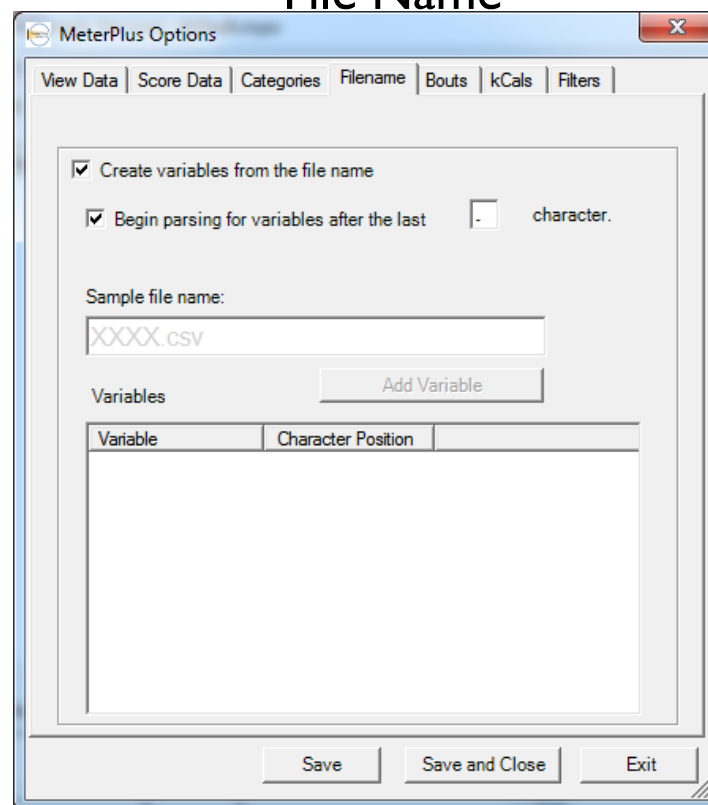


MeterPlus Options

View Data | Score Data | Categories | **Filename** | Bouts | kCals | Filters

Group/Category Name	Min Value	Max Value
[-] Evenson_Child (age 5 to 15)		
...not_wearing	-999	-999
...sedentary	0	50
...light	51	1147
...moderate	1148	2005
...vigorous	2006	100000
[+] Freedson_Adult_30sec (age 18 to 100)		
[+] Incline (age 0 to 100)		
[+] Freedson_Adult_60sec (age 18 to 100)		

File Name



MeterPlus Options

View Data | Score Data | Categories | **Filename** | Bouts | kCals | Filters

Create variables from the file name

Begin parsing for variables after the last  character.

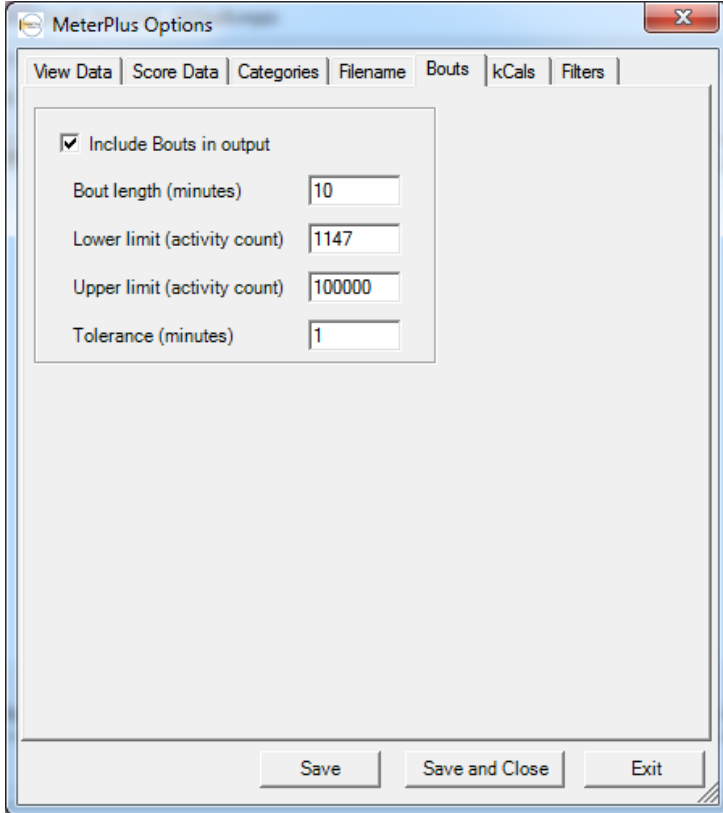
Sample file name:

Variable	Character Position

# Using Accelerometers

- Managing data with Meterplus™:

## Bouts



MeterPlus Options

View Data | Score Data | Categories | Filename | Bouts | kCals | Filters

Include Bouts in output

Bout length (minutes)

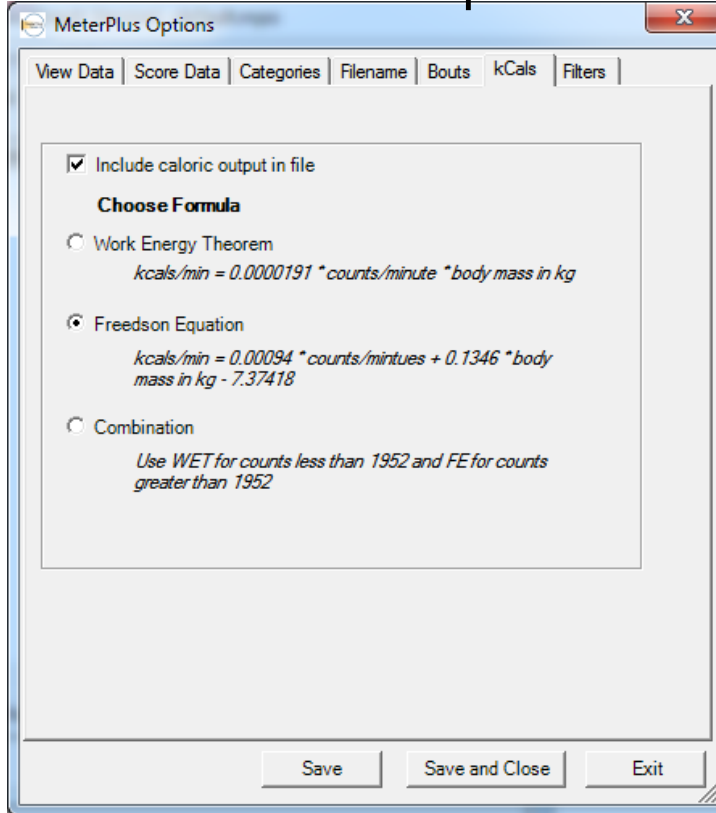
Lower limit (activity count)

Upper limit (activity count)

Tolerance (minutes)

Save Save and Close Exit

## Caloric Output



MeterPlus Options

View Data | Score Data | Categories | Filename | Bouts | kCals | Filters

Include caloric output in file

**Choose Formula**

Work Energy Theorem  
*kcal/min = 0.0000191 \* counts/minute \* body mass in kg*

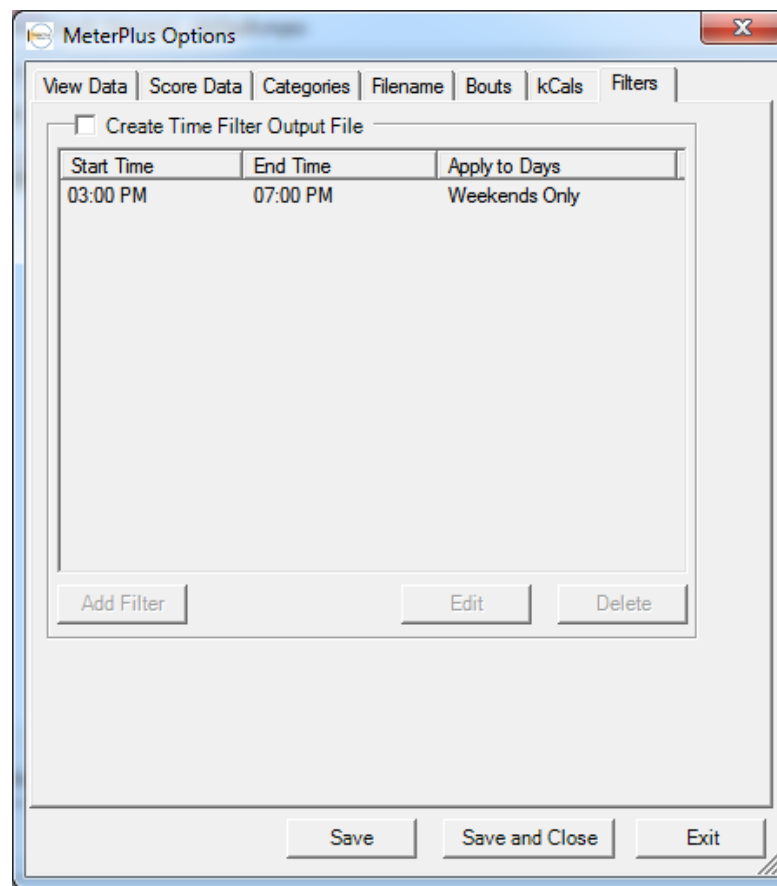
Freedson Equation  
*kcal/min = 0.00094 \* counts/minutes + 0.1346 \* body mass in kg - 7.37418*

Combination  
*Use WET for counts less than 1952 and FE for counts greater than 1952*

Save Save and Close Exit

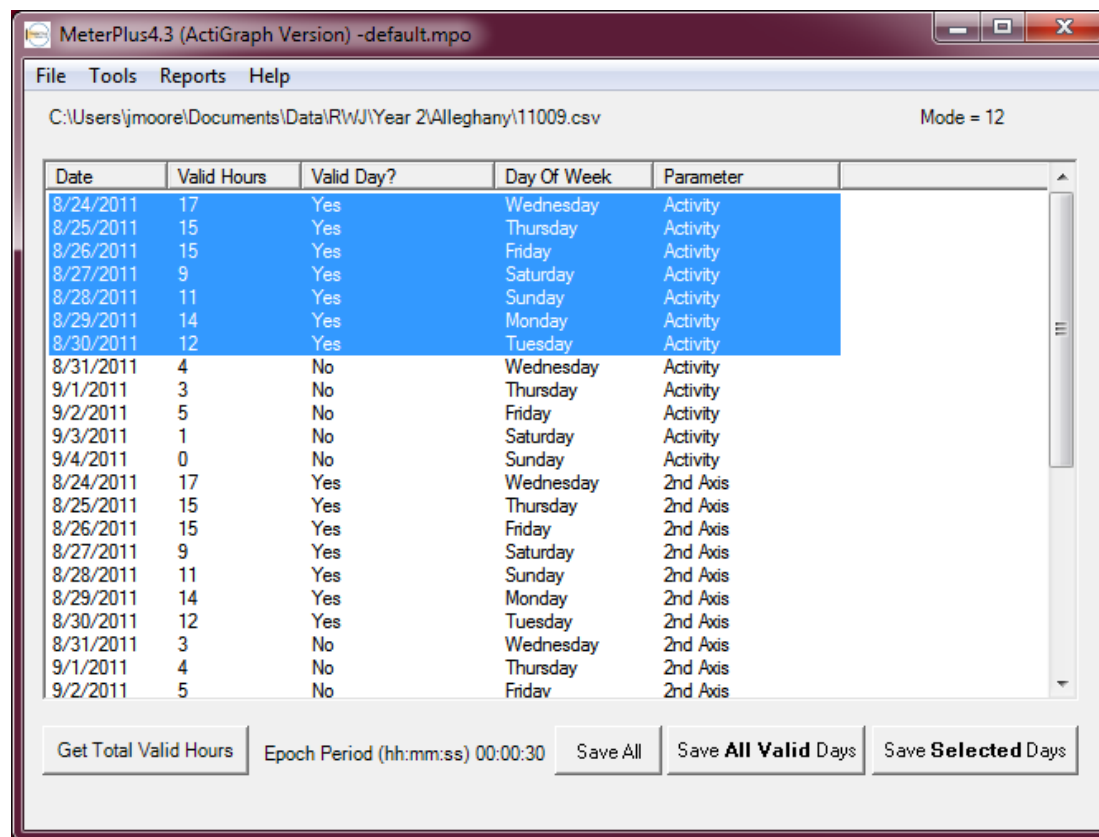
# Using Accelerometers

- Managing data with Meterplus™: Filters



# Using Accelerometers

- Managing data with Meterplus™: Processing Files



MeterPlus4.3 (ActiGraph Version) - default.mpo

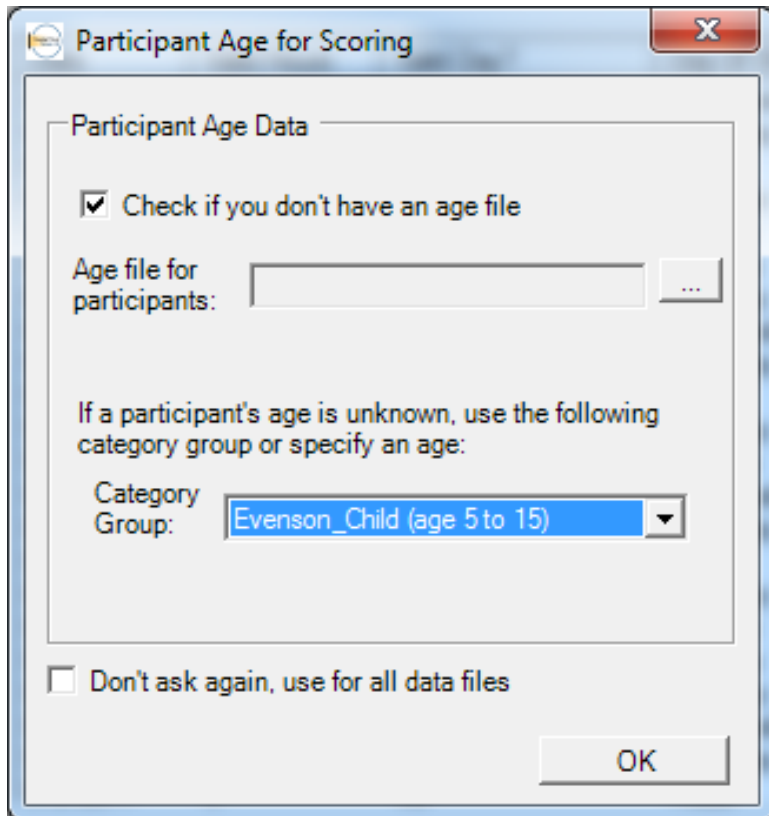
File Tools Reports Help

C:\Users\jmoore\Documents\Data\R\WJ\Year 2\Alleghany\11009.csv Mode = 12

Date	Valid Hours	Valid Day?	Day Of Week	Parameter
8/24/2011	17	Yes	Wednesday	Activity
8/25/2011	15	Yes	Thursday	Activity
8/26/2011	15	Yes	Friday	Activity
8/27/2011	9	Yes	Saturday	Activity
8/28/2011	11	Yes	Sunday	Activity
8/29/2011	14	Yes	Monday	Activity
8/30/2011	12	Yes	Tuesday	Activity
8/31/2011	4	No	Wednesday	Activity
9/1/2011	3	No	Thursday	Activity
9/2/2011	5	No	Friday	Activity
9/3/2011	1	No	Saturday	Activity
9/4/2011	0	No	Sunday	Activity
8/24/2011	17	Yes	Wednesday	2nd Axis
8/25/2011	15	Yes	Thursday	2nd Axis
8/26/2011	15	Yes	Friday	2nd Axis
8/27/2011	9	Yes	Saturday	2nd Axis
8/28/2011	11	Yes	Sunday	2nd Axis
8/29/2011	14	Yes	Monday	2nd Axis
8/30/2011	12	Yes	Tuesday	2nd Axis
8/31/2011	3	No	Wednesday	2nd Axis
9/1/2011	4	No	Thursday	2nd Axis
9/2/2011	5	No	Friday	2nd Axis

# Using Accelerometers

- Managing data with Meterplus™: Scoring



Participant Age for Scoring

Participant Age Data

Check if you don't have an age file

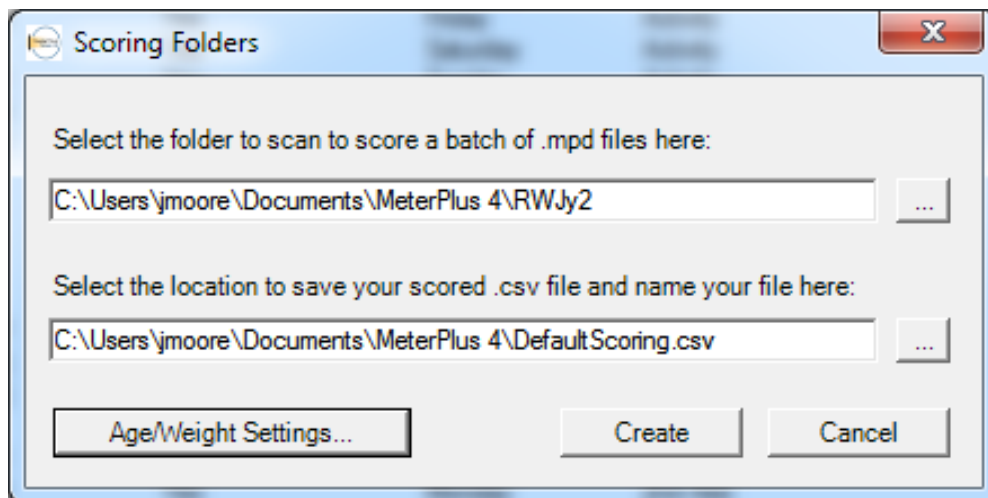
Age file for participants:  ...

If a participant's age is unknown, use the following category group or specify an age:

Category Group:

Don't ask again, use for all data files

OK



Scoring Folders

Select the folder to scan to score a batch of .mpd files here:

...

Select the location to save your scored .csv file and name your file here:

...

Age/Weight Settings... Create Cancel





# Collecting PA Data in Low Resource Communities

- How does this affect your choice of measure?
  - “White coat” trust issues
  - Literacy for grade
  - Location/setting concerns
  - Difficulties in following up with participants

# Collecting PA Data in Low Resource Communities

- How to mitigate effects on measurement?
  - Pilot testing
  - Choosing instruments validated for slightly younger study population
  - Reminder systems
  - Coordination with sites

# Collecting PA Data in Low Resource Communities

- **Coordinating with sites: Consent Process**

**Consent Plan:** \_\_\_\_\_ **County**

- Youth recruitment site(s):
- Person(s) at site(s) responsible for distributing consent forms:
- Person(s) at site(s) responsible for collecting consent forms:
- Opportunities/dates for in-person recruiting (PTA meetings, open houses, teacher conferences, etc.):
- Grouping of youth at sites for data collection purposes (grade, class, etc.):
- Plan for reminding youth/parents to return consent forms (Incentive planned if applicable):
- Date consent forms will be returned to county project coordinator:
- Person who will return consent forms to county project coordinator:
- Date project coordinator will send consent info spreadsheet to Sara:

# Collecting PA Data in Low Resource Communities

- What potential bias does it introduce into data?
  - Almost completely unknown
  - Very little research looks at systematic bias introduced by differences in wear time or other differential patterns

# Partnership: Key to Data Collection in Low Resource Communities

## Research Staff

University

State PAN  
Branch

Research  
Project  
Coordinator

## County Level

ESMM  
Community  
Grants project  
coordinators

Grantee  
partners

## Community Level

Community data collection  
sites

Research population

How can these principles apply  
to your work?



# Questions?

Please contact us at:

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