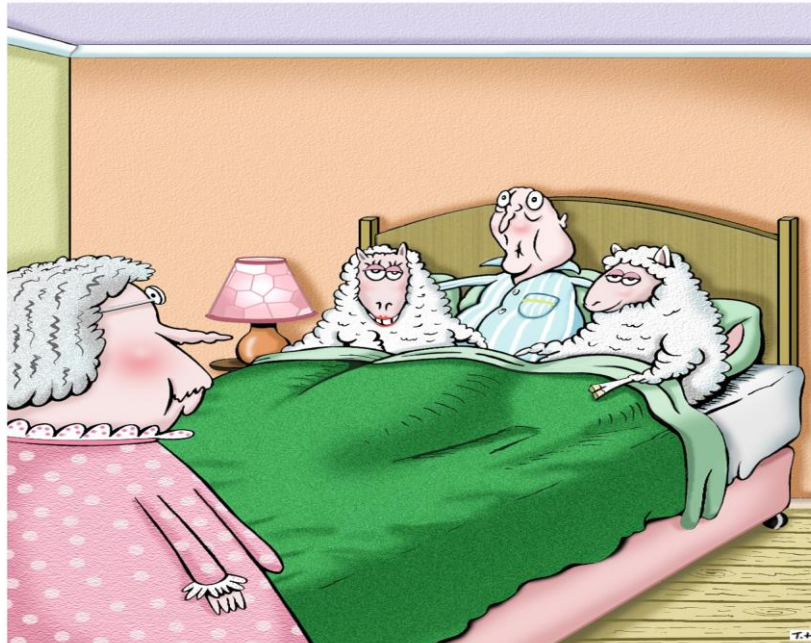


# Actigraphy

Professor Jason Ellis



"It's not what it looks like Laura, I just couldn't sleep."

What is the difference?



What is the difference?

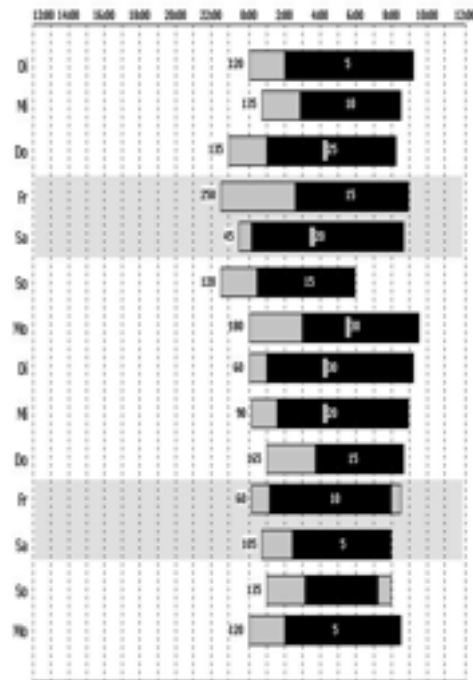


Criminal

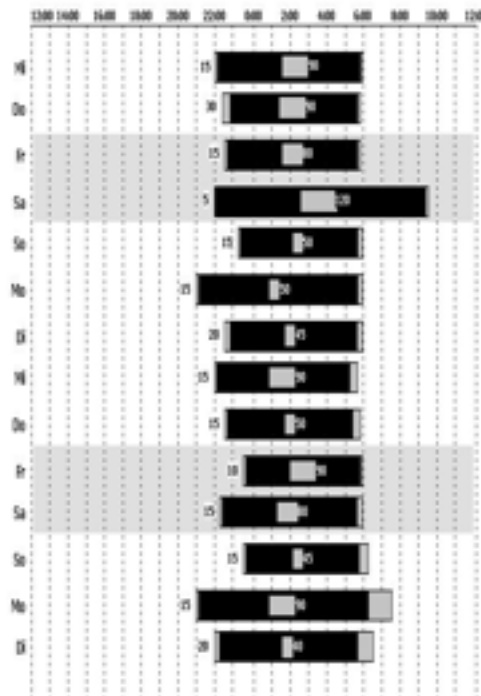


Patient

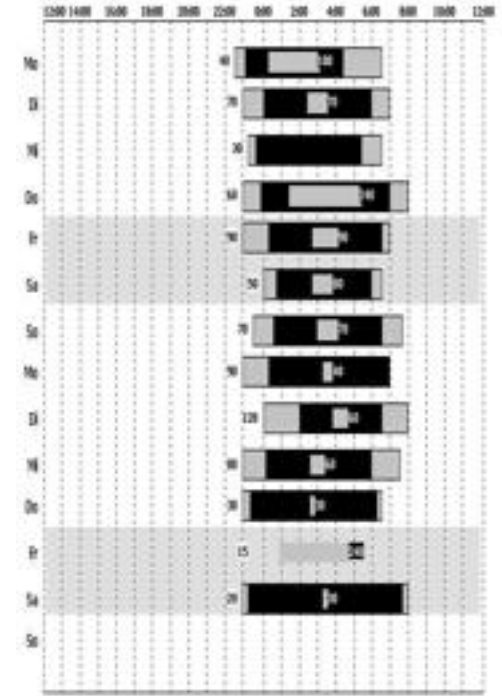
# What Can Actigraphy Tell Us?



Bettzeit	21:57 (00:00)	Wachzeit(Min)	15.0 (17.2)
Aufwachzeit	07:33 (07:30)	Schlafzeit(Min)	342.9 (342.0)
Aufstehzeit	08:31 (08:30)	Schlafeffizienz(%)	67.6 (67.5)
Einschlafzeit(Min)	123.9 (126.0)	Tageschlaf(Min)	8.6 (6.0)



Bettzeit	22:18 (22:17)	Wachzeit(Min)	73.1 (64.0)
Aufwachzeit	05:55 (05:39)	Schlafzeit(Min)	270.0 (270.0)
Aufstehzeit	06:22 (06:30)	Schlafeffizienz(%)	56.3 (56.3)
Einschlafzeit(Min)	38.9 (22.0)	Tageschlaf(Min)	8.0 (0.0)



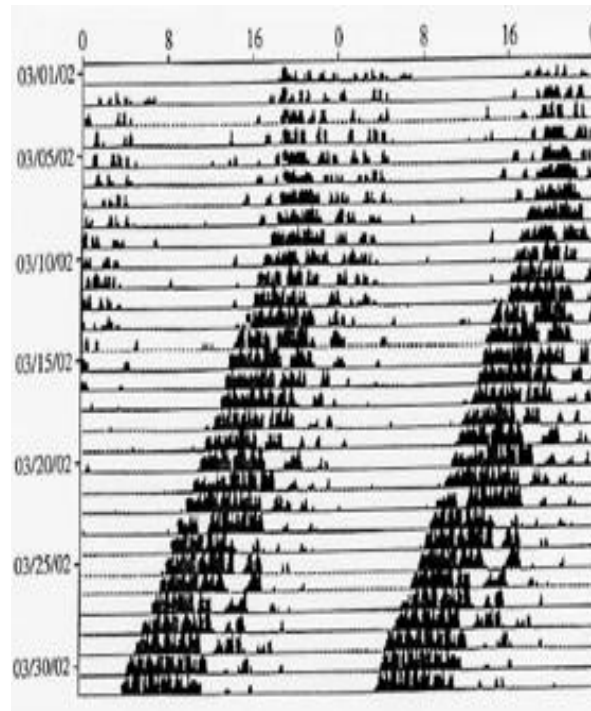
Bettzeit	23:36 (23:13)	Wachzeit(Min)	99.2 (93.8)
Aufwachzeit	06:17 (06:08)	Schlafzeit(Min)	291.7 (278.8)
Aufstehzeit	07:11 (07:11)	Schlafeffizienz(%)	61.6 (58.3)
Einschlafzeit(Min)	58.8 (55.6)	Tageschlaf(Min)	0.4 (0.5)

Courtesy of Prof. Dieter Riemann

# THE ROLE OF ACTIGRAPHY DURING CBT-I

## PRE TREATMENT

To identify circadian abnormalities

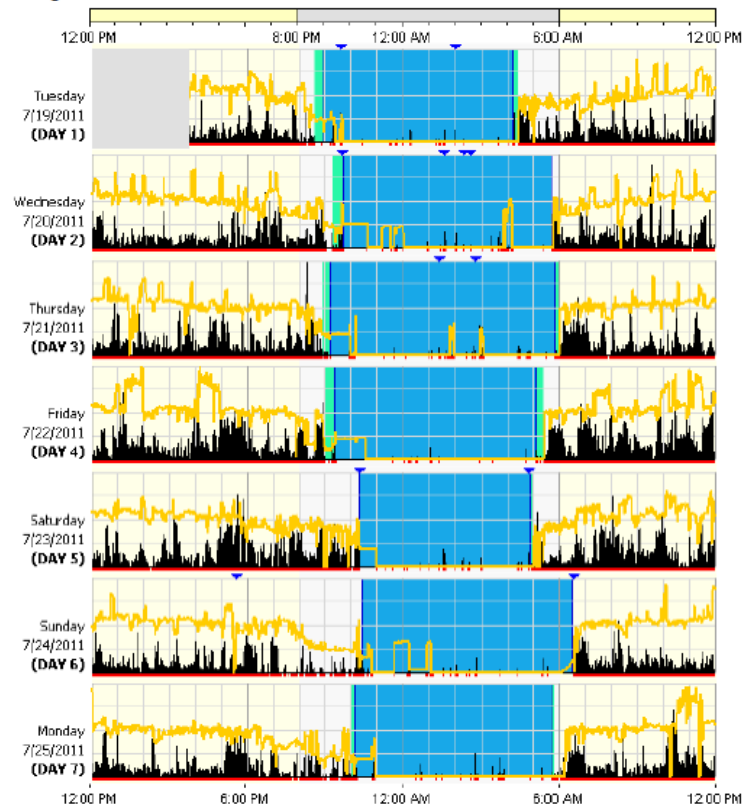


# THE ROLE OF ACTIGRAPHY DURING CBT-I

## PRE TREATMENT

To identify light influences

Actogram:



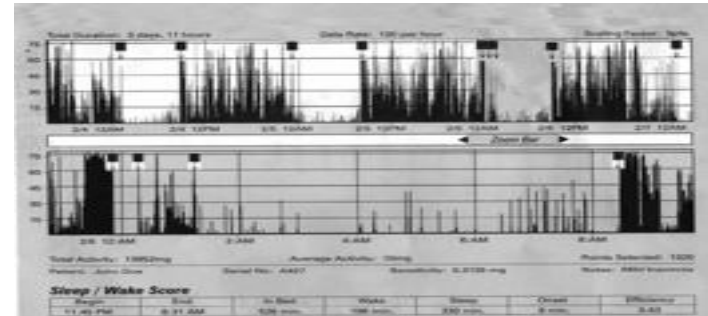
# THE ROLE OF ACTIGRAPHY DURING CBT-I

## PRE TREATMENT

To identify any subjective - objective discrepancies

COMPLETE IMMEDIATELY ON AWAKENING (PLEASE CALCULATE TOTAL TIME IN BED AND TOTAL SLEEP TIME)

	MON	TUES	WED	THURS	FRI	SAT	SUN
TIME TO BED (CLOCK TIME)	10:00	11:00	12:00	11:00	10:00	12:00	11:00
TIME OUT OF BED (CLOCK TIME)	6:00	6:00	6:00	6:00	6:00	8:00	8:00
(TIB) TOTAL TIME IN BED	400	420	360	420	400	480	420
TIME TO BED (DEV FROM 1)	40	0	60	0	40	60	0
TIME OUT OF BED (DEV FROM 2)	40	40	40	40	40	60	60
(SL) TIME TO FALL ASLEEP	35	55	45	35	50	65	20
(NMA) NUMBER TIMES AWAKENED	2	1	3	3	4	2	1
(WASO) WAKE AFTER SLEEP ONSET	20	45	60	35	45	55	35
(TTOB) TOTAL AMOUNT TIME OUT OF BED	0	0	0	0	0	0	0
(TST) TOTAL SLEEP TIME (MIN)	425	380	255	350	375	360	365
(SE) SLEEP EFFICIENCY	88.5	71.4	70.8	83.3	76.1	75.0	86.9
SLEEP QUALITY (POOR 1-5-2-3-4-5 GOOD)	0	1	2	3	0	1	1
FATIGUE (NONE 1-2-3-4-5 A LOT)	5	4	3	5	5	4	5



How discordant does the Sub-Ob have to be to be PI ?!

# NOTE:

## SOMETIMES IT IS AS THEY SAY

### Actiware Print Report

Analysis Name: New Analysis

Subject ID:

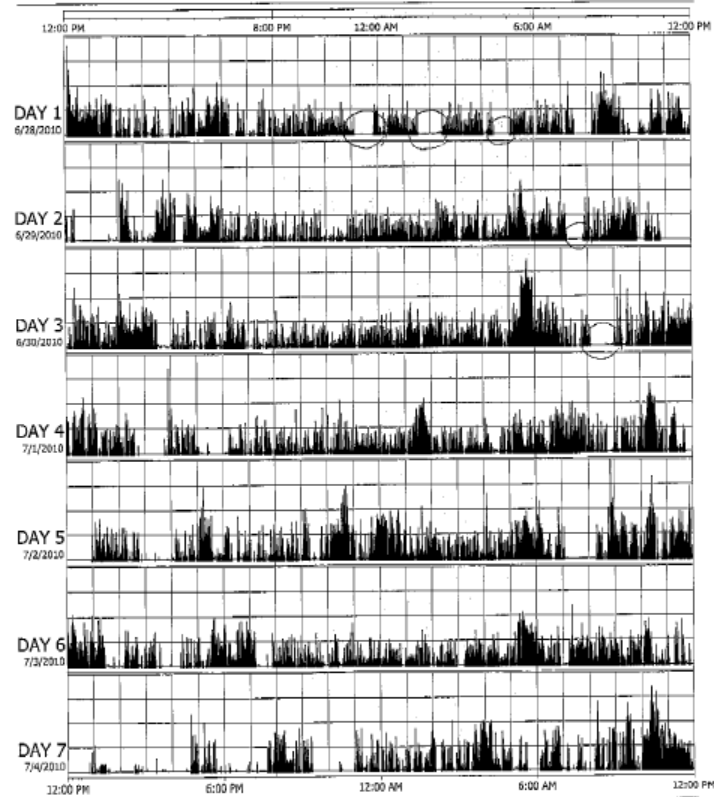
Data Collection Start: 6/28/2010, 12:06:00 PM

Date of Birth: 4/14/1945

Data Collection End: 7/9/2010, 11:17:00 AM

Gender: Male

Actiwatch SN: V963162



Printed: 7/9/2010, 11:20:43 AM

Milti Mitter Company, Inc.

Page 2



# THE ROLE OF ACTIGRAPHY DURING CBT-I

## DURING TREATMENT



**PTB vs. TTB ?**

**PTOB vs. TOB ?**

**WASO-IN vs. WASO-OUT**

# THE ROLE OF ACTIGRAPHY DURING CBT-I

## DURING TREATMENT



IN PLACE OF DIARIES FOR THOSE UNABLE TO KEEP A DIARY

LANGUAGE ISSUES  
INTELLECTUAL ISSUES  
DISEASE ISSUES  
PERCEPTUAL ISSUES

# THE ROLE OF ACTIGRAPHY DURING CBT-I

## DURING TREATMENT



NANNY CAM EFFECT

# So how does it Work?

Principle: When humans sleep they are immobile

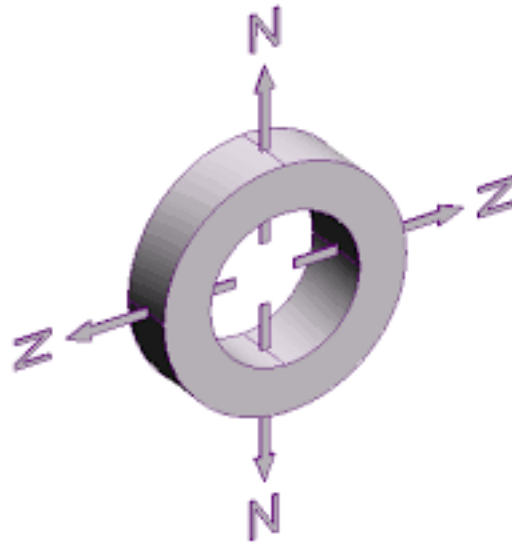
- Immobile = no movements = sleep
- Mobile = movements = awake

# So how does it Work?

Principle: When humans sleep they are immobile

- Immobile = no movements = sleep
- Mobile = movements = awake

# So how does it Work?



Biaxial Polarized Magnets / Triaxial Polarized Magnets

# So why would we use it?

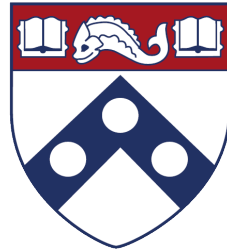
- Inexpensive
- Easy to use (record and score)
- Ambulatory (use in home and lab)
- Collect longer-term data
- Easy to interpret
- Non intrusive (for most populations)

# So are there limitations?

- Only gross estimations of sleep continuity
- Limited information for assessment of other sleep disorders
- People tend to take them off (newer models correct for this)
- Assumes no movement equals sleep (lying still in bed awake)
- Cant tell if movement is voluntary or involuntary



# So what is available?



Next Slides Courtesy of:

**Michael A. Grandner PhD**

*University of Pennsylvania*

*Center for Sleep and Circadian Neurobiology*

*Division of Sleep Medicine*

*Department of Medicine*

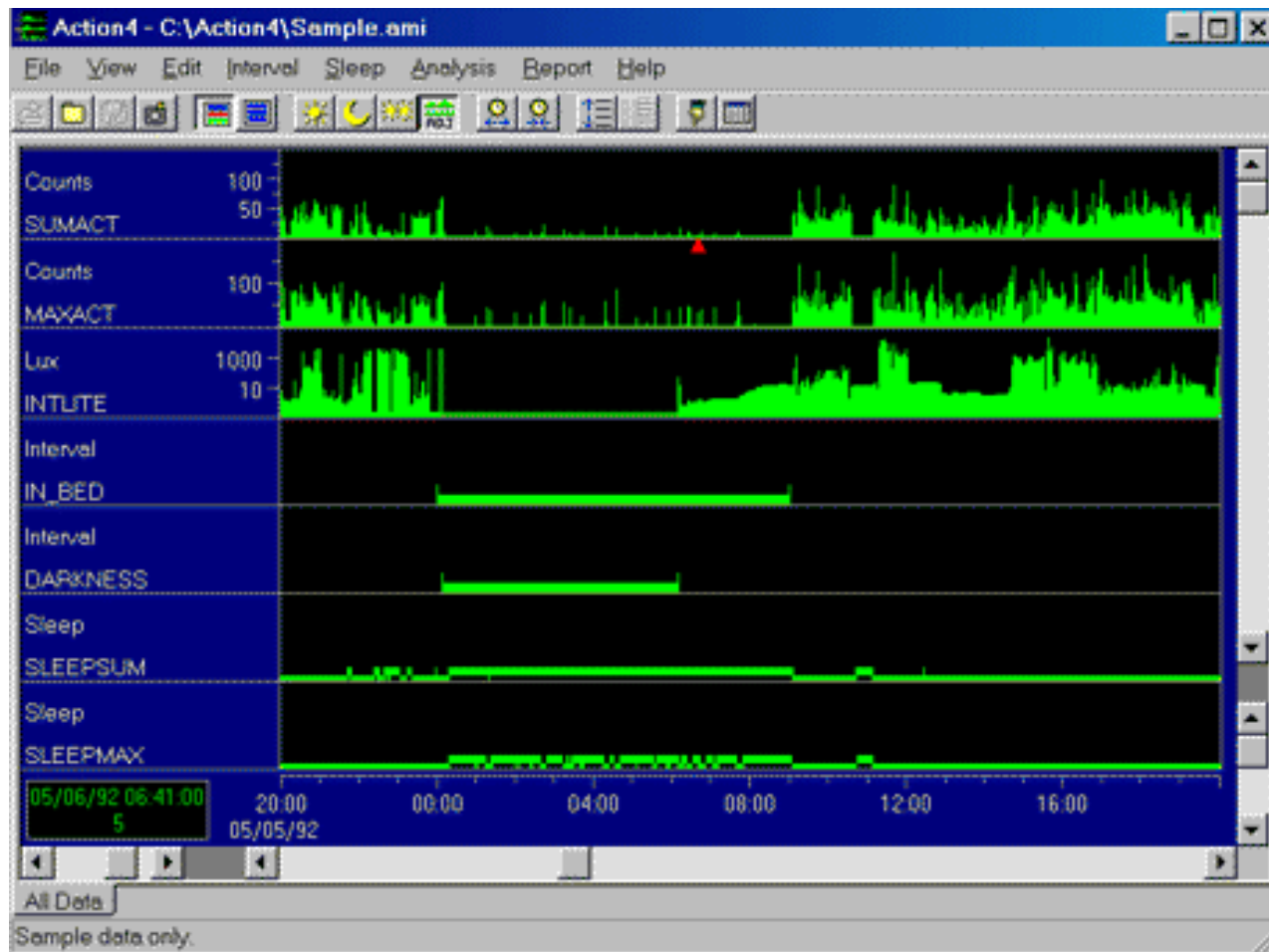
# Micro Motionlogger



- Manufacturer:
  - Ambulatory Monitoring, Inc.
- Cost:
  - \$750-\$995
- Research Data:
  - Used in many research studies
- Pros:
  - Widely used in sleep research, best validation data
- Cons:
  - No off-wrist detection, not waterproof



# Action Software



# Actiwatch-64



- Manufacturer:
  - Mini Mitter
- Cost:
  - Not currently available
- Research Data:
  - Several research studies validating actiwatch against PSG
- Pros:
  - Widely used in sleep research
- Cons:
  - No longer being manufactured
  - Calibrations may be out of date
  - No light channel



# Actiwatch-L



- Manufacturer:
  - Mini Mitter
- Cost:
  - Not currently available
- Research Data:
  - Several research studies validating actiwatch against PSG
- Pros:
  - Small, inexpensive, includes light
  - Widely used in sleep research
  - One of the first small devices
- Cons:
  - Agreement with polysomnography not ideal
  - No longer manufactured or calibrated

# Actiwatch-2

- Manufacturer:
  - Philips-Respironics
- Cost:
  - \$800
- Research Data:
  - Several research studies using actiwatch
- Pros:
  - Standard actiwatch technology, waterproof
- Cons:
  - No watch face, no off-wrist detection

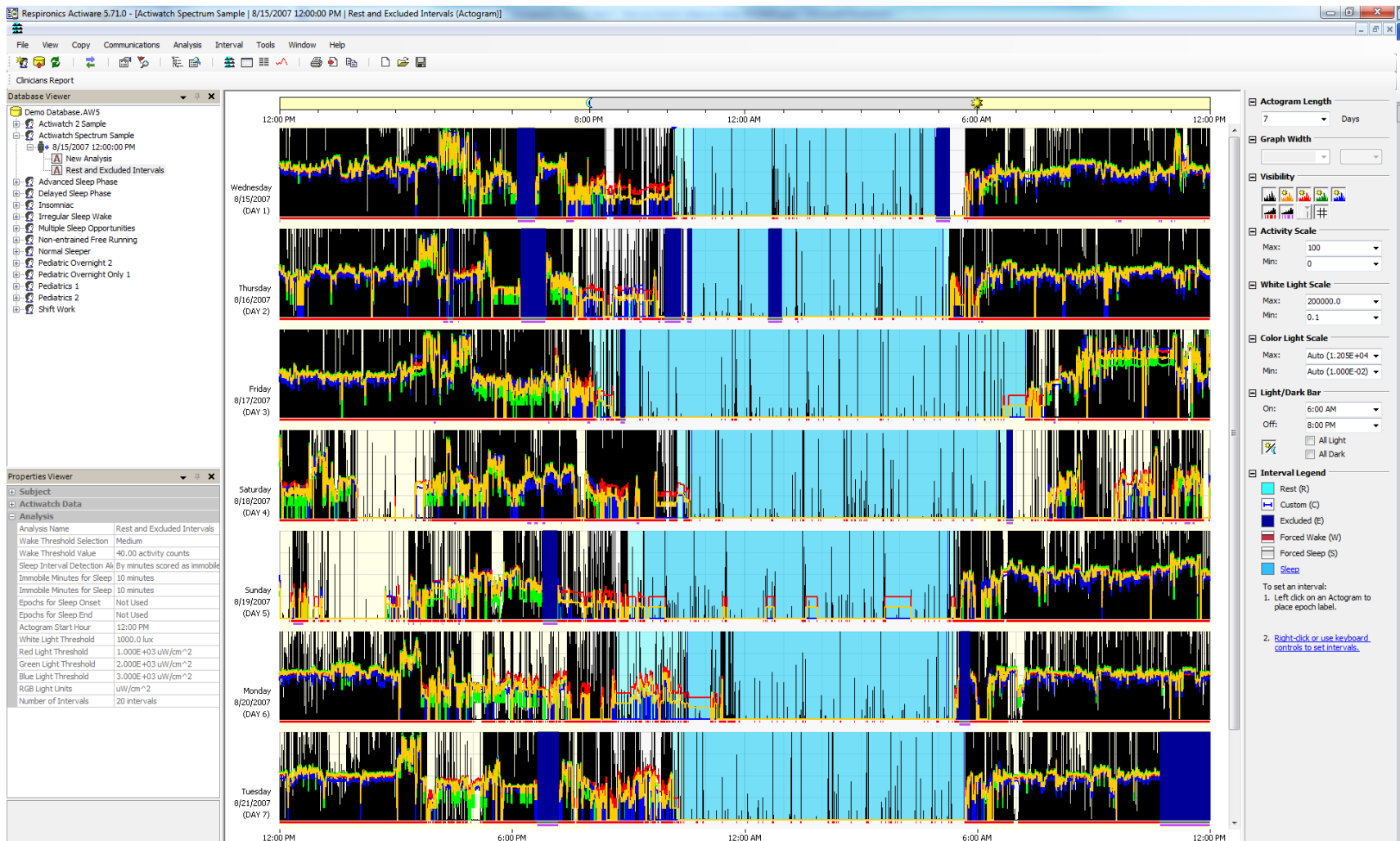


# Actiwatch Spectrum

- Manufacturer:
  - Philips-Respironics
- Cost:
  - Will be replaced by PRO and PLUS models (~\$1000 each)
- Research Data:
  - See Kripke et al., 2010 and Minier et al., 2013
- Pros:
  - Photometers separate red, green, and blue light, has clock face and off-wrist detection
  - Well studied, many features provided
- Cons:
  - More expensive



# Actiware Software





# Actigraph GT3x



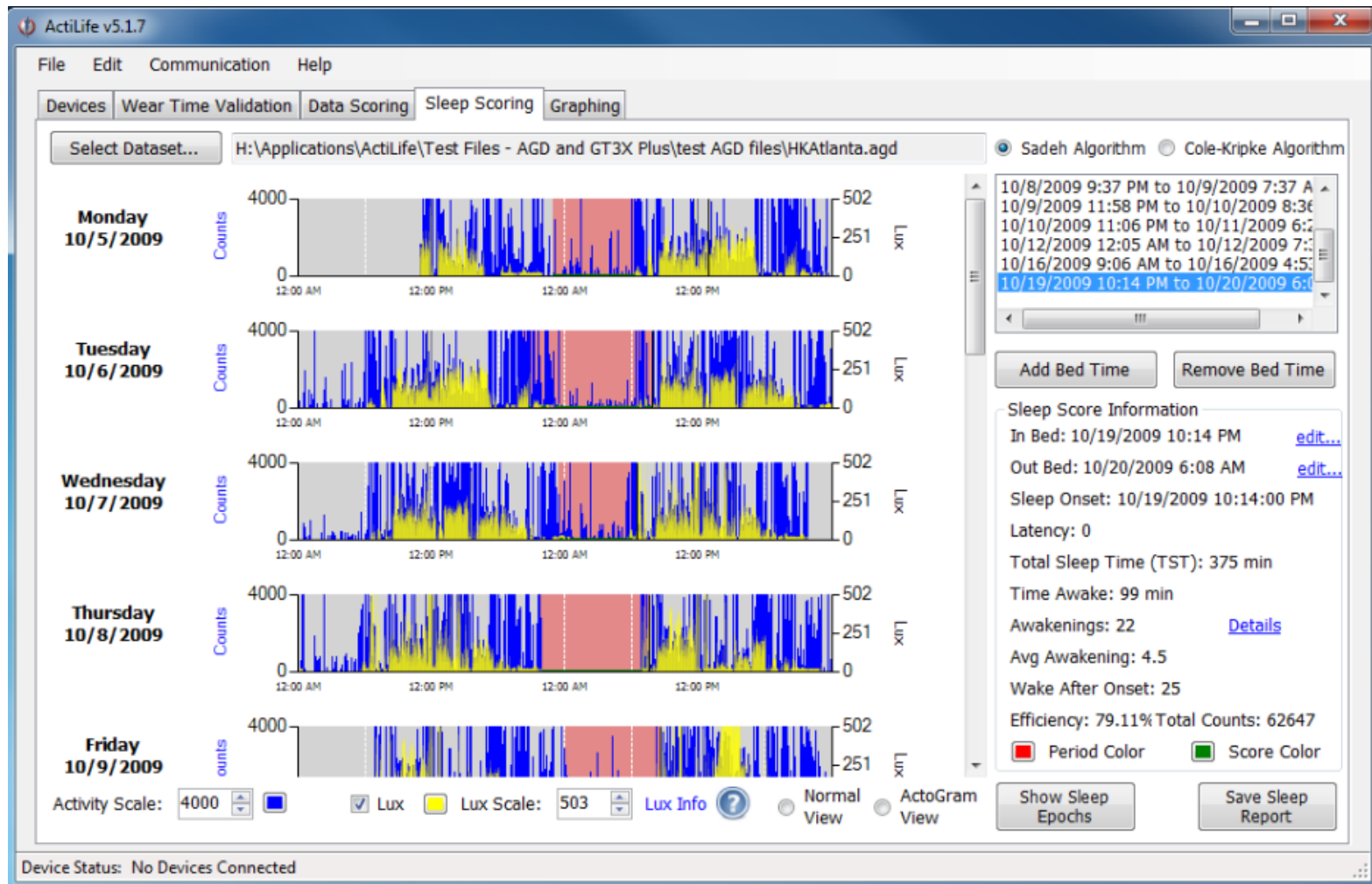
- Manufacturer:
  - ActiGraph
- Cost:
  - \$225
- Research Data:
  - No published validation studies
- Pros:
  - Frequently used in physical activity research
  - Much less expensive than other models
  - Choose scoring algorithm
  - New bluetooth models
- Cons:
  - Limited validation data , no off-wrist detection

# ActiSleep



- Manufacturer:
  - ActiGraph
- Cost:
  - \$299
- Research Data:
  - None available
- Key Features:
  - More sensitive for sleep than GT3x and includes actogram data view
- Pros:
  - Less expensive
  - New bluetooth models
  - Select scoring algorithm
  - Includes Actogram view
- Cons:
  - Limited validation data, no off-wrist detection, limited hand scoring

# ActiLife Software



# MotionWatch



- Manufacturer:
  - CamNtech
- Cost:
  - \$1500
- Research Data:
  - Limited but growing
- Key Features:
- Pros:
  - Based on standard actiwatch technology
  - Waterproof, very light, replaceable battery, exportable data
- Cons:
  - No off-wrist detection



# MotionWare



# GENEActiv Asleep



- Manufacturer:
  - GENEActiv Asleep
- Cost:
  - \$375
- Research Data:
  - Used in 11 research studies (1 sleep validation)
- Pros:
  - Continuous, unfiltered data for ~1 month
  - Includes skin temperature
- Cons:
  - Limited sleep validation

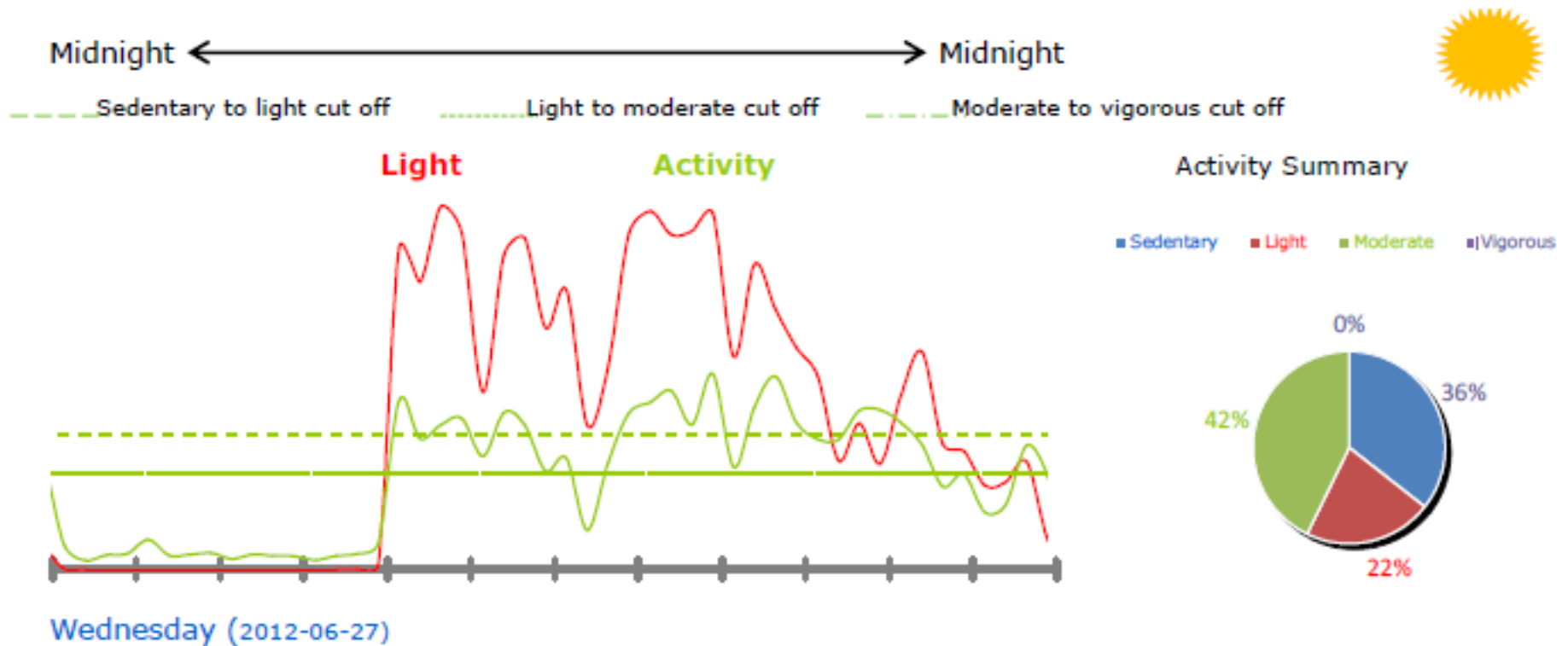




# GENEActiv software



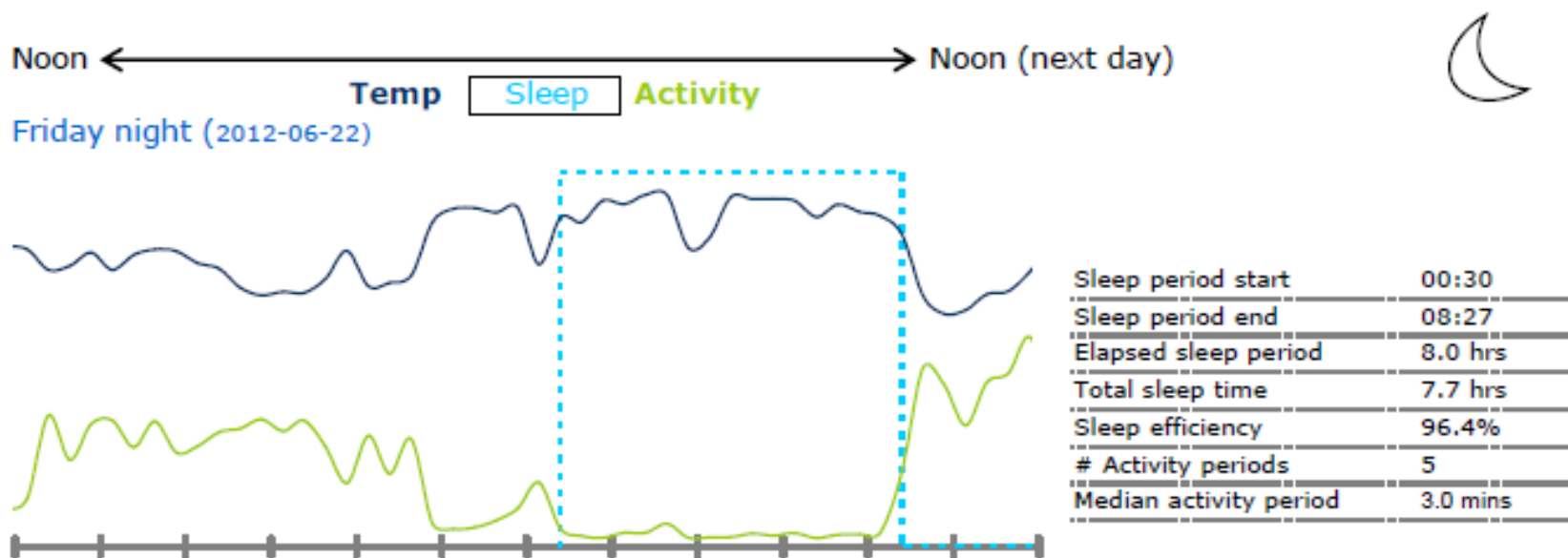
# GENEActiv physical activity report







# GENEActiv sleep report



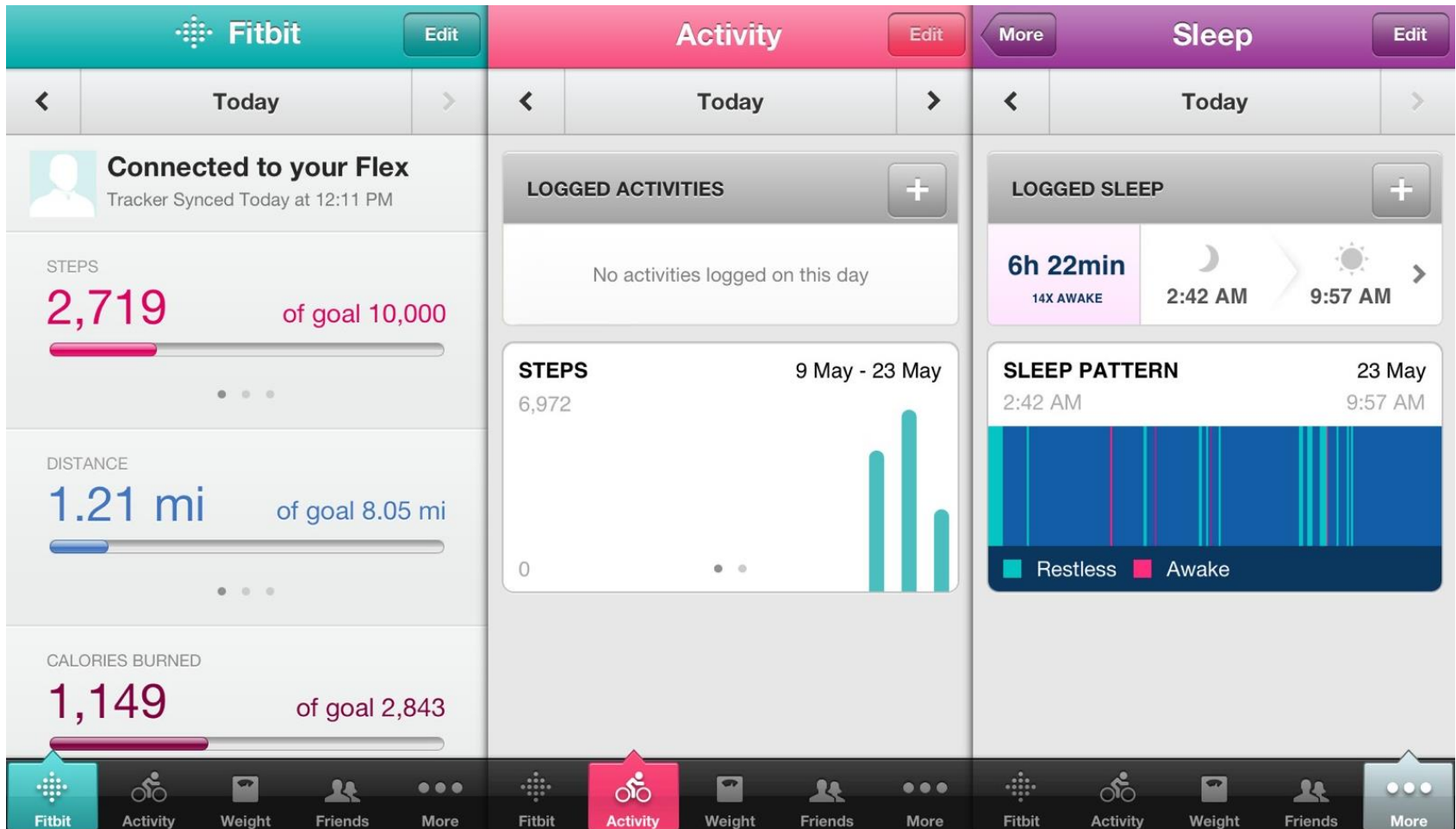
# FitBit



- Manufacturer:
  - FitBit
- Cost:
  - \$130
- Research Data:
  - None
- Key Features:
  - Inexpensive, sync with app. Steps, calories, and sleep. Adds altimeter for better activity measurement and clock face.
- Pros:
  - Inexpensive, waterproof, vibrating alarms.
- Cons:
  - Insufficient validation data. No data export. Algorithms and recording modes are proprietary.



# FitBit App



# UP

# JAWBONE



- Manufacturer:
  - Jawbone
- Cost:
  - \$130
- Research Data:
  - None
- Key Features:
  - Inexpensive, sync with app. Steps, calories, and sleep.
- Pros:
  - Inexpensive, waterproof.
- Cons:
  - Insufficient validation data. No data export. Algorithms and recording modes are proprietary.

# UP App

JAWBONE

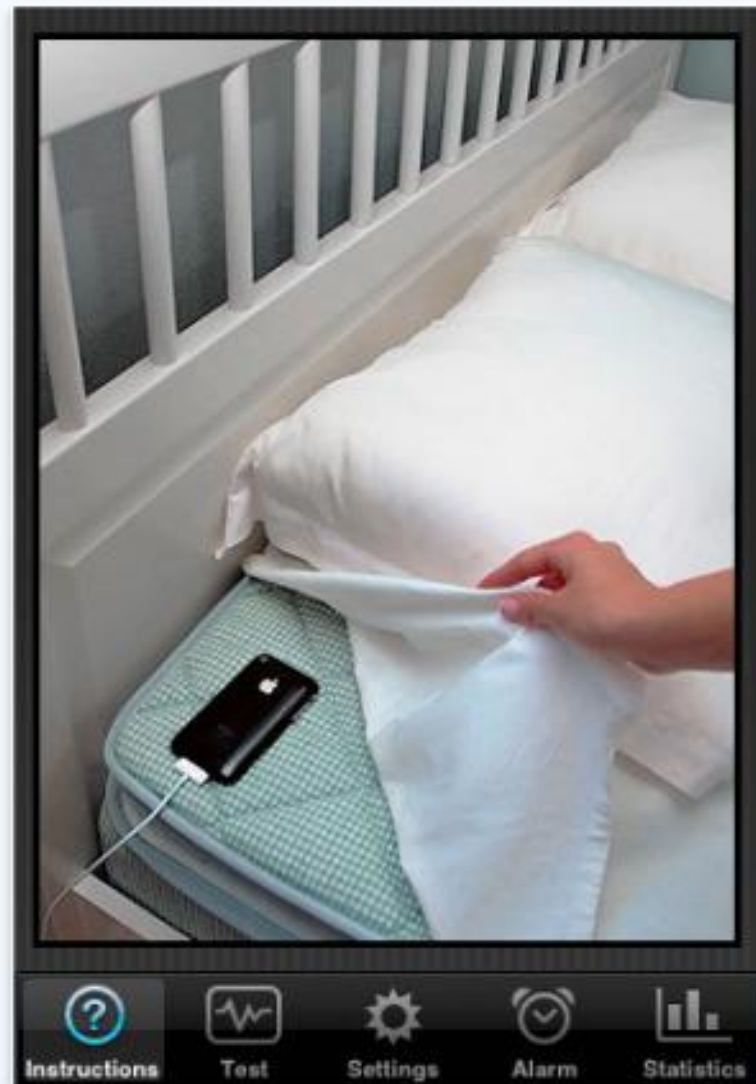


# ActiCal

- Manufacturer:
  - Philips-Respironics
- Cost:
  - \$600
- Research Data:
  - Weiss et al., 2010.
- Pros:
  - Lightweight, less expensive than actiwatch.
- Cons:
  - Calibrated for energy expenditure, not sleep.

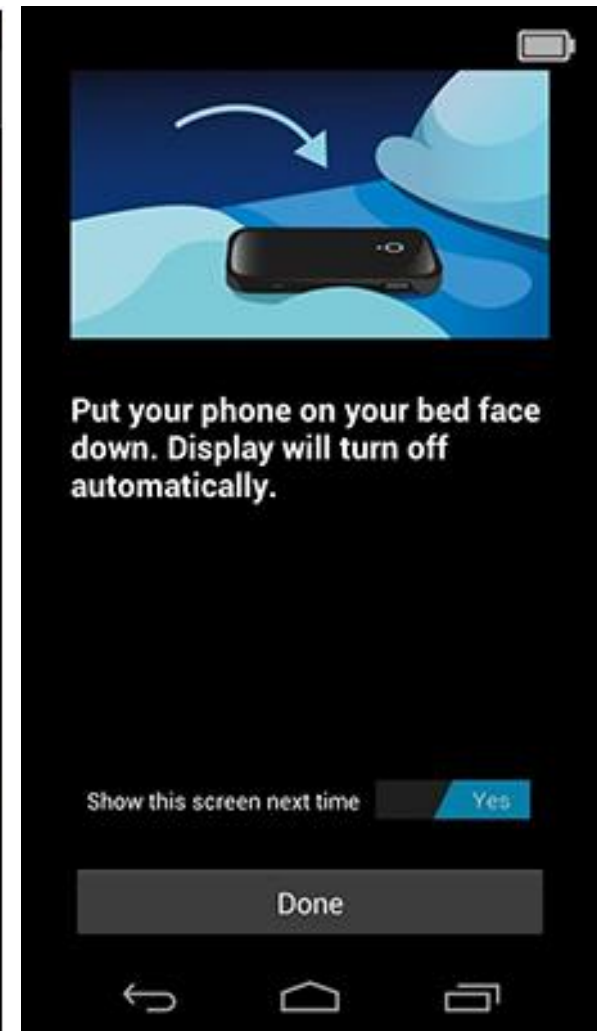
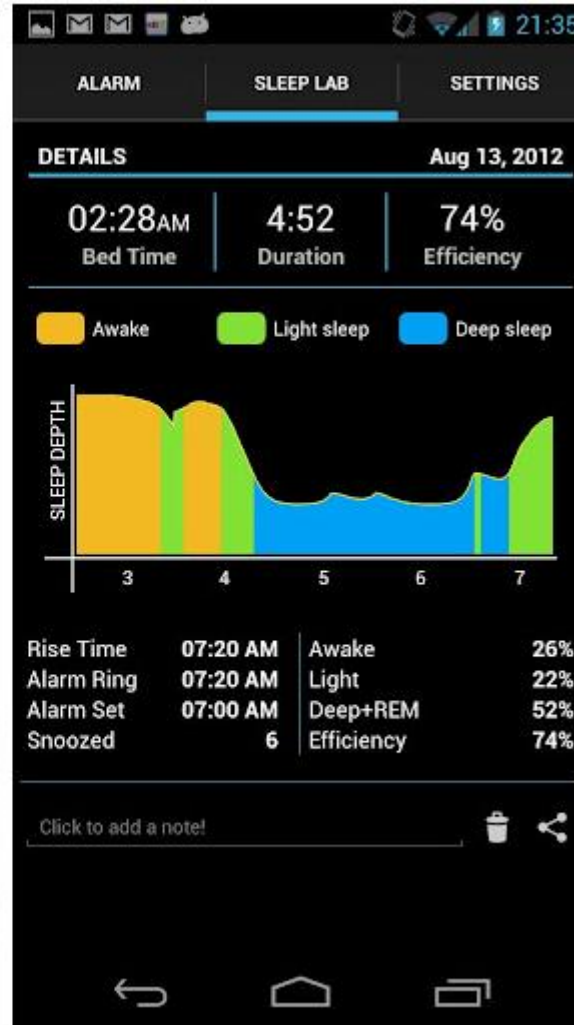
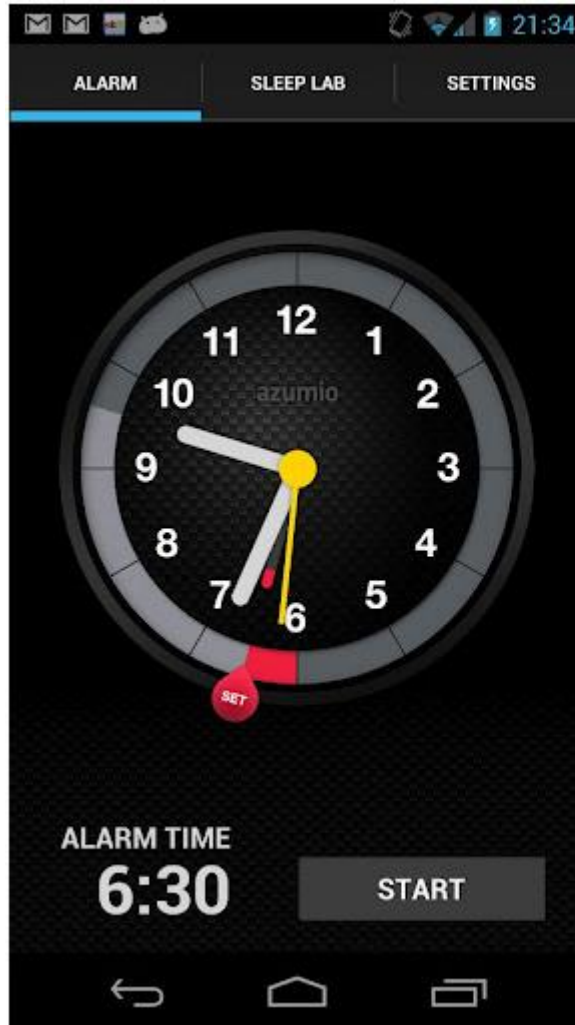


# Sleep Cycle app





# Sleep Time app





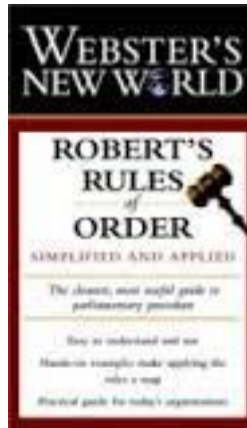
# So how do I use it?

- Step 1: Determine data quality
- Step 2: Determine missing intervals
- Step 3: Set intervals for time in bed
- Step 4: Automated scoring algorithm
- Step 5: Correction with hand scoring

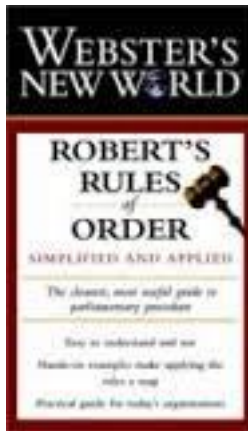
# So what should I get?

- Sleep latency
  - [Time sleep onset] – [Time into bed]
- Wake After Sleep Onset
  - [Awakening1] + [Awakening2] ...
- Early Morning Awakening
  - [Time out of bed] – [Time final awakening]
- Time in bed
  - [Time out of bed] – [Time into bed]
- Total Sleep Time
  - [Time in bed] – [Sleep latency] – [WASO] – [EMA]
- Sleep Efficiency
  - [ [Time in bed] / [Total Sleep Time] ] \* 100

# What happens after autoscore?

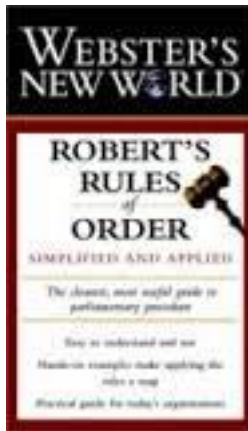


The most accepted hand scoring rules  
to be done after autoscoreing



# Webster's Rules

- If you have **4-9 mins** of wake, recode the first 1 min of sleep as wake
- If you have **10-14 mins** of wake, recode the first 3 min of sleep as wake
- If you have **15+ mins** of wake, recode the first 4 min of sleep as wake



# Webster's Rules

- If you have **10-19 mins** of wake surrounding a period of sleep, any sleep period of 6 mins or less should be recoded as wake
- If you have **20 mins** of wake surrounding a period of sleep, any sleep period of 10 mins or less recoded as wake

# How long is long?

- Baseline
  - Minimum three days
  - Standard one week
  - Best practice two weeks

