

Exploratory Graphics for Functional Actigraphy Data

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William Shannon

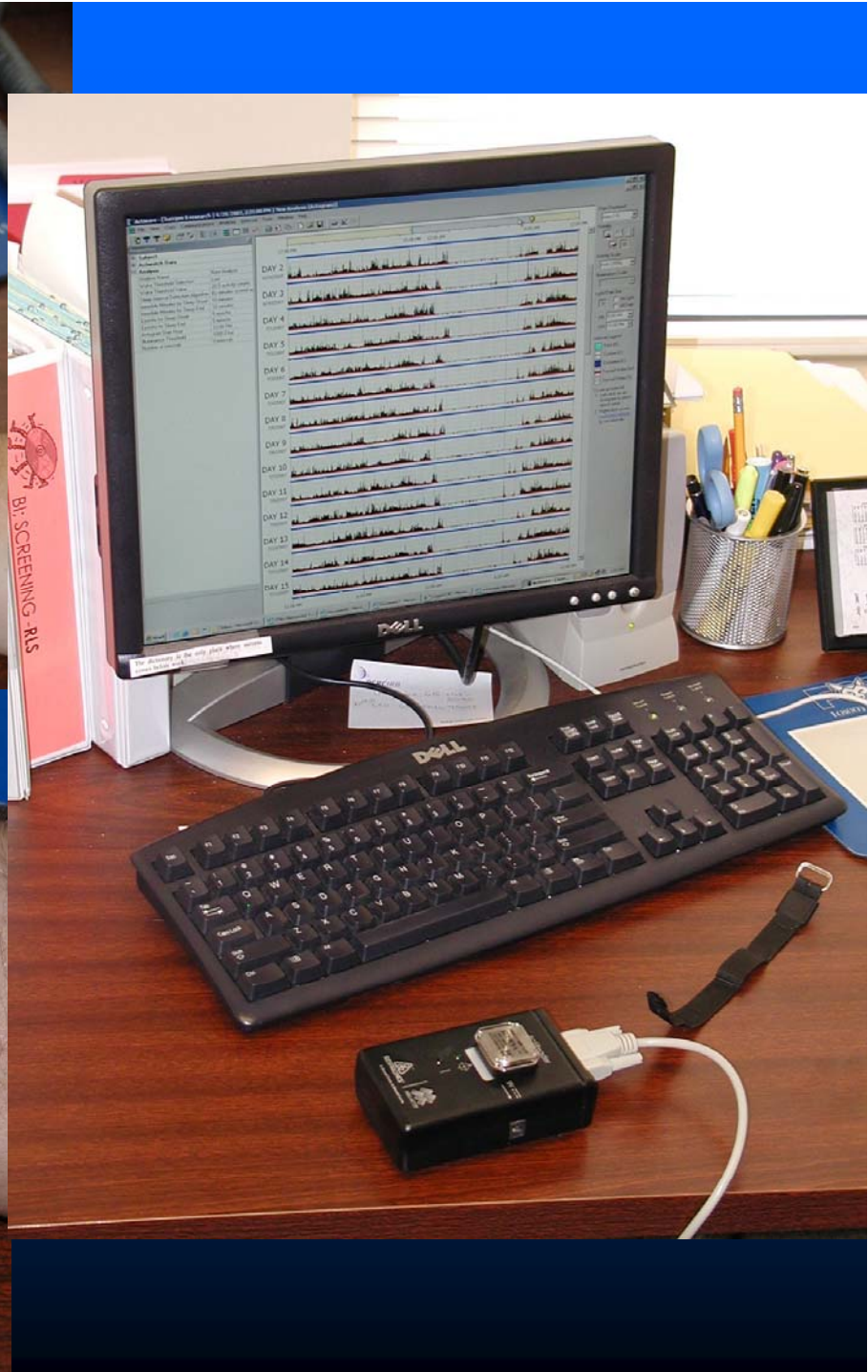
Washington University, St. Louis, MO

Contents

- Background
- Current Visualization of Actigraphy Data
- Future Visualization of Actigraphy Data
- Conclusion

Background (1)

- **Actigraphy**: emerging technology for measuring a patient's activity level continuously over time
- **Actigraph**: watch-like device (attached to the wrist or a leg) that uses an accelerometer to measure (human) movements (every minute or more often)



Background (2)

- **Analysis of Human Actigraphy Data:**
Useful for detecting sleep, for assessing insomnia and restless leg syndrome, for tracking recovery after heart attacks, and as an assessment tool for overall status of HIV patients
- Actigraphy Data can be best described as functional data

Overall Research Goals

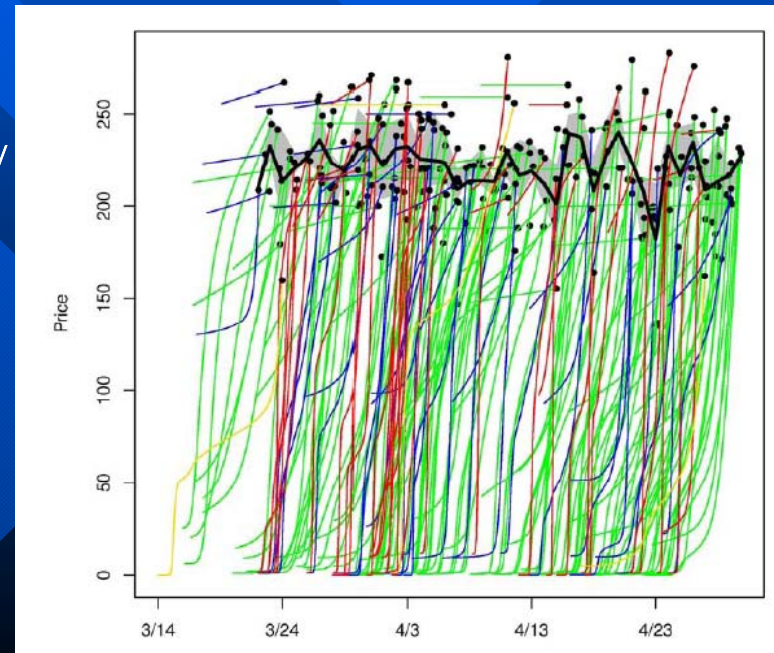
- 1) Define an object oriented data model for actigraphy and patient-level data
- **2) Develop and program new and advanced statistical and visualization methods that operate on these actigraphy data objects**
- 3) Validate and improve the tools developed and apply them to several patient subgroups

Visualization of Functional Data

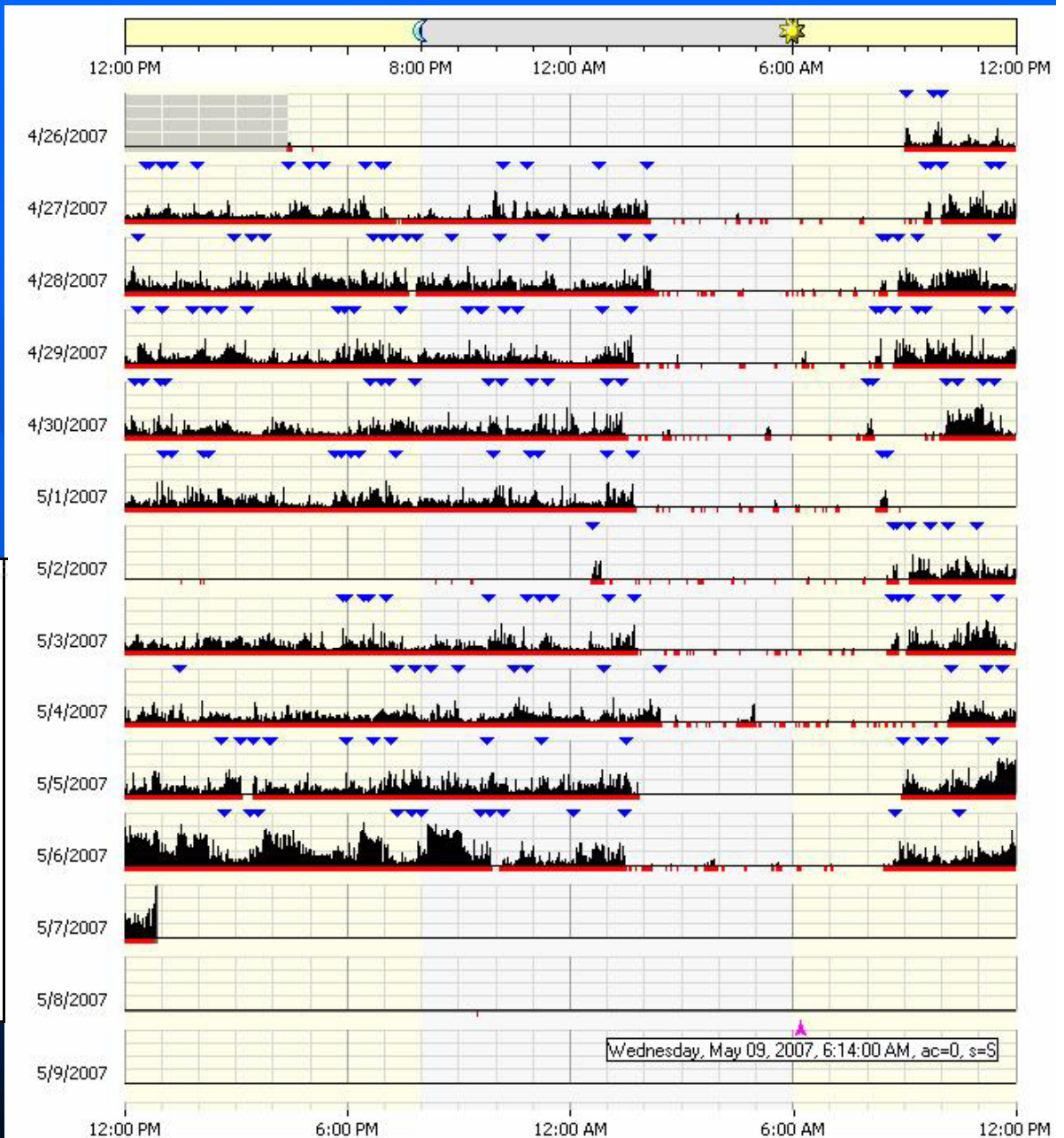
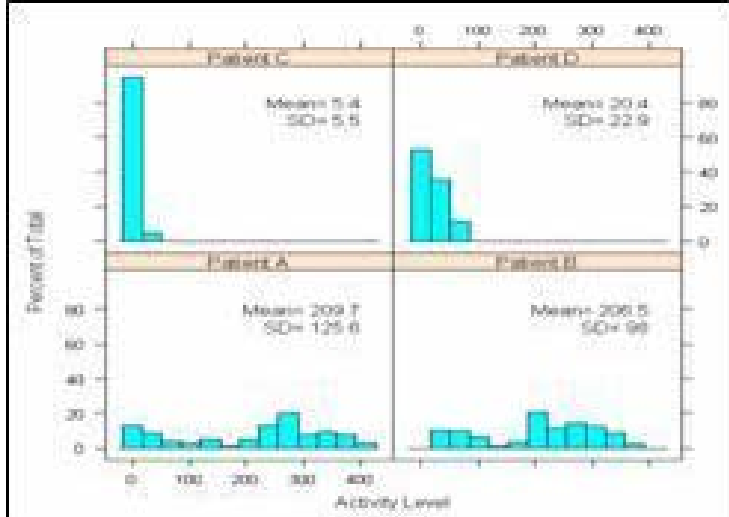
- Very limited ! A rare example is:

Jank, W., Shmueli, G., Plaisant, C., Shneiderman, B. (2008): Visualizing Functional Data with an Application to eBay's Online Auctions, In: Chen, C., Härdle, W., Unwin, A. (Eds.), Handbook of Data Visualization, Springer, Berlin/Heidelberg, 873-898.

- Figure from <http://www.smith.umd.edu/faculty/wjank/DIV-Berlin2006.pdf> (page 30).

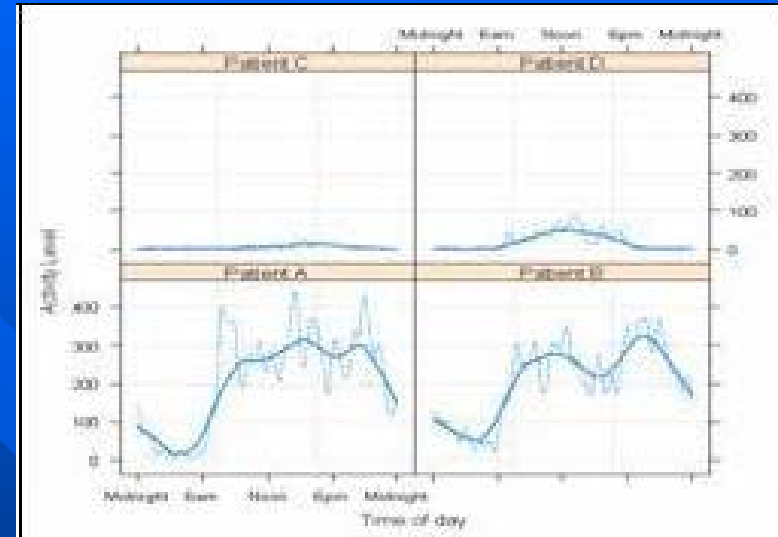


Current Visualization of Actigraphy Data

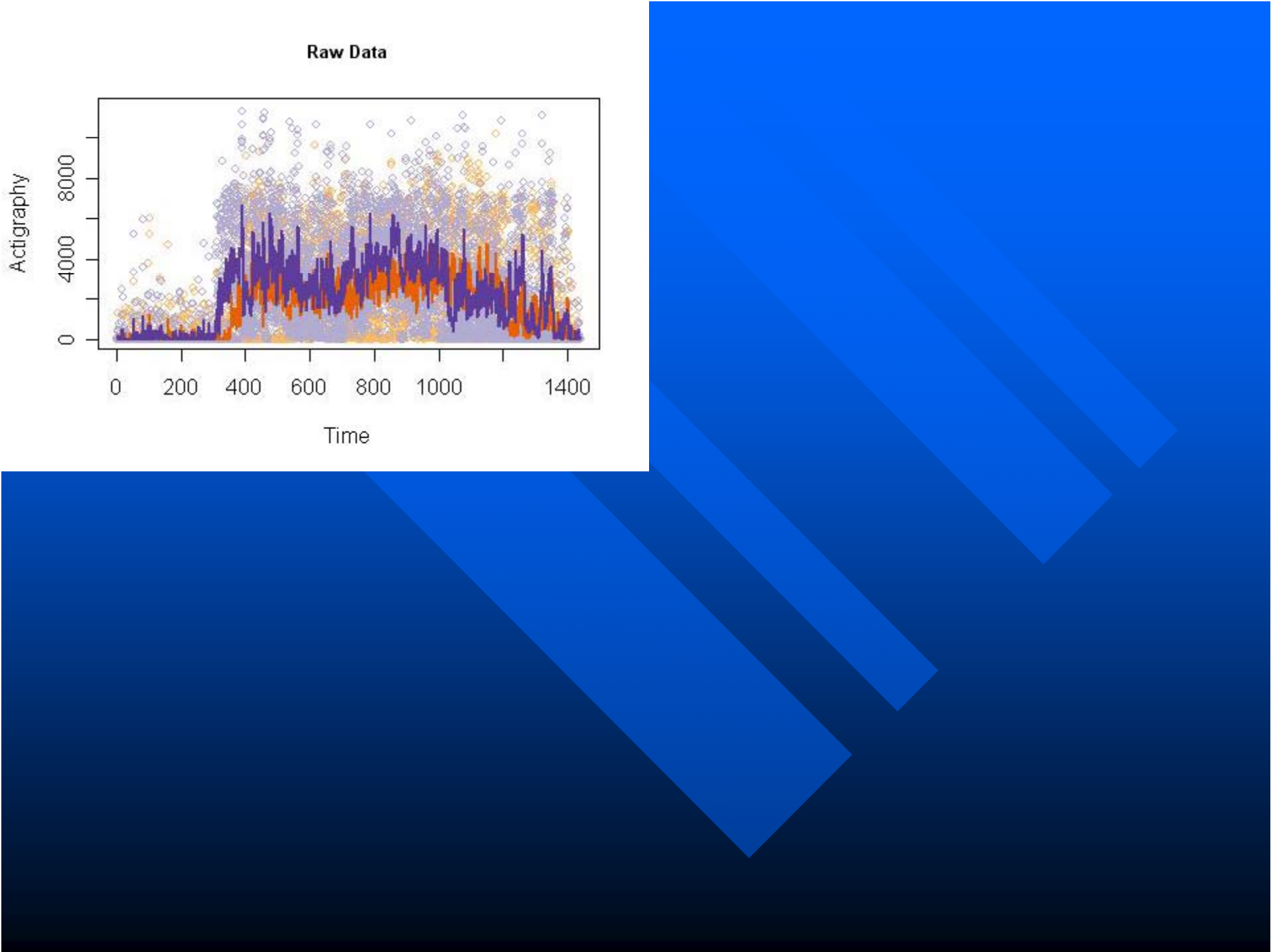
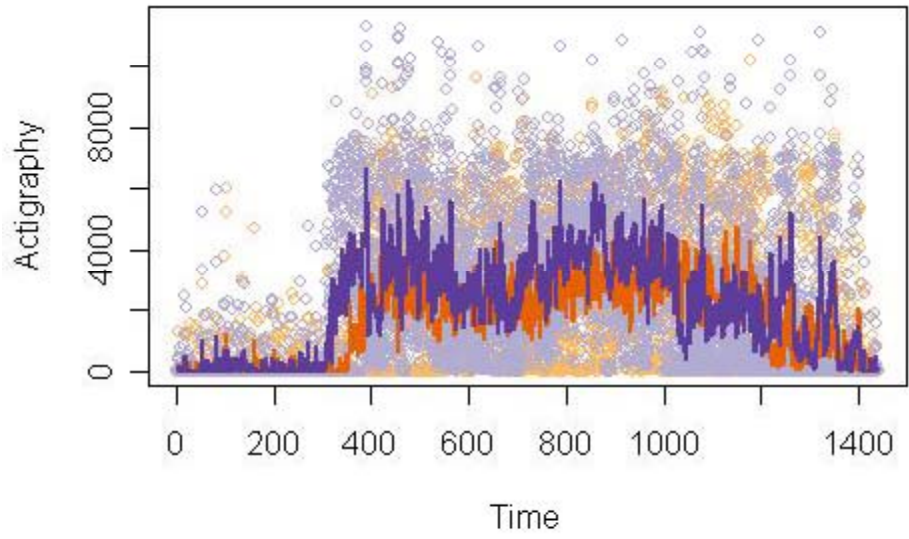


Suggested Future Visualization of Actigraphy Data (1)

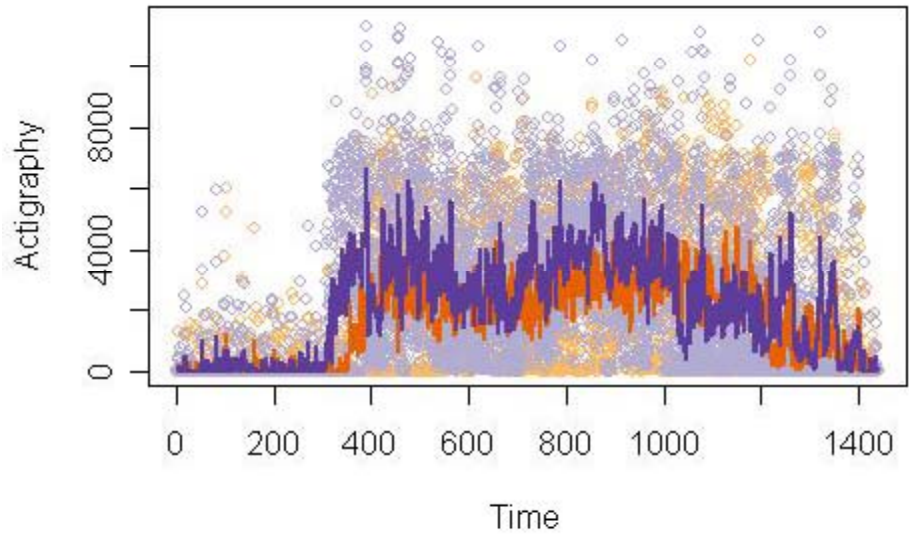
- Displays for
 - Raw data
 - Smoothed data
 - Averages etc.
 - Velocity (First Derivative)
 - Acceleration (Second Derivative)
 - Brushing & Linking
 - Cumulative Sums
- Example: 1 Subject
 - Orange: 5 Days at Baseline
 - Purple: 5 Days after 6 Months



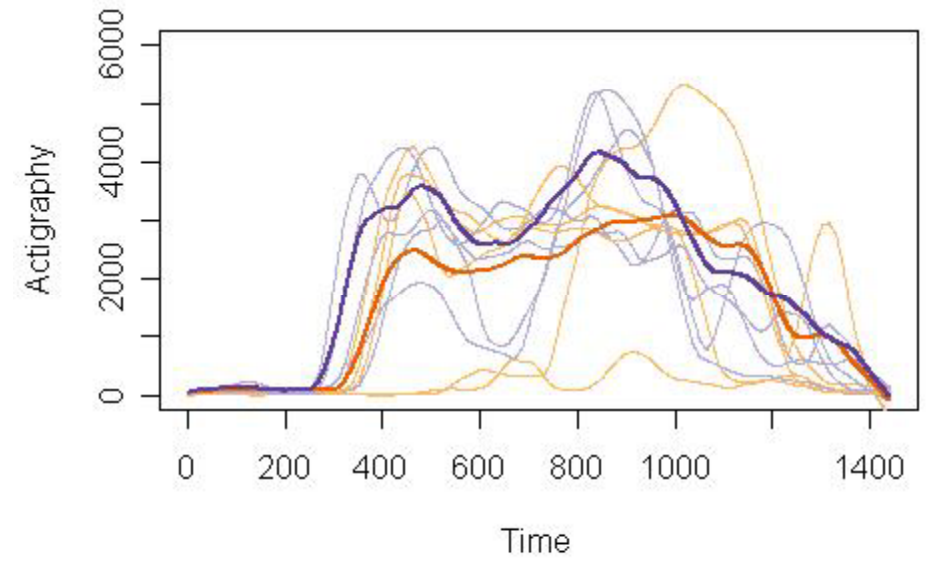
Raw Data



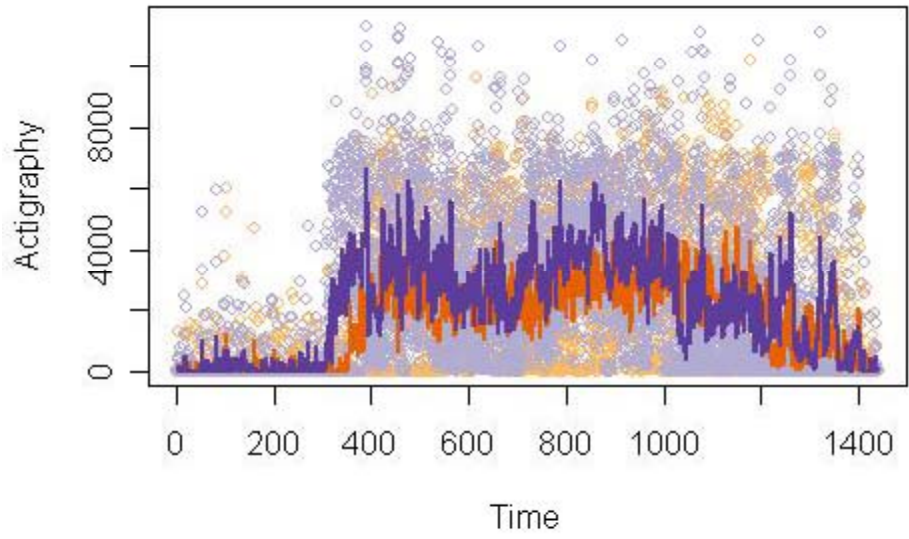
Raw Data



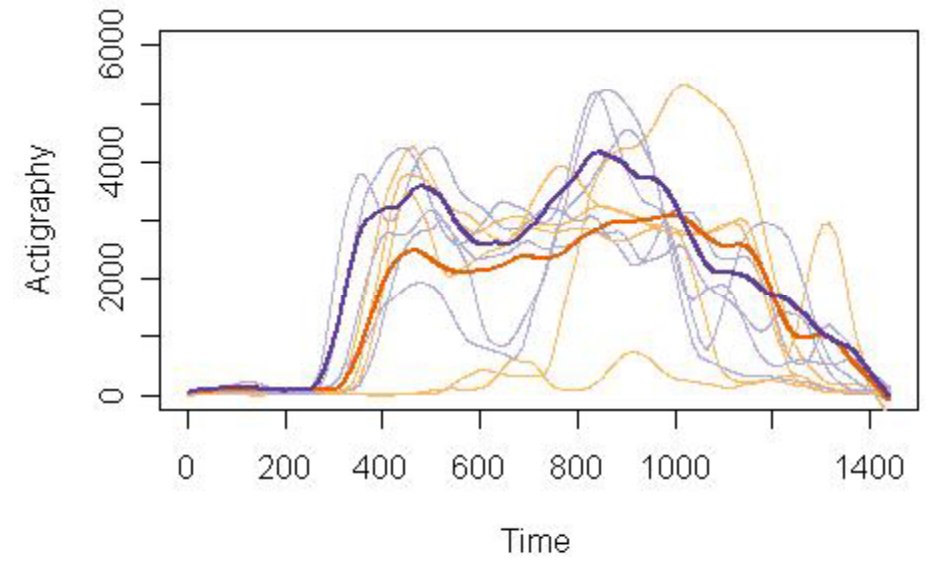
Smoothed Daily Data



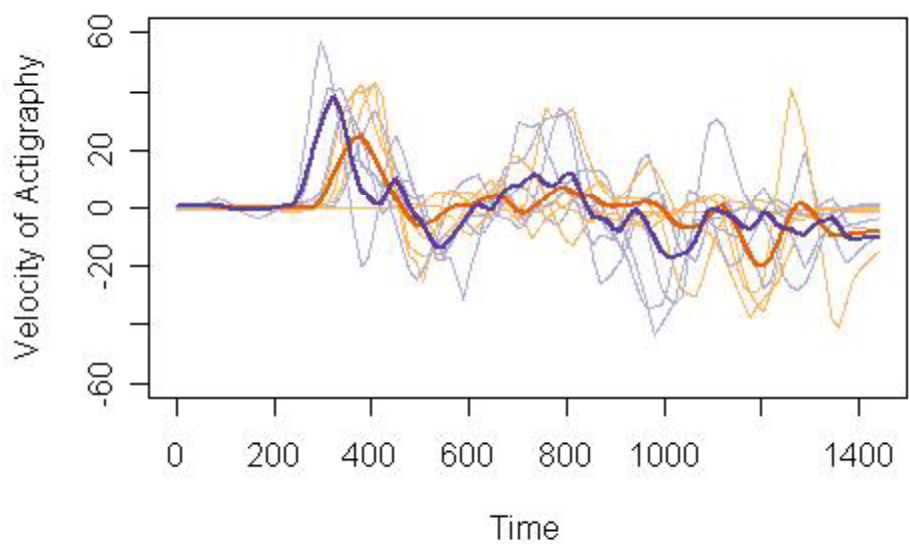
Raw Data



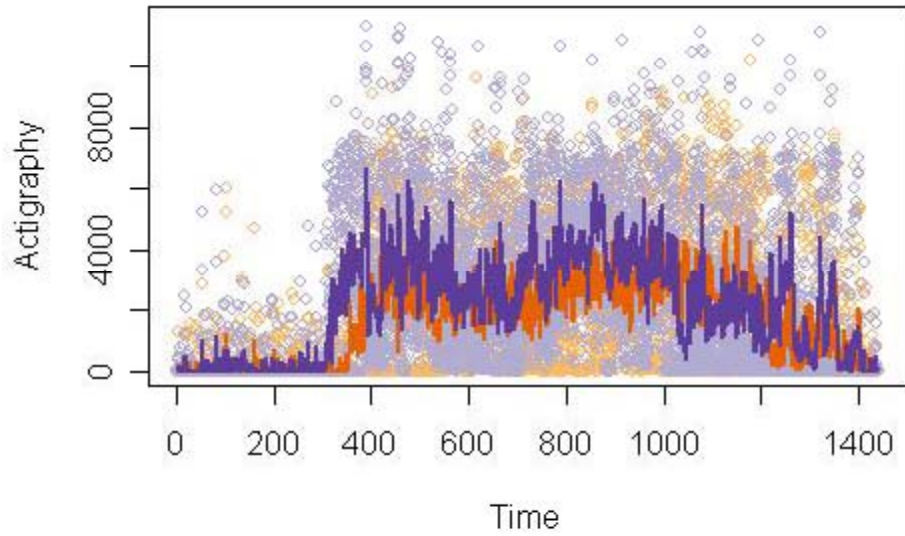
Smoothed Daily Data



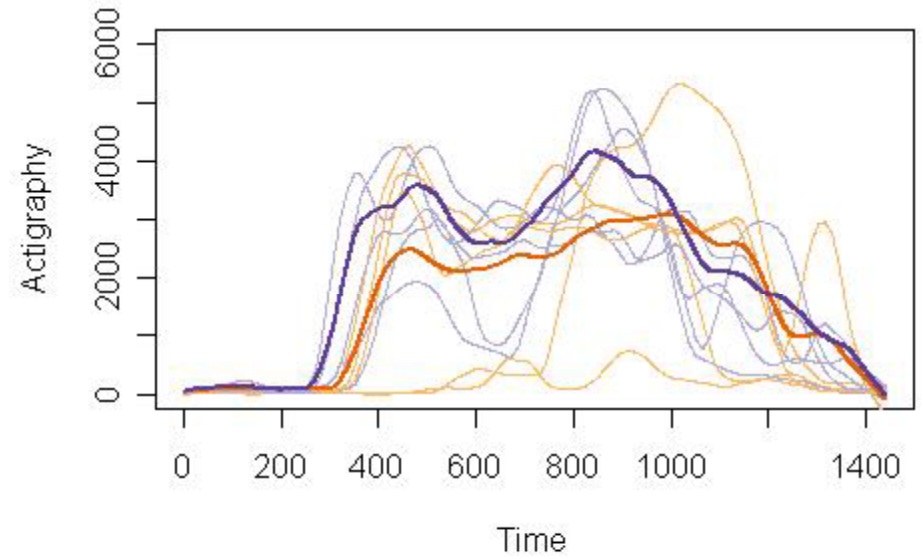
Velocity (First Derivative) of Smoothed Daily Data



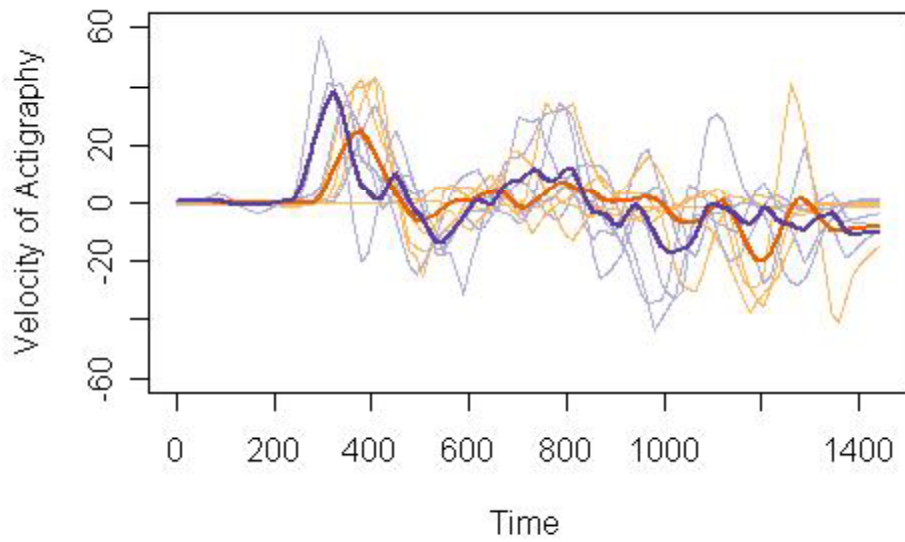
Raw Data



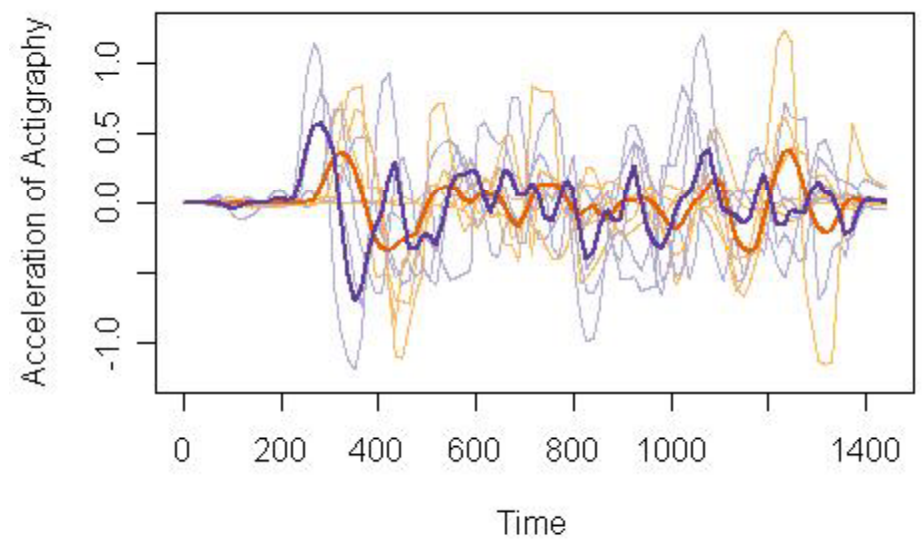
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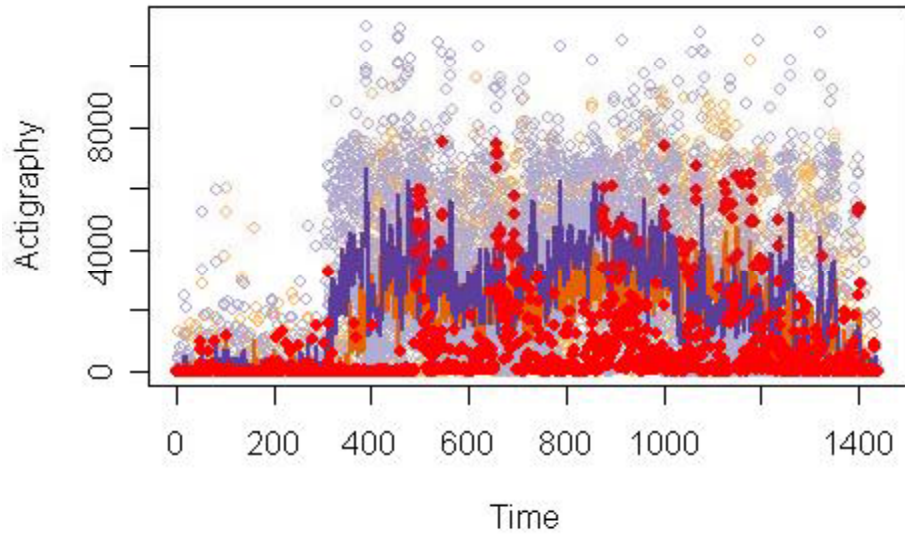
Velocity (First Derivative) of Smoothed Daily Data



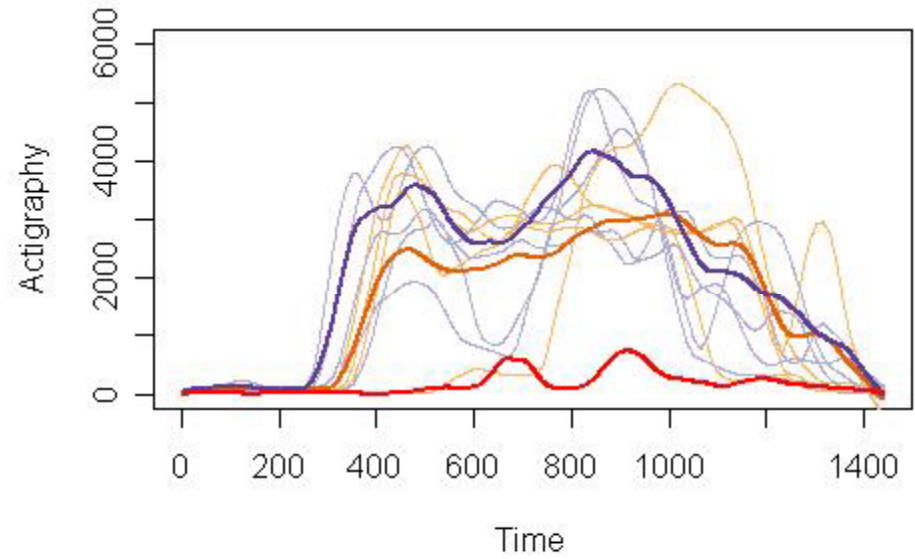
Acceleration (Second Derivative) of Smoothed Daily Data



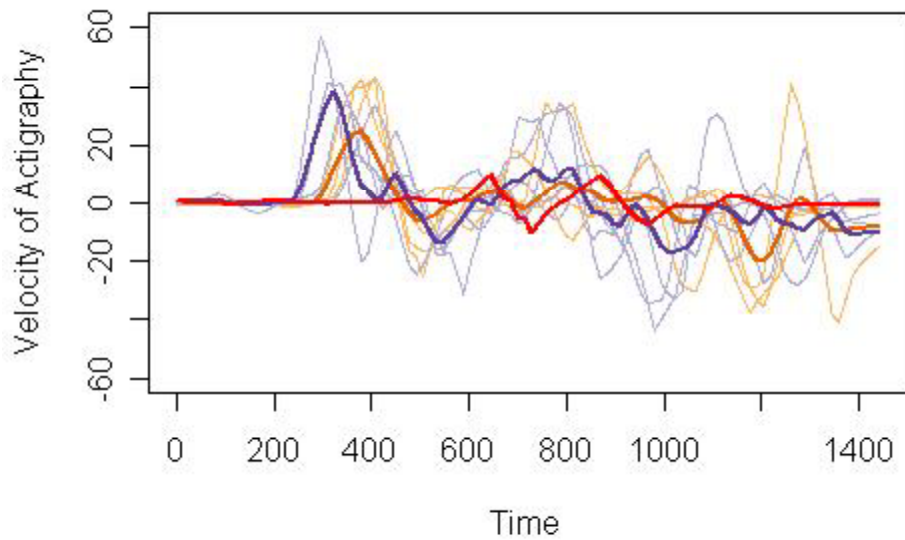
Raw Data (Base Day 3 Brushed)



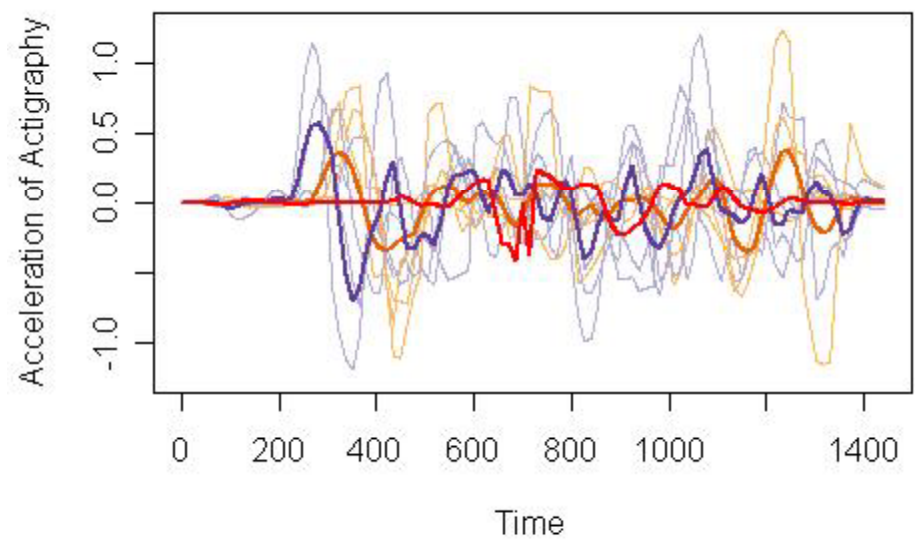
Smoothed Daily Data (Base Day 3 Brushed)



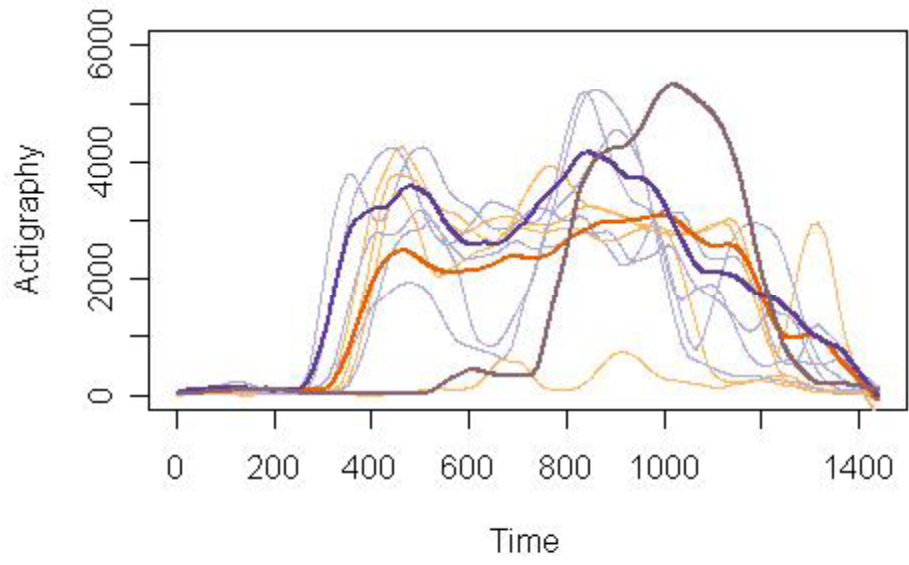
Velocity (First Derivative) of Smoothed Daily Data (Base Day 3 Brushed)



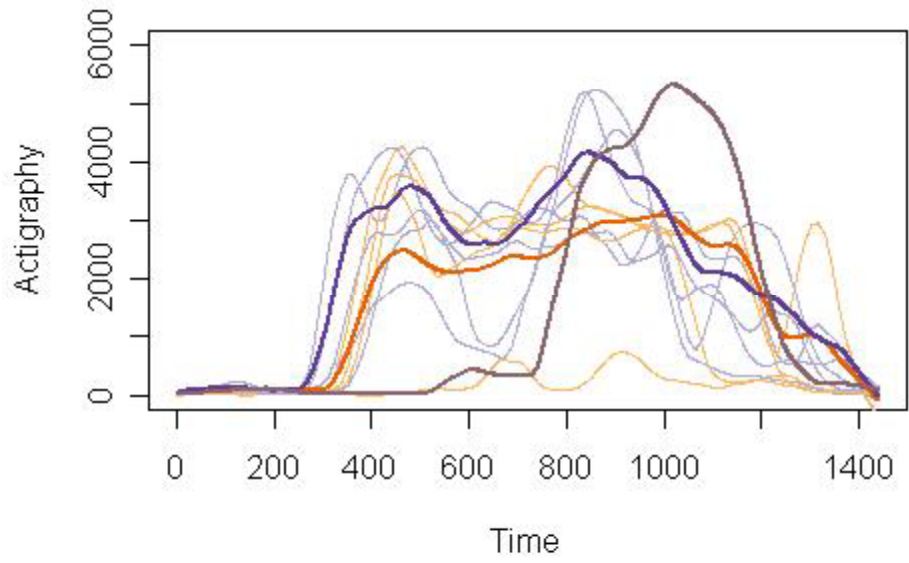
Acceleration (Second Derivative) of Smoothed Daily Data (Base Day 3 Brushed)



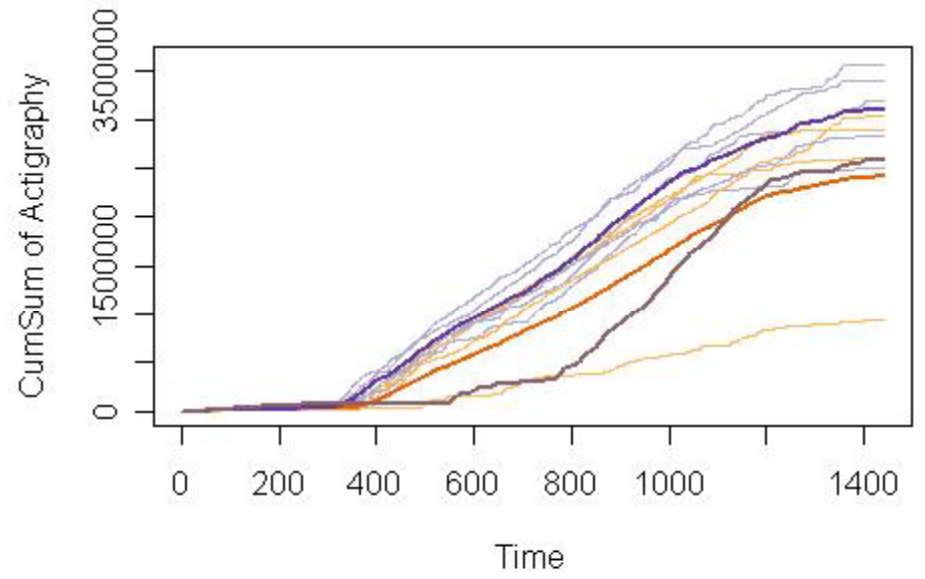
Smoothed Daily Data (Base Day 2 Brushed)



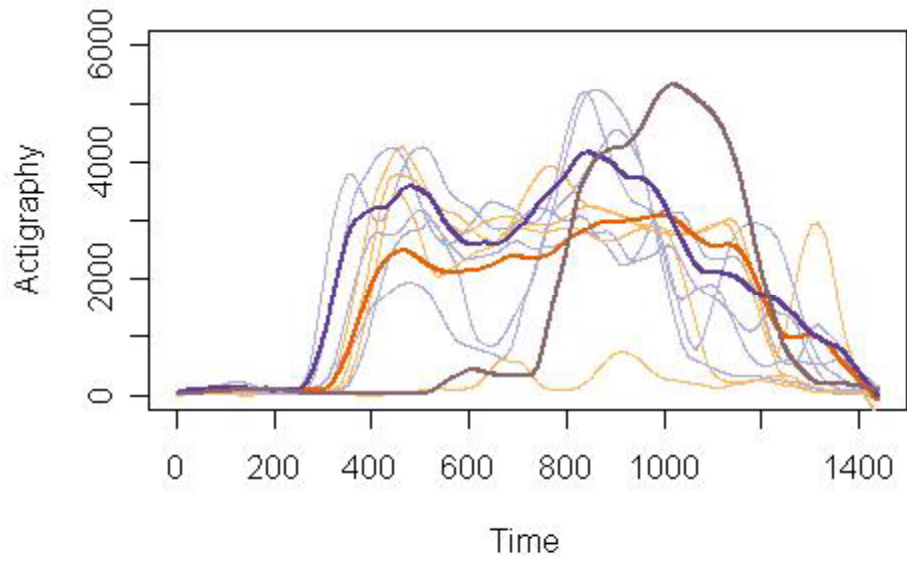
Smoothed Daily Data (Base Day 2 Brushed)



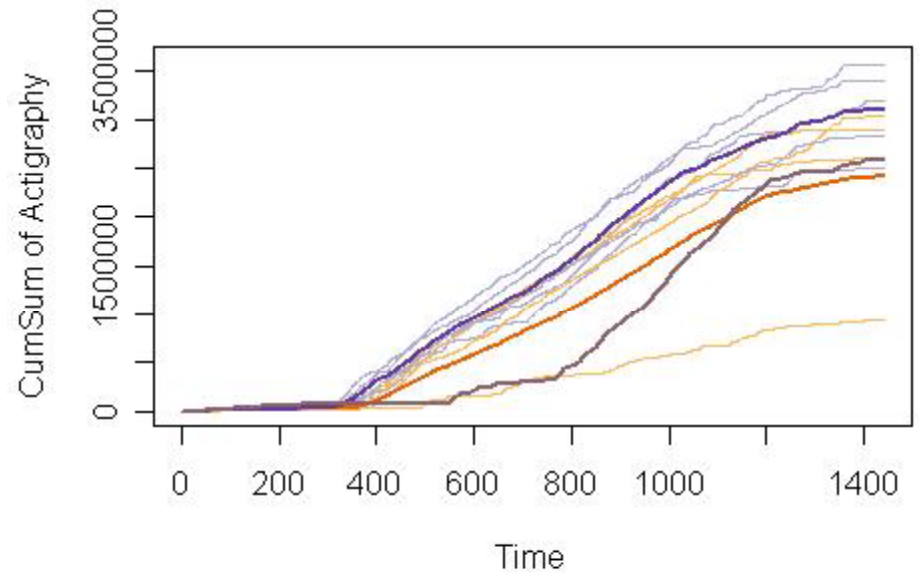
Cumulative Sums (Base Day 2 Brushed)



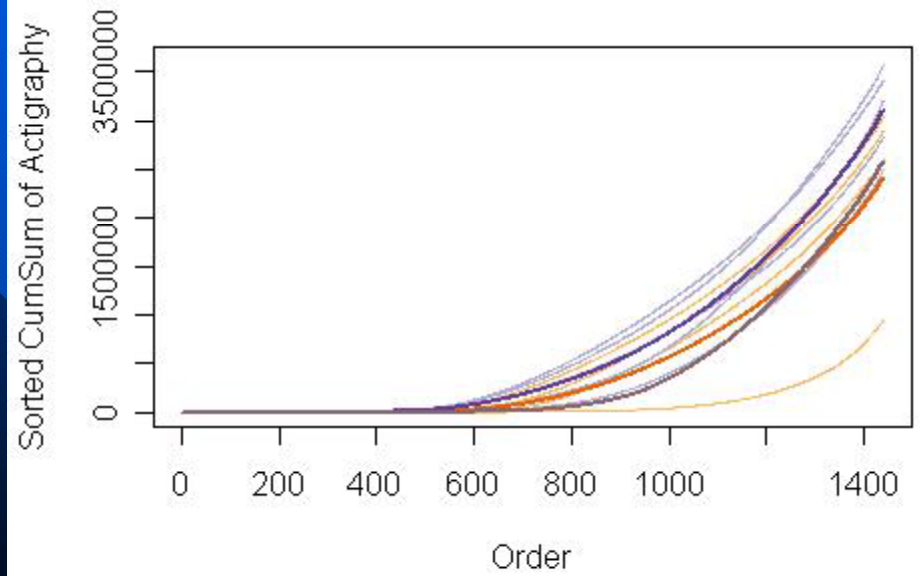
Smoothed Daily Data (Base Day 2 Brushed)



Cumulative Sums (Base Day 2 Brushed)



Sorted Cumulative Sums (Base Day 2 Brushed)



Conclusions

Visualization of Actigraphy Data provides

- Potential for application in various medical fields
- Additional insights into actigraphy data
- Ease to compare baseline and past-treatment data
 - » of a single patient
 - » of multiple patients
 - » to identify outliers
 - » to compare averages

Suggestions, please !!!