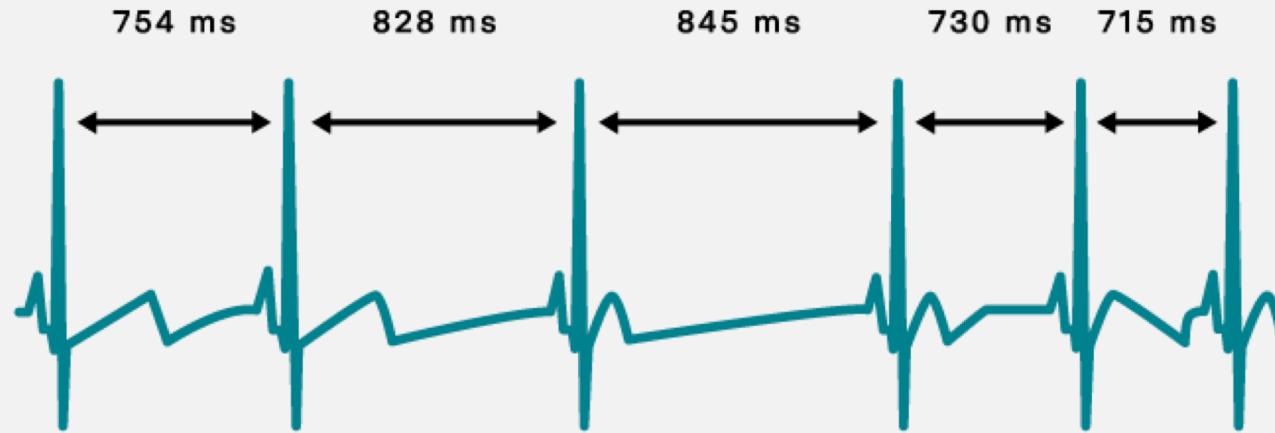


Heart Rate Variability to predict stress and rest

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Metis Fall 2020

Heart Rate Variability (HRV)



- High HRV is associated with rest and recovery
- Low HRV is associated with stress and fatigue
- HRV Summary metric = RMSSD (Root Mean Square of Successive Differences)

Using HRV to predict daily stressors

Dataset: MMASH (Multilevel Monitoring of Activity and Sleep in Healthy people)

- 24 hour continuous monitoring of 22 healthy volunteers

Heart Rate Monitor



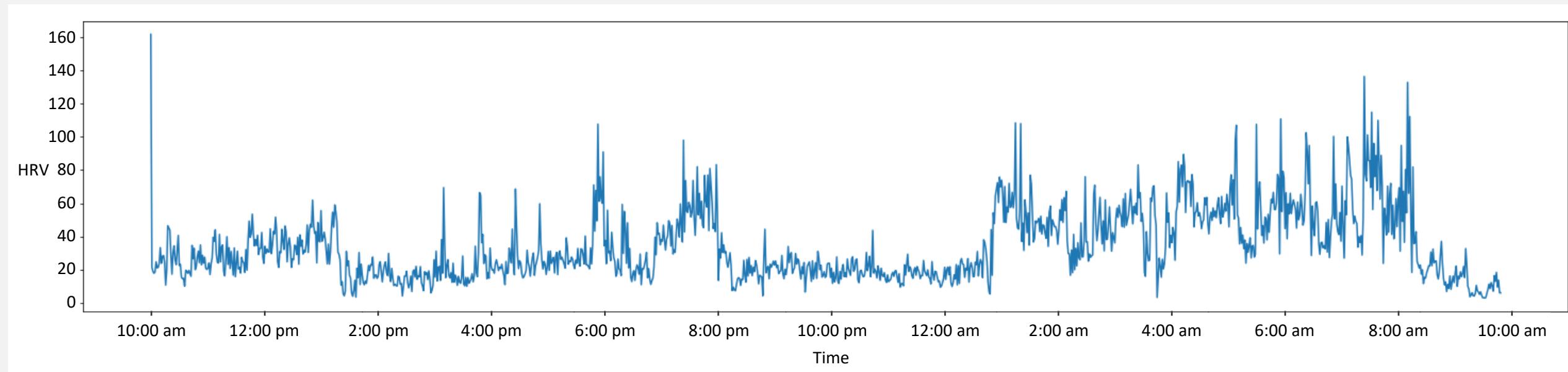
Accelerometer



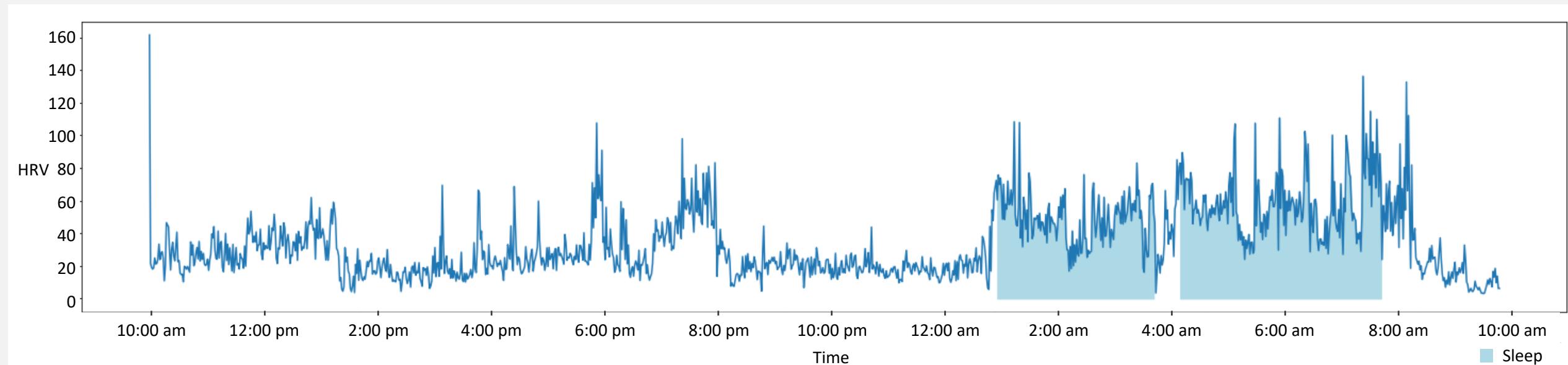
Aims

- 1) Use HRV and actigraphy to predict daily stressors: exercise, smoking, alcohol
- 2) Use HRV to identify sleep disturbance

HRV changes throughout the day

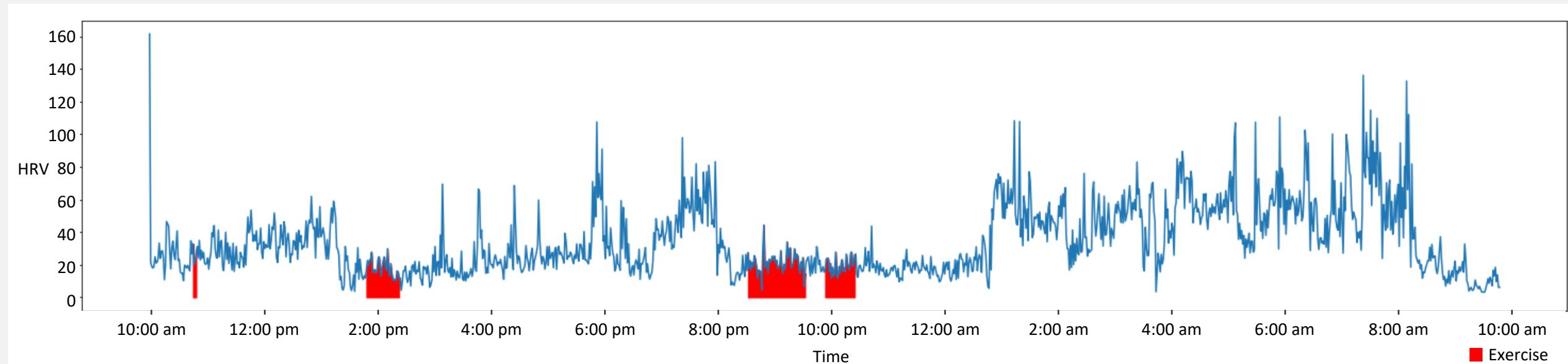


HRV changes throughout the day



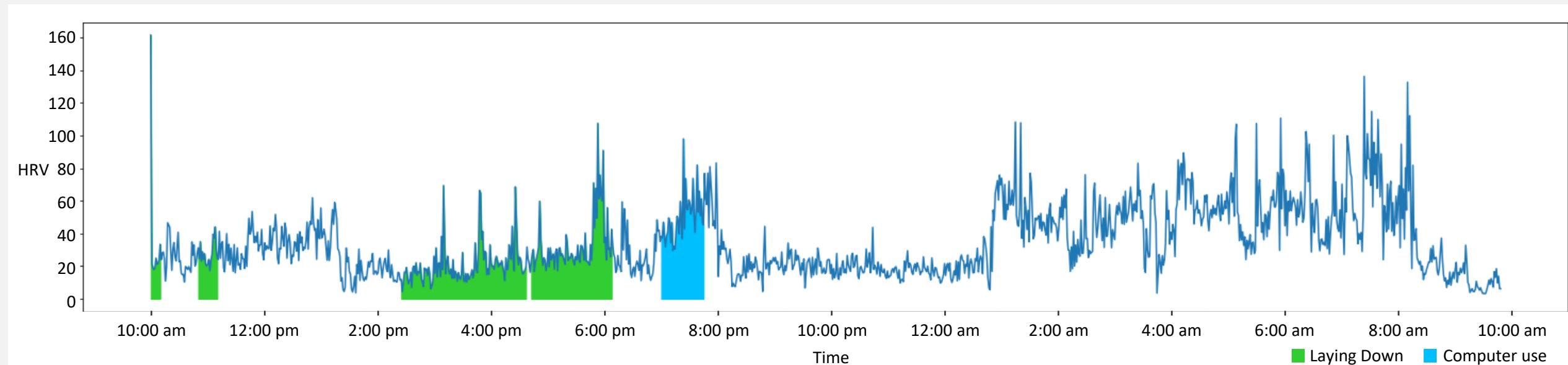
HRV is highest during sleep

HRV changes throughout the day



HRV is lower during stressful periods

HRV changes throughout the day



HRV is higher during restful periods

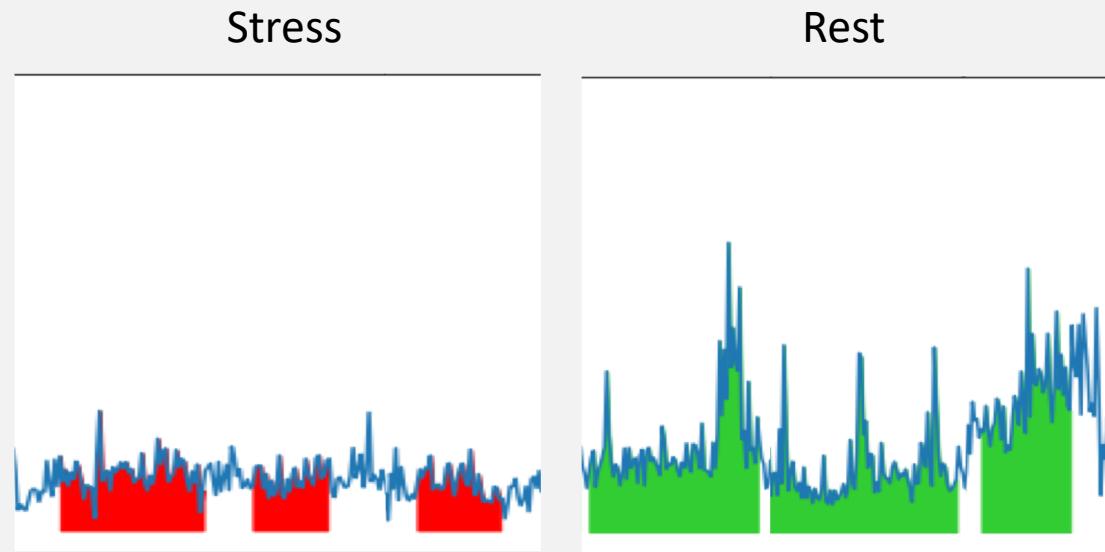
Predicting stressors

Feature construction:

- Captured rolling 3 - 5 min windows
- Calculated:
 - Mean HRV
 - Mean Actigraphy Vector Magnitude

Label:

- Stress = Exercise, Alcohol, Smoking
- Rest = Laying Down, Sitting



Predicting stressors

Random Forest Classifier

accuracy = 0.86

pos. Class Precision = 0.84

pos. Class Recall = 0.87

Positive Class = Stress: Exercise, alcohol, smoking

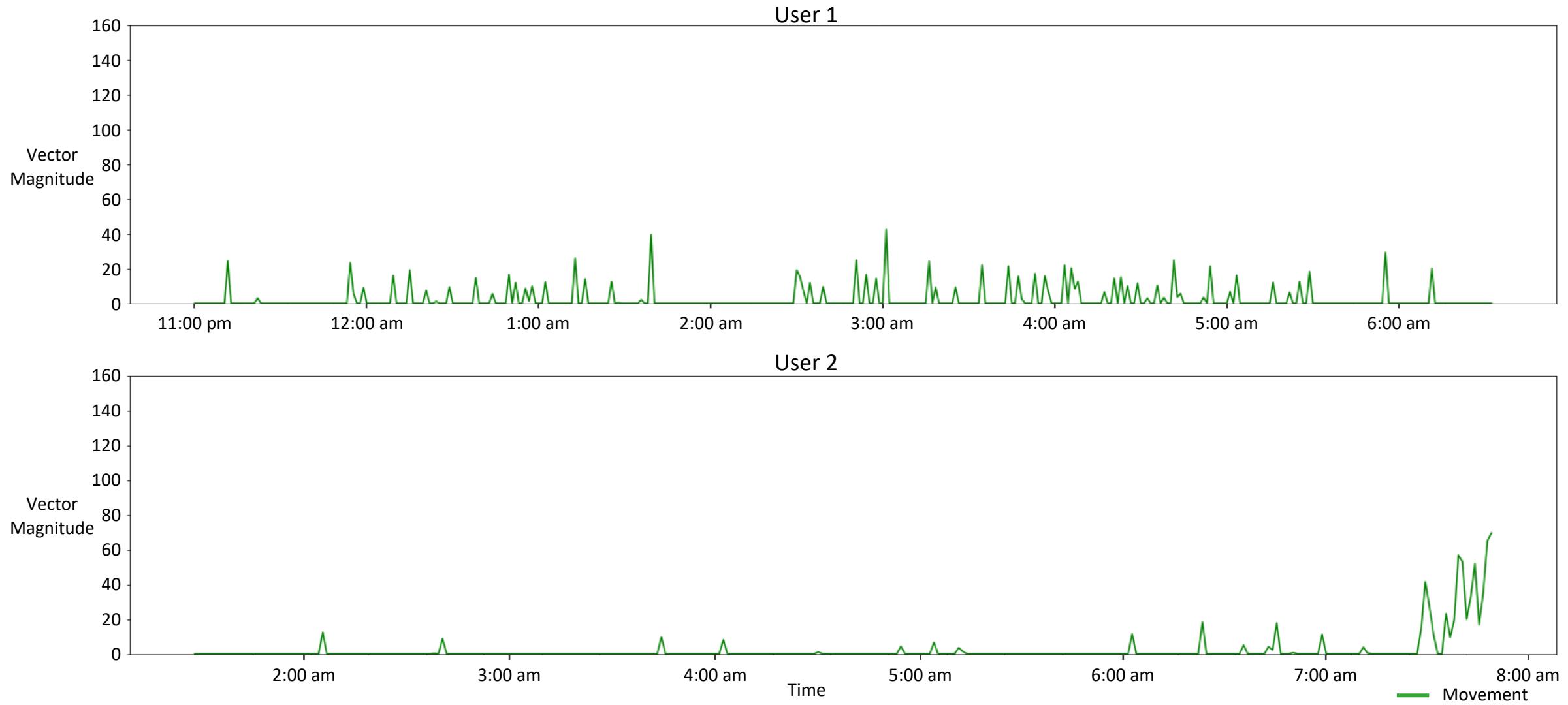
Negative Class = Rest: Laying down, sitting

Confusion Matrix

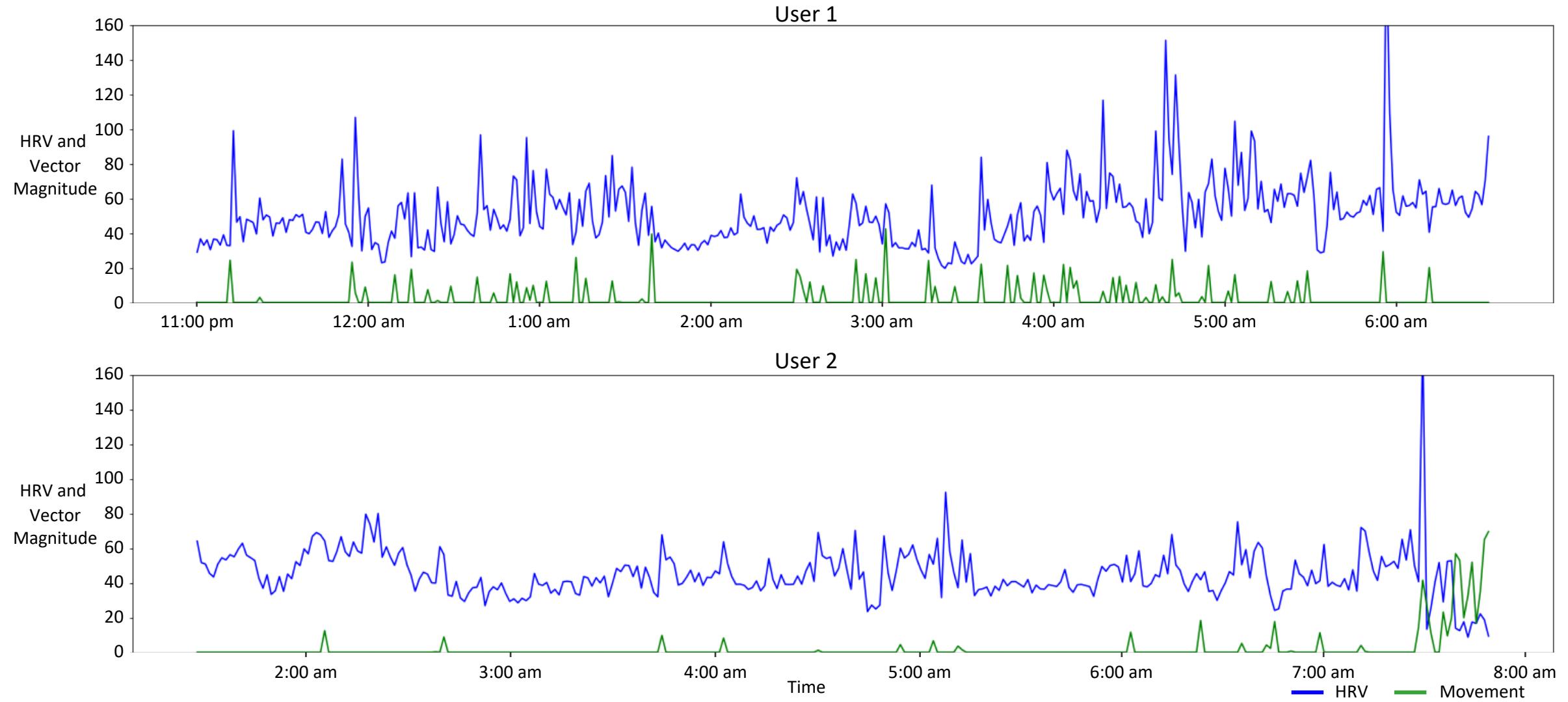
		Prediction	
		Rest	Stress
Actual	Rest	117	22
	Stress	17	118

Aim 2: Use HRV to predict sleep disturbance

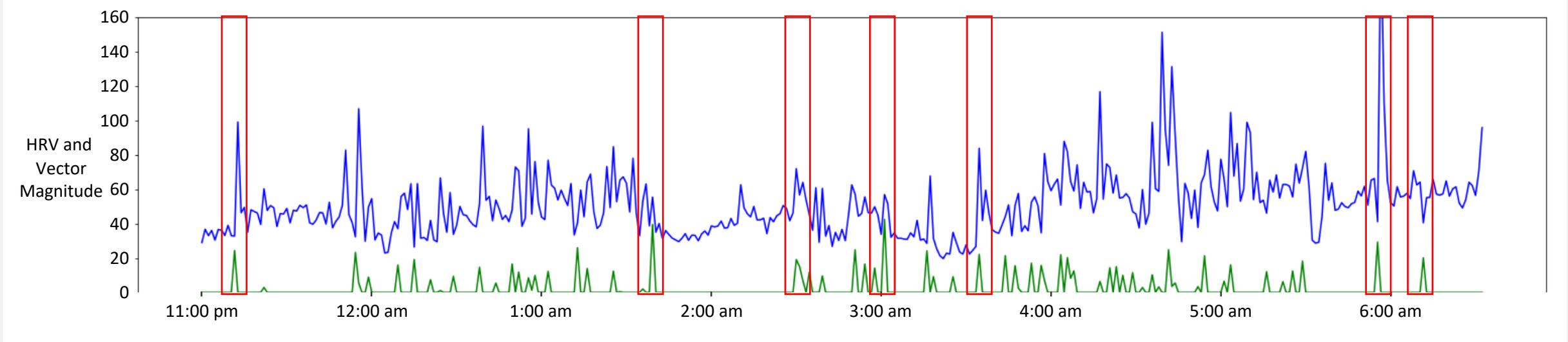
Accelerometry identifies movement during sleep



HRV changes reflect movement during sleep



Can HRV identify sleep disturbances?



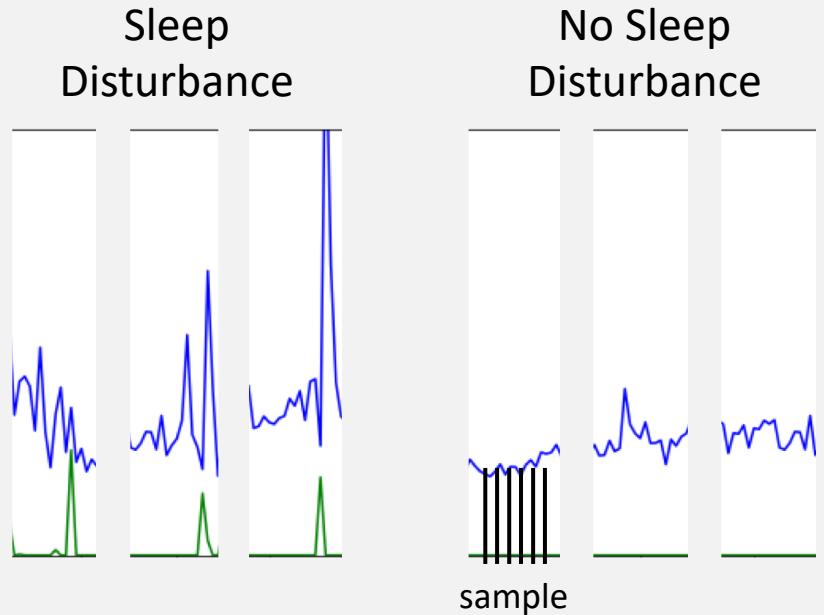
Predicting sleep disturbance

Feature construction:

- Captured rolling 10 min windows
- Sampled 6 x 1 min periods and calculated:
 - Mean HRV
 - Mean HR

Label:

- Sleep Disturbance = Movement in last minute of interval
- No Sleep Disturbance = No movement during interval



Predicting sleep disturbance

Random Forest Classifier

accuracy = 0.89

pos. Class Precision = 0.87

pos. Class Recall = 0.91

Positive Class = Sleep Disturbance

Negative Class = No Sleep Disturbance

Confusion Matrix

		Prediction	
		No Sleep Disturbance	Sleep Disturbance
Actual	No Sleep Disturbance	794	130
	Sleep Disturbance	85	883

Summary

Heart rate data is sufficient to identify disturbances during sleep with high accuracy

HRV together with Actigraphy can distinguish between stressful and restful periods during the day

Next Steps...

Normalize HRV to movement to help better identify stressors vs changes in movement