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Timing and Sequence Matter: Investigating the Relationship between Sleep and Day-time Events

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Outline of Research Project

Background

The effect of time-of-day has been well-studied in sports science surrounding human physical performances. Yet it is not clear if the effect of time-of-day also correlates to sleep quality.

Hypothesis: the timing and sequence of day-time events, in addition to the events per se, may have an impact on our sleep.

Objective: to investigate the relationships between night sleep quality and the timing and sequential patterns of day time events

Research Questions

Investigating relationship between sleep and day-time events

1. Measuring sleep

Despite of the convenience of consumer sleep tracking devices, do they produce valid results?

2. Measuring day-time events

How to reduce the burden of events logging in studying daily activities?

3.Modelling relationships

How is sleep associated to the temporal and sequential patterns of diurnal events?

Impact: new data collection approach for non-invasive longitudinal studies; new knowledge on human sleep

WP1: Validation of Consumer Wearable Sleep Tracking Devices

Methodology

1. Data collection

23 healthy participants (14 males, 21~30 years)

Fitbit Charge 2 + medical 1-channel EEG

Sleep tracking for 3 nights at home

2. Data analysis

Epoch-wise (30s) comparison → 4 X 4 confusion matrix
Pearson correlation coefficients → accuracy predictors

Results

1. Confusion matrix

Medical / Fitbit	Wake	Light	Deep	REM
Wake	**38%±20%**	3%±2%	3%±11%	5%±6%
Light	48%±19%	**69%±8%**	30%±24%	32%±20%
Deep	6%±11%	22%±70%	**64%±30%**	3%±9%
REM	8%±7%	6%±6%	3%±8%	**60%±25%**

2. Accuracy predictors

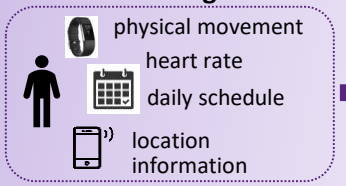
Lower **ratio of NREM** and higher **ratio of REM** are associated to higher rate of correct detection of light epochs and lower rate of mis-classifying light epochs as REM.

Higher **SE**, **TST** and longer **N2** are associated to higher rate of correct detection on REM epochs and lower rate of mis-classifying deep and REM epochs as light sleep.

WP2: Development of Low-burden Events Logging and Sensing Platform

Methodology

Pervasive sensing + machine learning



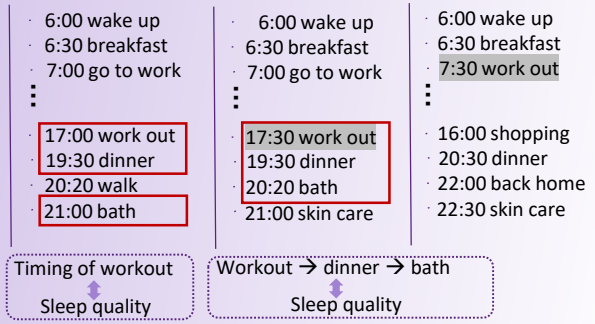
Expected Outcomes

A platform that automatically detects significant diurnal events based on multimodal sensing data

WP3: Data Mining on Relationship between Sleep and Diurnal Events

Methodology

Sequential pattern mining



Expected Outcomes

Better understanding on the temporal and sequential patterns of lifestyle that associate to good/poor sleep