Social Sensing for Epidemiological Behavior Change

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Paper Overview

2010

2011

Social Sensing for Epidemiological Behavior Change

Social Sensing: Obesity, Unhealthy Eating and Exercise in Face-to-Face Networks

Using Social Sensing to Understand the Links Between Sleep, Mood, and Sociability

Goal

- Understand connection between behavior patterns and physical and mental health syndroms
    - Possibility for better epidemiological models
    - Basis for early-warning systems

- Use mobile phone sensors to gather data

- Detection and classification of health status without need to „see" the person

SIR Model

- Transition from Susceptible to Infectious to Recovered
- Expressed by a set of differential equations
- Uses constant number of contacts to other people
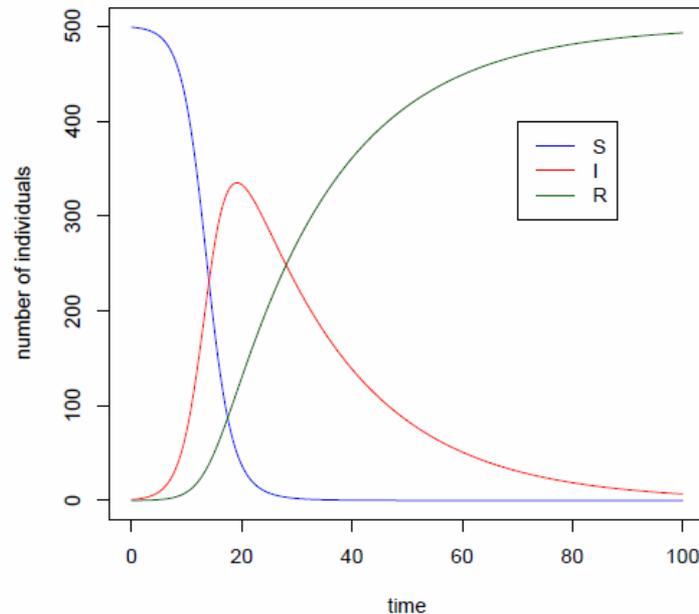
Method

- Study with 70 residents of an undergraduate hall
  - Collected data for 2 months

- Social interaction data from mobile phones
  - Call data records
  - SMS logs
  - Bluetooth co-location sensing
  - WLAN-based location sensing

- Use of a daily survey for symptom data
  - Questions designed by an epidemiologist
  - Smartphone unusable if survey not answered after 3 reminders
  - 63% completion rate

Privacy

- Problem of Privacy when collecting a dataset like this
  - Approval by the Institutional Review Board (IRB)
  - Sensing scripts captures only hashed identifiers
  - Collected data is secured and anonymized before use

Results: Behavior Change

Effects of Fever:
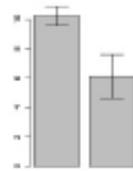
(a) Late night early morning calls and SMS decrease **
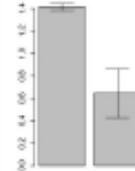
(b) Late night morning Bluetooth counts and entropy decrease*
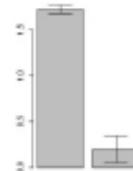
(c) WLAN based entropy with respect to university WLAN APs decreases ***
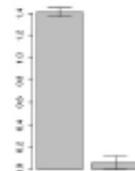
(d) WLAN Entropy with respect to external WLAN APs decreases ***

Results: Sympton Classification

- Use of K-nearest-neighbor clustering to infer 4 classes of symptoms
  - stress + depression
  - runny nose + sore throat
  - fever + influenza
  - runny nose + sore throat + fever + influenza

- Classification using a Bayesian-network classifier with MetaCost

- Overall prediction accuracy of 60-80%

Results: Forecasting

Highest ranked PSI (Phase Slope Index) relationships:
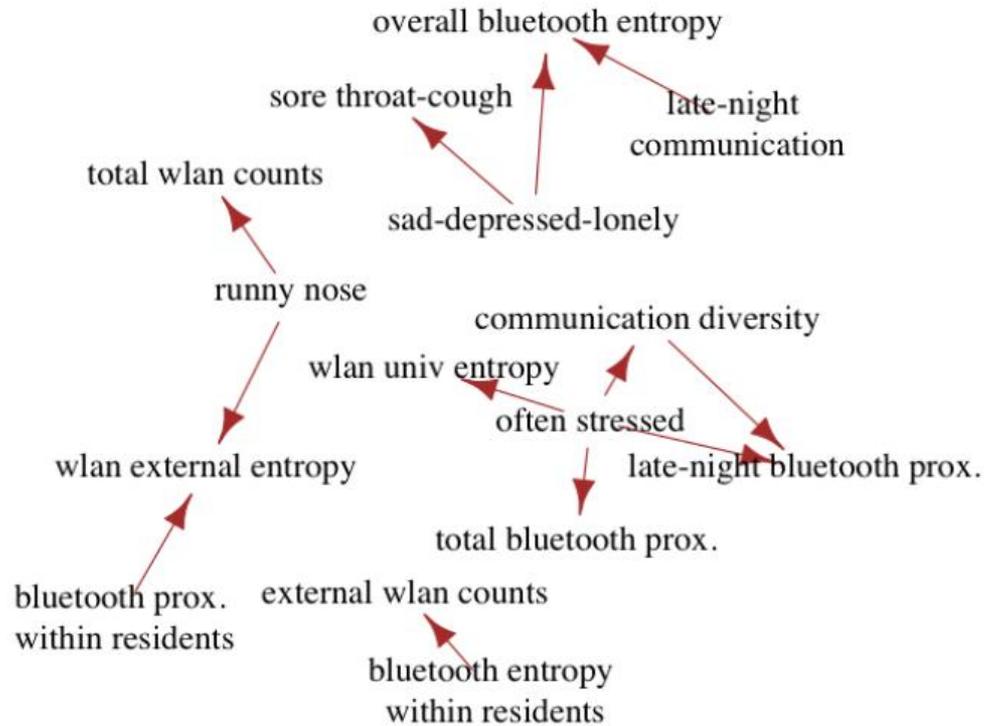
Ratings/Reviews

- 10 Reviews with average of 1.7
- Limitations of Paper:
  - Assumption that the samples are independent
  - Does not consider behavior changes due to external events
  - Do people still answer the survey when ill or stressed?

Additional Paper 1

Social Sensing: Obesity, Unhealthy Eating and Exercise in Face-to-Face Networks (2010)

- Goal:
  - Understanding the connection between social interactions and behavior considering eating and exercise

- Method:
  - Same dataset used as for main paper
  - Regular surveys about weight, eating habits and exercise

Additional Paper 1 cont.

- Results:
  - Most significant correlation of BMI increase and exposure to people with substantial weight gain
  - Exposure to overweight/obese people has influence on BMI
  - Exposure to unhealthy eating habits influences eating habits
  - No correlation with exposure to people with weight loss and healthy diet

- Limitations:
  - Does not consider other factors like stress, illness, etc.
 - No interpretation of why these results occur

Additional Paper 2

Using Social Sensing to Understand the Links Between Sleep, Mood, and Sociability (2011)

- Goals:
  - Learn more about the associations between sleep, mood and sociability
  - Improve public awareness of connections
  - Set a starting point for behavioral interventions that can improve public health through better social interaction

- Method:
  - Study in young-family residential living community
  - Duration of 1 month, 54 participants
  - Social and behavioral software sensing platform „Funf" used
 - Regular surveys

Additional Paper 2 cont.

- Results:

Sleep duration for good and poor mood

Sleep duration and previous day's sociability

Additional Paper 2 cont.

- Results:

Sleep duration and following day's sociability

Sleep Duration
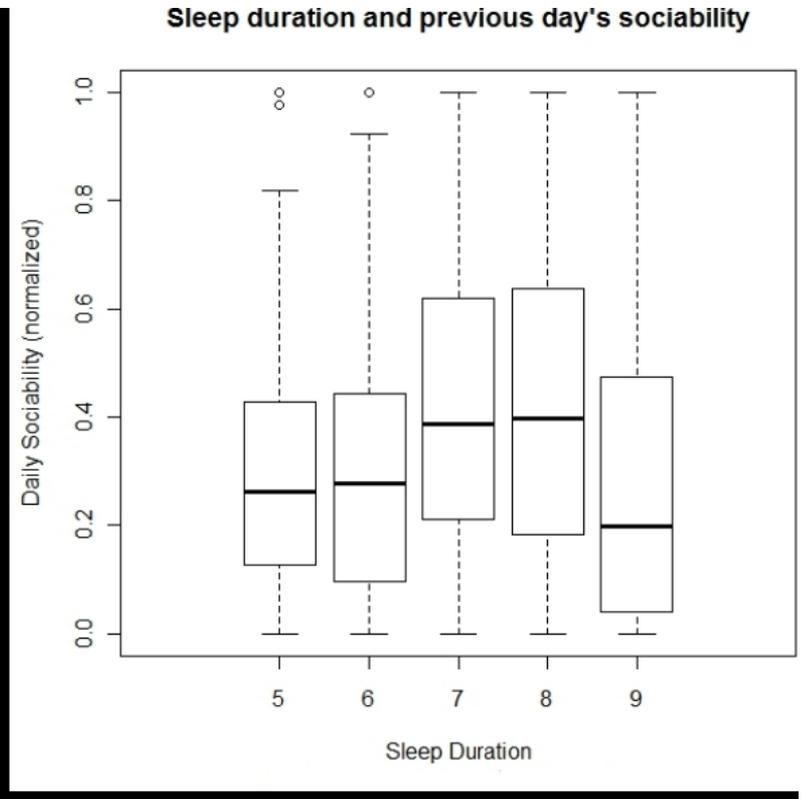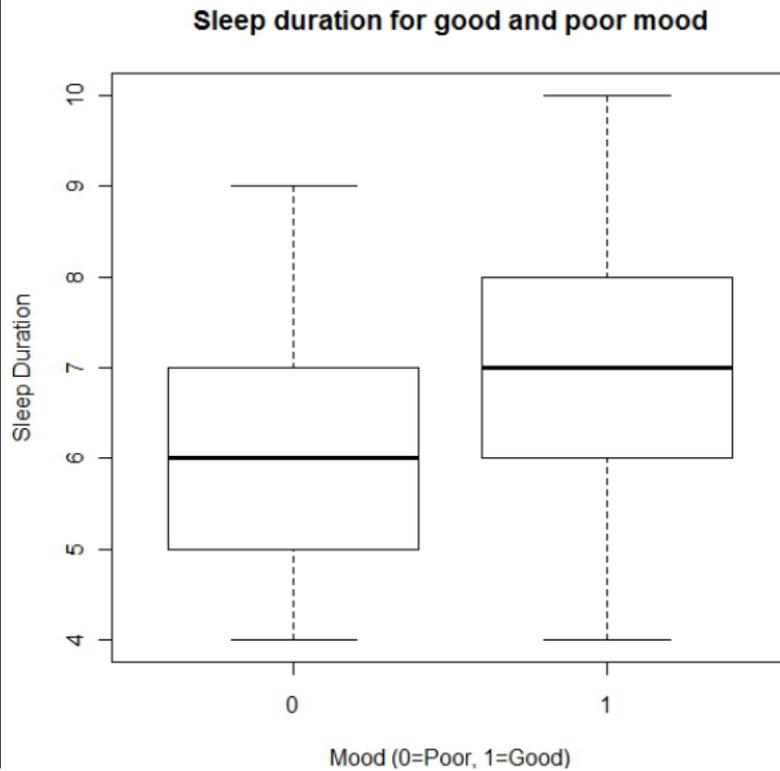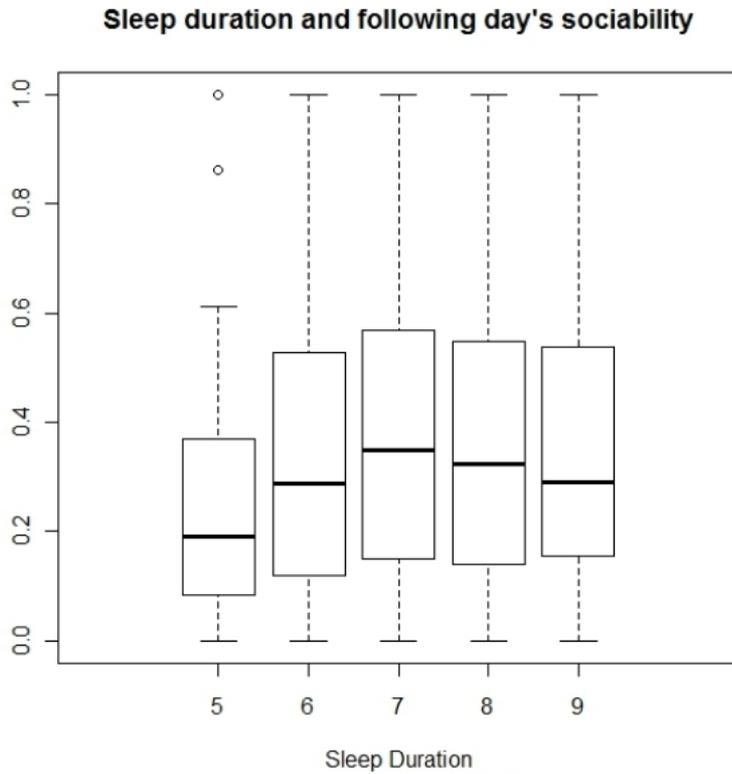
Contribution

- Use of off-the-shelf phones for social sensing

- Convincing results on connections in different fields:
  - Epidemiology and behavior changes
  - Sleep, Mood and Sociability
  - Obesity, Unhealthy eating, Exercise and face-to-face networks

- Starting point for new epidemiological models considering changes in behavior

- Showing the possibility on inexpensive personal health monitoring

Future Work

- Applications to predict illness based on gathered data
- Give people advice for healthier lifestyle
- Use of findings for a new epidemiologic model
- Application for automatic information of doctors, etc.
  - Privacy issues?

Discussion

- Does one model for epidemiological behavior change hold for all different cultures?

- What future applications could you imagine using the proposed solutions?

- What privacy implications does it have if such applications are widely used?

- What's the impact of communication channels not covered by the study such as WhatsApp, Skype, etc.?