CS 4518 Mobile and Ubiquitous Computing

Computing
Lecture 17: Smartphone Sensing Apps: StudentLife

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StudentLife

College is hard…

Rui Wang, Fanglin Chen, Zhenyu Chen, Tianxing Li, Gabriella Harari, Stefanie Tignor, Xia Zhou, Dror Ben-Zeev, and Andrew T. Campbell. 2014. StudentLife: assessing mental health, academic performance and behavioral trends of college students using smartphones. In *Proceedings of the 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing* (UbiComp '14)

- **Lots of Stressors in College**
  - Lack of sleep
  - Exams/quizzes
  - High workload
  - Deadlines
  - 7-week term
  - Loneliness (e.g. freshmen, international students)

- **Consequences**
  - Burnout
  - Decline in psychological well-being
  - Academic Performance
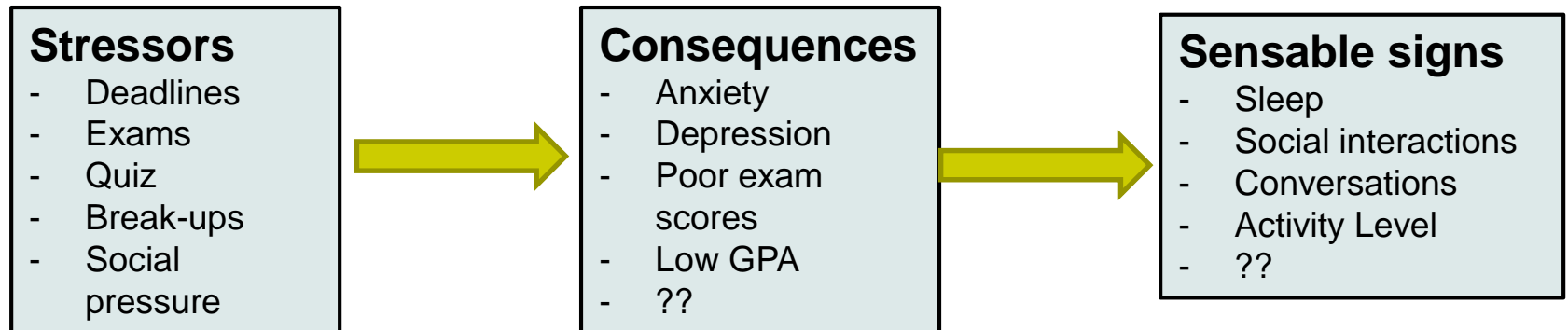
Students who Need Help Not Noticed

- Many stressed/overwhelmed students not noticed
  - Even worse in large classes (e.g. intro classes with 150-200 students)
  - Many do not seek help
  - E.g. < 10% of clinically depressed students seek counseling

# StudentLife: Continuous Mobile Sensing

- **Research questions:** Are sensible patterns (sleep, activity, social interactions, etc) reliable indicator of suffering student (e.g. low GPA, depressed, etc)?

Stressors
- Deadlines
- Exams
- Quiz
- Break-ups
- Social pressure

→

Consequences
- Anxiety
- Depression
- Poor exam scores
- Low GPA
- ??

→

Sensable signs
- Sleep
- Social interactions
- Conversations
- Activity Level
- ??

StudentLife Continuous Sensing App

- Use smartphone sensing to assess/monitor student:
  - Psychological well-being (depression, anxiety, etc)
  - Academic performance
  - Behavioral trends, stress patterns as term progresses
- Demonstrates strong correlation between sensed data and clinical measures of mental health (depression, loneliness, etc)
- **Shows smartphone sensing COULD be used to give clinically valid diagnoses?**
  - Get clinical quality diagnosis without going to clinic
- Pinpoint factors (e.g. classes, profs, frats) that increase depression/stress
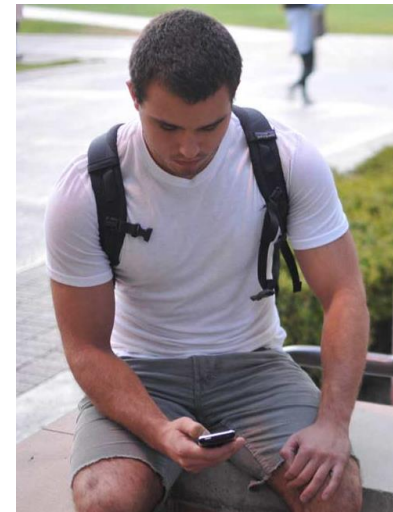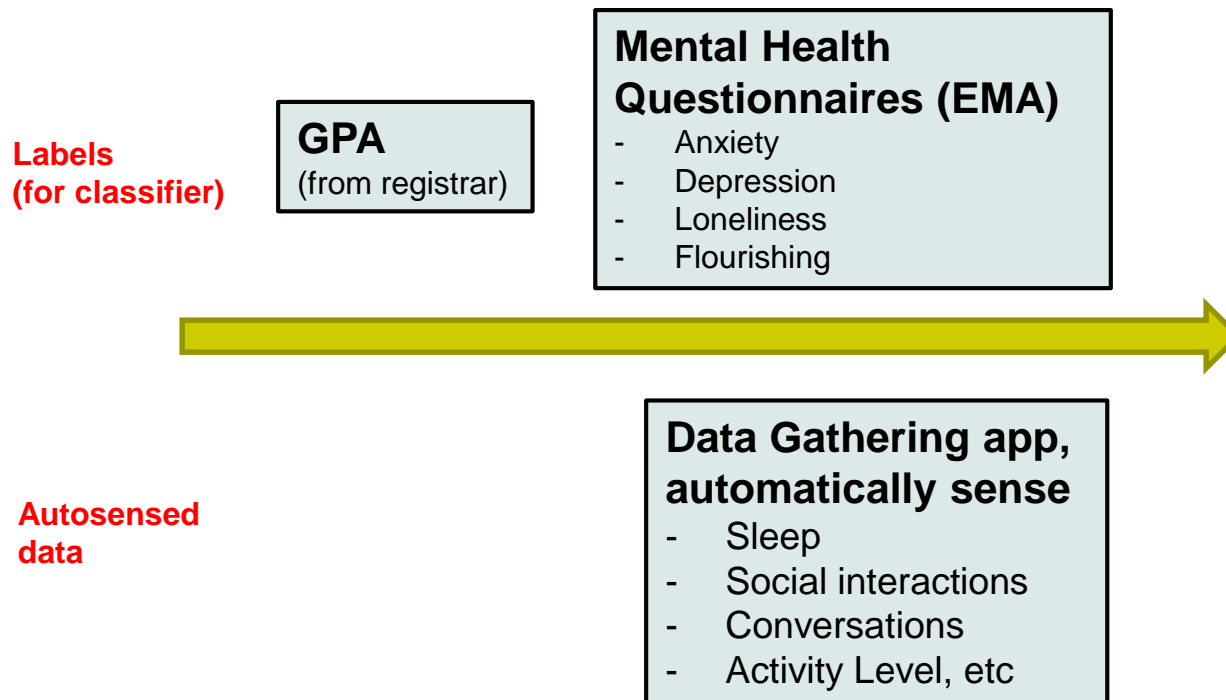
Potential Uses of StudentLife

- Student planning and stress management
- Improve Professors' understanding of student stress
- Improve Administration's understanding of students' workload
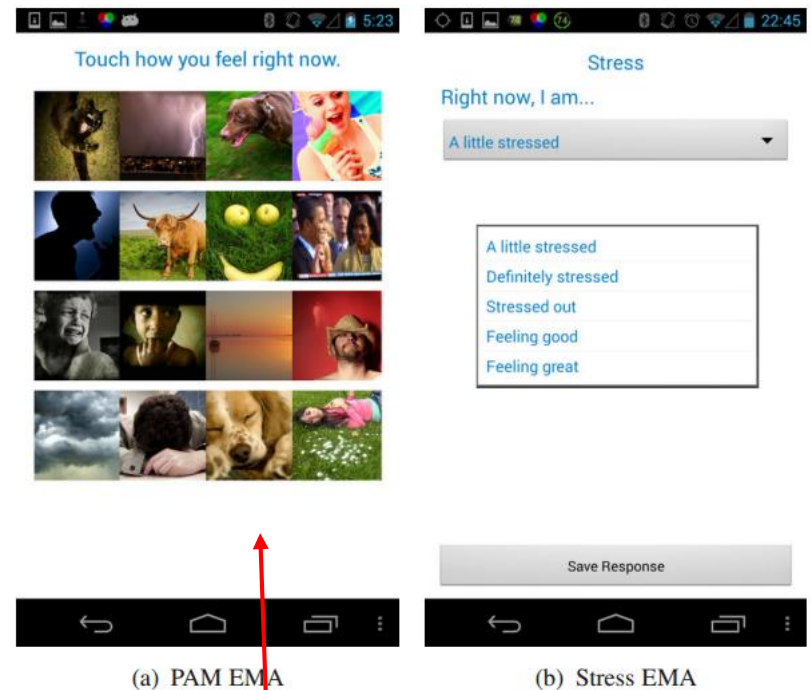
General StudentLife Approach

- Semester-long Study of 49 Dartmouth College Students
  - Continuously gather sensible signs (sleep, activity level, etc)
  - Administer mental health questionnaires periodically as pop-ups (called EMA)
  - Also retrieve GPA, academic performance from registrar
- **Labeling:** what activity, sleep, converstation level = high depression

Labels (for classifier)

GPA
(from registrar)

Mental Health Questionnaires (EMA)
- Anxiety
- Depression
- Loneliness
- Flourishing

Autosensed data

Data Gathering app, automatically sense
- Sleep
- Social interactions
- Conversations
- Activity Level, etc

Specifics: Data Gathering Study

- **Entry and exit surveys at Semester start/end**
  - on Survey Monkey
  - E.g. PHQ-9 depression scale

- **8 MobileEMA and PAM quizzes per day**
  - Stress
  - Mood (PAM)

- **Automatic Sensed data**
  - **Activity Detection:** activity type, WiFi's seen
  - **Conversation Detection:**
  - **Sleep Detection:** duration

Touch how you feel right now.

(a) PAM EMA

Stress

Right now, I am...

A little stressed

A little stressed
Definitely stressed
Stressed out
Feeling good
Feeling great

Save Response

(b) Stress EMA

PAM: Pick picture depicting your current mood

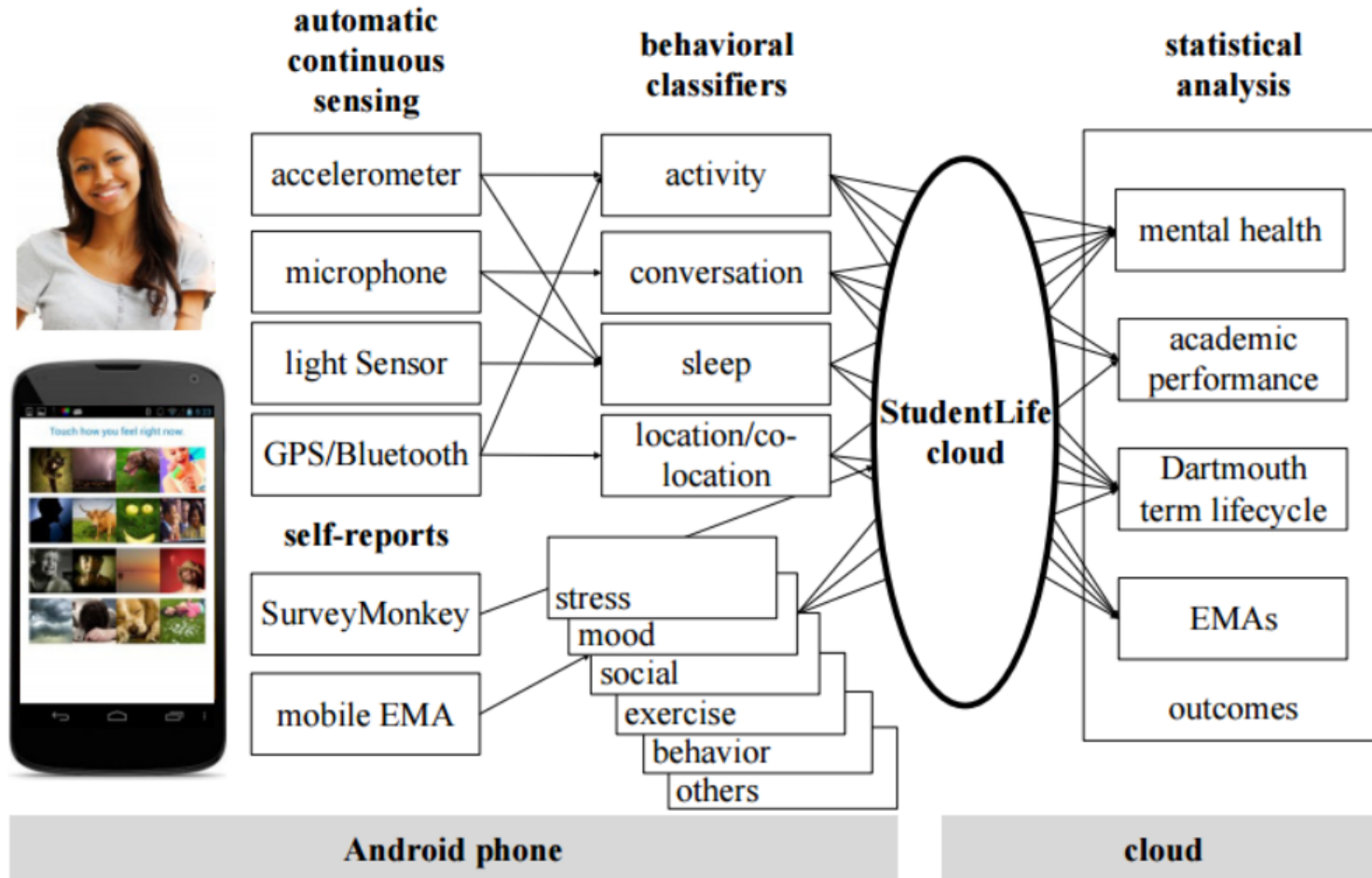# StudentLife Data Gathering Study Overview

Figure 2. StudentLife app, sensing and analytics system architecture.

Clinical Mental Health Questionnaires

- MobileEMA popped up mental health questionnaires (widely used by psychologists, therapists, etc)

  - **Patient Health Questionnaire (PHQ-9)**
    - Measures depression level

  - **Perceived Stress Scale**
    - Measures Stress level

  - **Flourishing Scale**
    - Measures self-perceived success in relationships, self-esteem, etc

  - **UCLA loneliness survey**
    - Measures loneliness (common in freshmen, int'l students)

Stress

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(b) Stress EMA

Study Details

- 60 Students started study
  - All enrolled in CS65 Smartphone Programming class
  - 12 students lost during study (NR'd class?)
  - 30 undergrad/18 graduate level
  - 38 male/10 female
- Incentives given to study participants
  - StudentLife T-shirt (all students)
  - **Week 3 & 6:** 5 Jawbone UPs (like fitbit) to 5 in raffle
  - **End of study:** 10 Google Nexus phones in raffle
- 10 weeks of data collection

Some Findings

- Fewer conversations or co-locations correlate with
  - Higher chance of depression

- Higher stressed correlated with
  - Higher chance of depression

- More social interactions correlated with
  - Higher flourishing, GPA scores
  - Lower stress

- More sleep correlates with
 - Lower stress

Findings (cont'd)

- Less sleep?
  - Higher chance of depression

- Less activity?
  - More likely to be lonely, lower GPAs

- No correlation between class attendance and academic performance (Hmm…)

- As term progressed:
  - Positive affect and activity duration plummeted
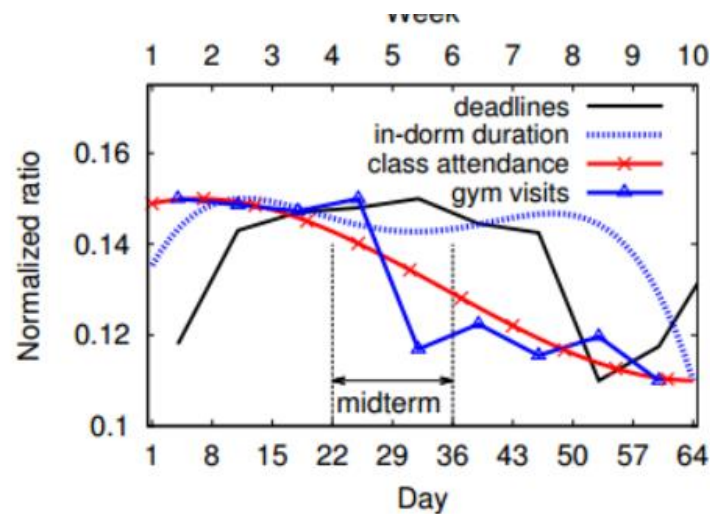
Findings (cont'd)

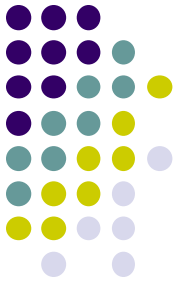- Plotted total values of sensed data, EMA etc for all subjects through the term
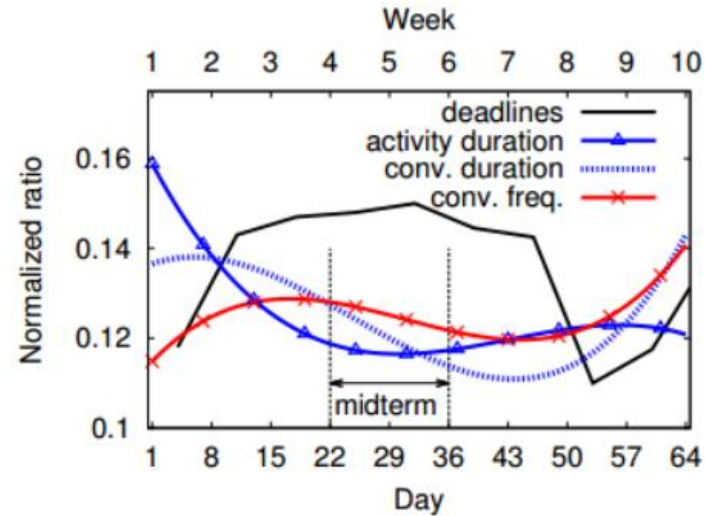
(b) Automatic sensing data
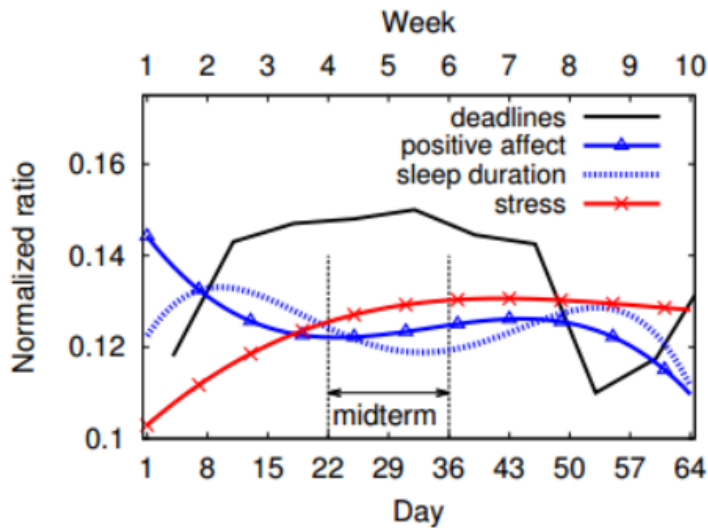
(a) EMA and sleep data

(c) Location-based data

Study Limitations/Trade Offs

- ## Sample Selection
  - Voluntary - CS65 Smartphone Programming class (similar to CS 4518)

- ## User participation
  - **Burden:** Surveys, carrying phone
  - Disinterest (Longitudinal study, EMA annoyance)

- ## Lost participants

- ## Sleep measurement inaccuracy
  - Naps

Discussion

- Expand to other colleges
  - Semester vs 10 week vs 7 week term
  - Similar results?

- Privacy concerns