StudentLife

Andrew T. Campbell — Dartmouth College

Conference on Web and Social Media (ICWSM 2015), Oxford, May 2015

student life is complex

what happens when life throws you a “googly”?

EDUCATION

More College Freshmen Report Having Felt Depressed

By ALAN SCHWARZ FEB. 5, 2015

High numbers of students are beginning college having felt depressed and overwhelmed during the previous year, according to an annual survey released on Thursday, reinforcing some experts' concern about the emotional health of college freshmen.

The survey of more than 150,000 students nationwide, "The American Freshman: National Norms Fall 2014," found that 9.5 percent of respondents had frequently "felt depressed" during the past year, a significant rise over the 6.1 percent reported five years ago. Those who "felt overwhelmed" by schoolwork and other commitments rose to 34.6 percent from 27.1 percent.

Conducted by the Cooperative Institutional Research Program at the


11% of Dartmouth students were diagnosed with depression in 2014.
12% reported depression has having an impact on academic performance
28% have seen a mental health counselor in 2014


BIG
Questions

why do students burn out, drop classes, do poorly, even drop out of college when others excel?

what is the impact of stress, mood, workload, sociability, sleep and mental health on academic performance?

is there a set of behavioral trends or signature to the semester?

most faculty are unaware that their students are struggling beyond grades

Instructor _____

Date: _____

Dean Lisa Thum

Please return to Hinman Box 6064 by **February 9, 2015**.

REPORT OF MIDTERM STANDING

The Office of the Dean of Undergraduate Students is in the process of assessing the current academic progress for the student listed below. An estimated grade from you, along with any relevant comments, would be especially helpful.

NOTE: Requests of this sort are made for a variety of reasons, and do not necessarily imply any deficiency in the student's current or past academic work.

Professor: **Campbell, Andrew T.**

Midterm grade_____ ☐ Actual ☐ Estimated

☐ Check here if grade not yet assigned

Comments:

Instructor _____

Date: _____

Dean Larissa Hopkins

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Student name

Course:

Professor:

Midterm grade _____ ☐ Actual ☐ Estimated

☐ Check here if grade not yet assigned.

Comments.

Instructor

Instructor _____

Date: _____

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REPORT OF MIDTERM STANDING

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Student name:

Course:

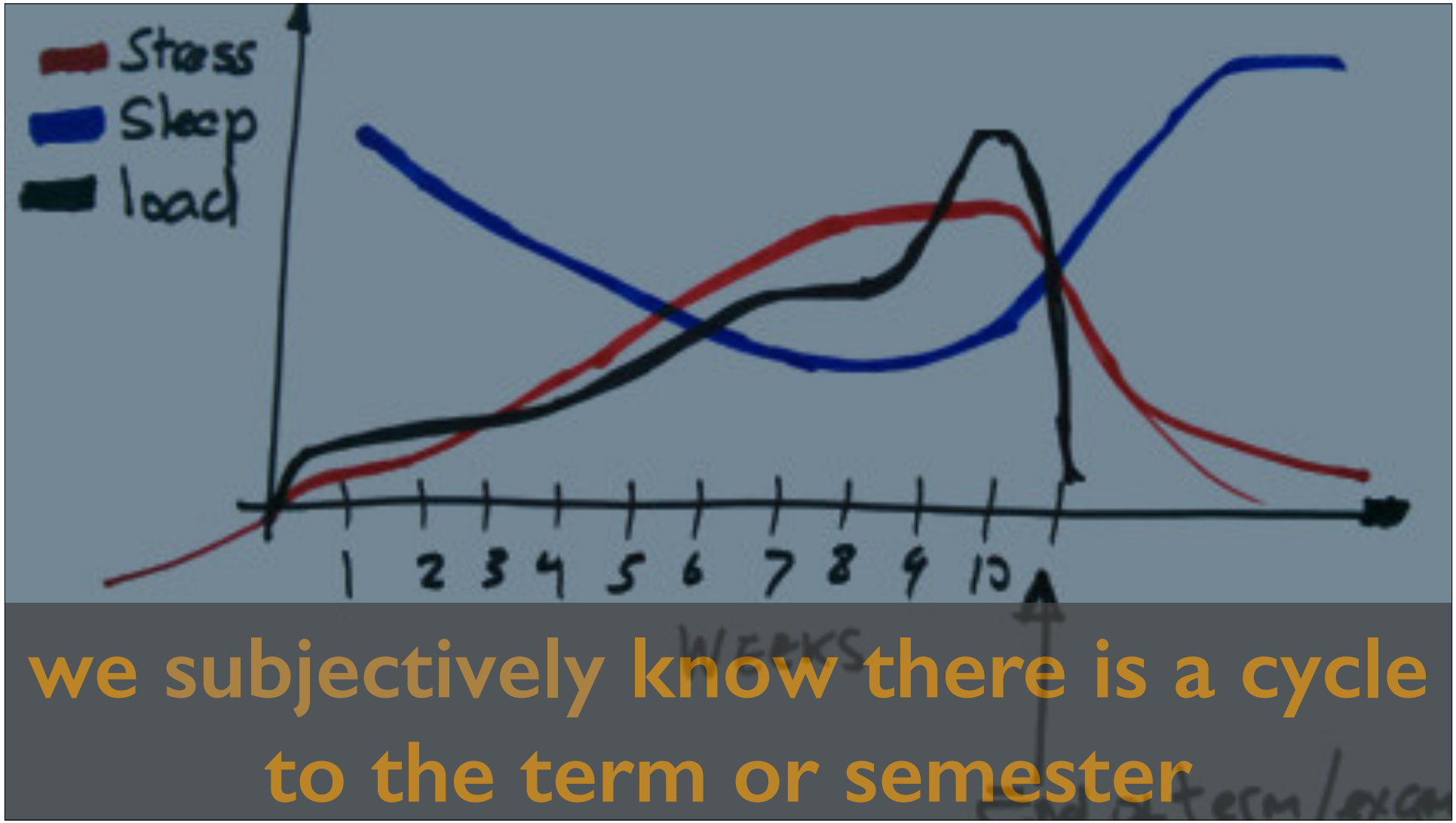
Professor: **Campbell, Andrew**

Midterm grade _____ ☐ Actual ☐ Estimated

☐ Check here if grade not yet assigned.

Comments:

Instructor _____



we subjectively know there is a cycle to the term or semester

but there is no objective data

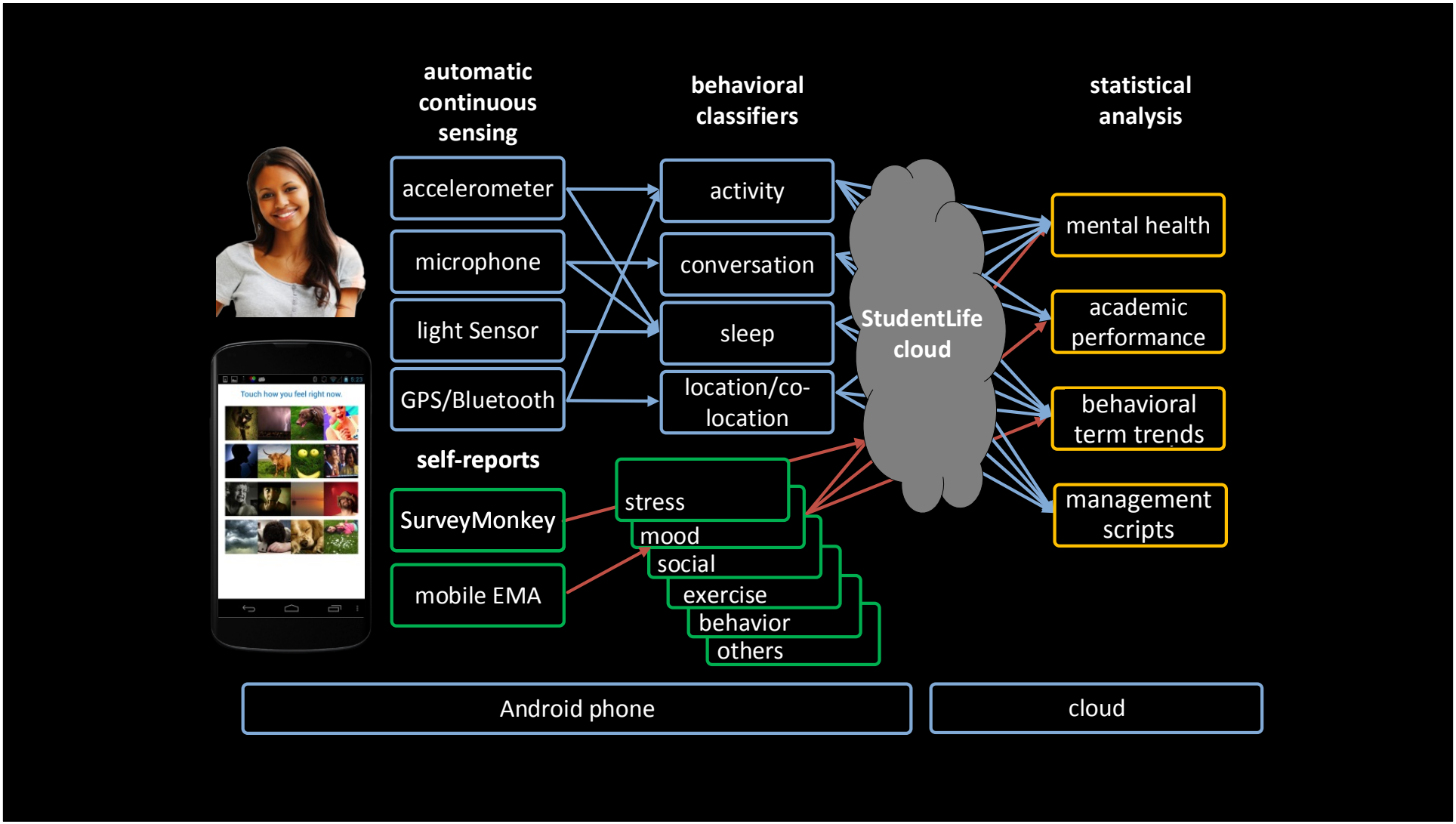
StudentLife study

48 students over 10 week Spring 2013 term

- 10 female, 38 male CS students
- 30 undergraduates, 18 graduates
- 8 seniors, 14 juniors, 6 sophomores, 2 freshmen, 3 Ph.D students, 1 second-year Masters student, and 13 first-year Masters students
- 23 Caucasians, 23 Asians and 2 African-Americans.

sensing system

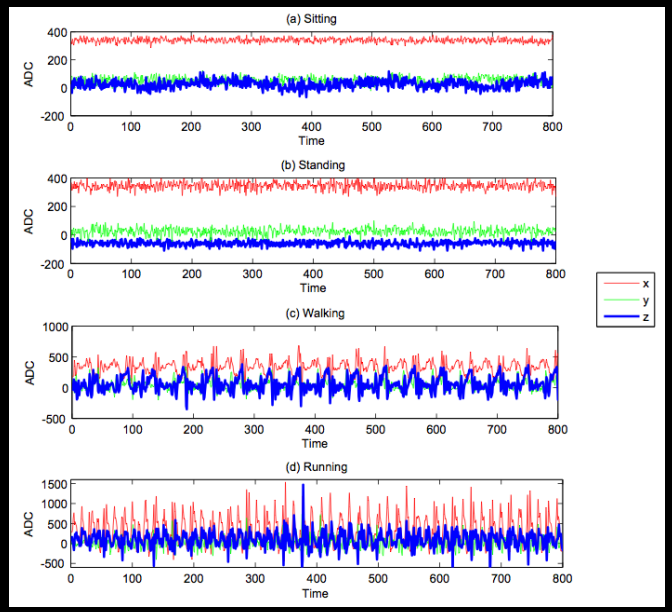

SAMSUN

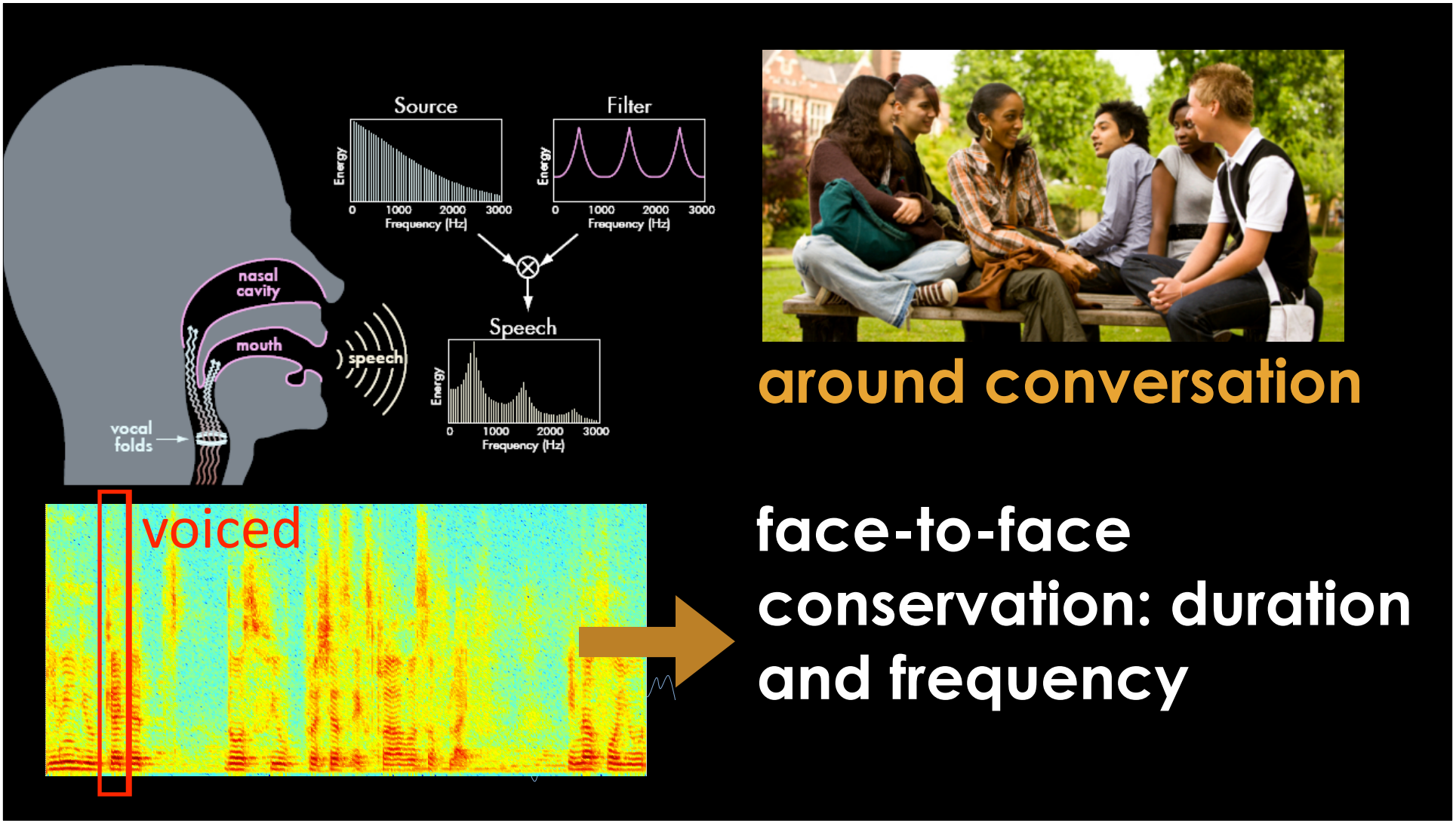

automatic continuous sensing
behavioral classifiers
statistical analysis
accelerometer
microphone
light Sensor
GPS/Bluetooth
activity
conversation
sleep
location/co-location
StudentLife cloud
mental health
academic performance
behavioral term trends
management scripts
self-reports
SurveyMonkey
mobile EMA
stress
mood
social
exercise
behavior
others
Touch how you feel right now.
Android phone
cloud

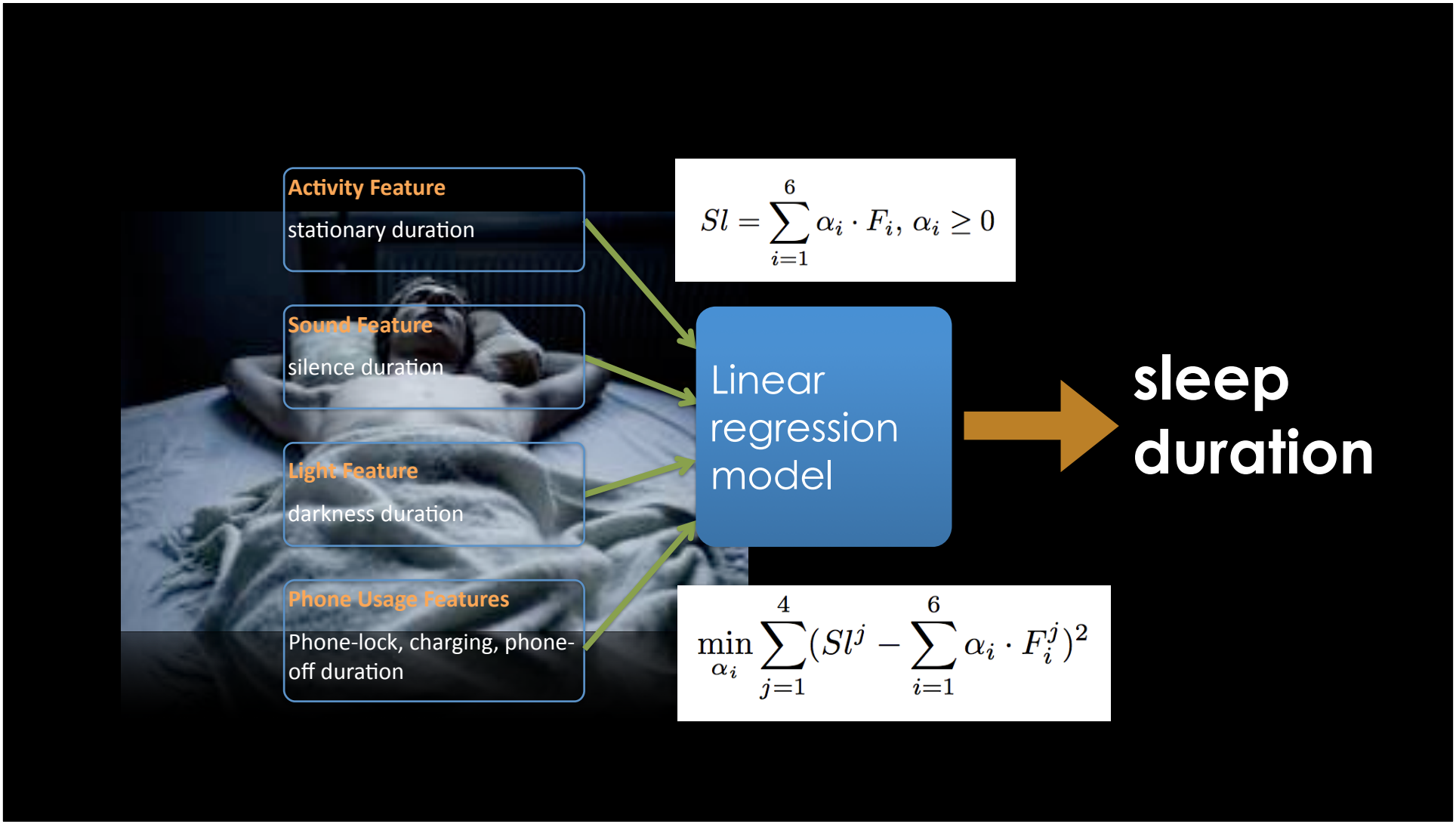
classifiers

activity

- sitting
- standing
- walking
- running



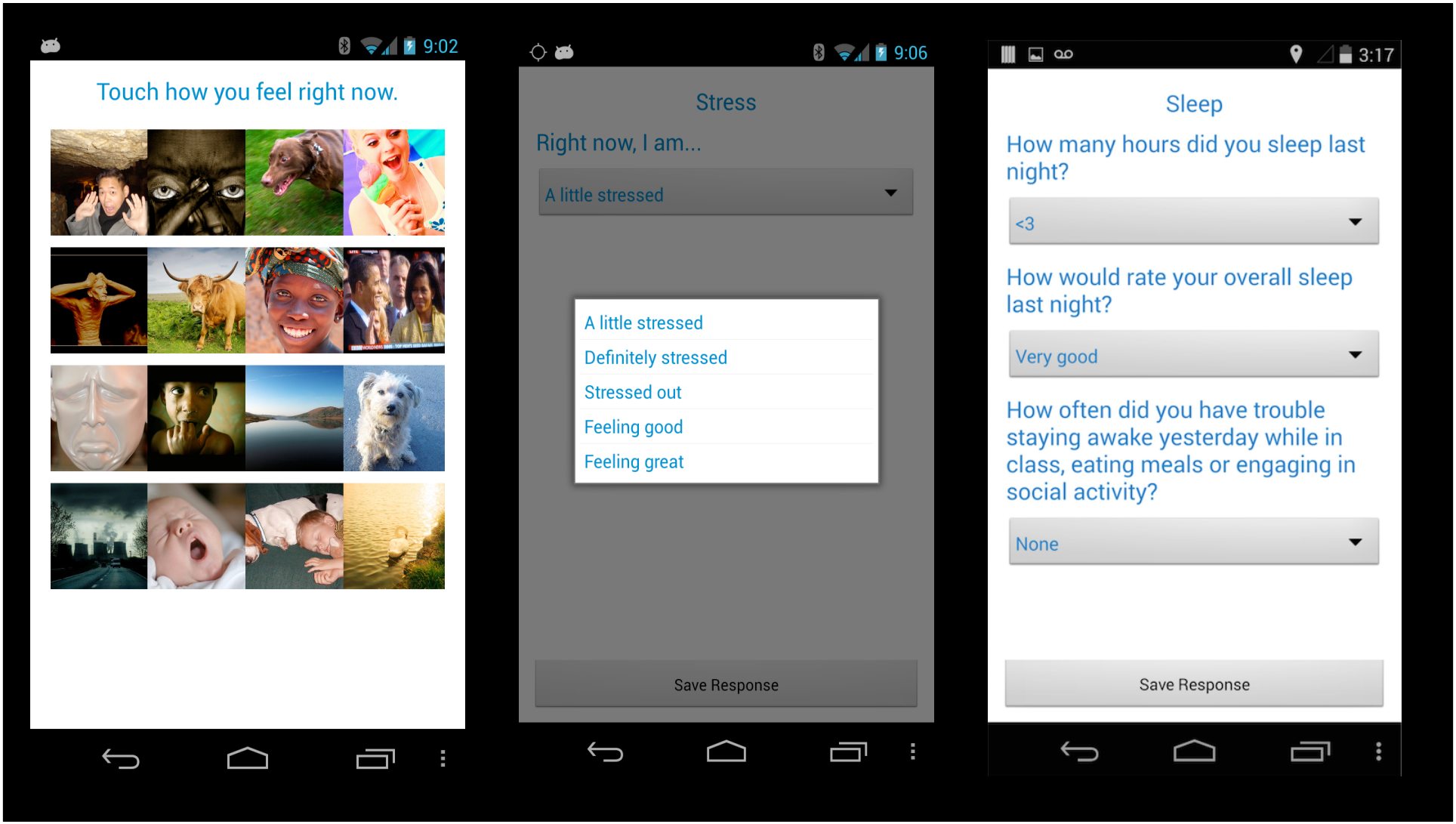

Source
Filter
Energy
0
1000
2000
3000
Frequency (Hz)
nasal cavity
mouth
speech
vocal folds
Speech
voiced
around conversation
face-to-face conservation: duration and frequency

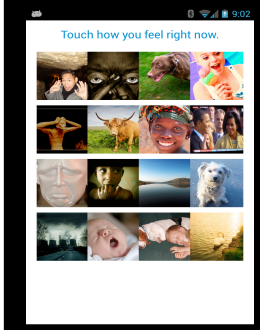

Activity Feature
stationary duration
Sound Feature
silence duration
Light Feature
darkness duration
Phone Usage Features
Phone-lock, charging, phone-off duration
$Sl = \sum_{i=1}^{6} \alpha_i \cdot F_i,\ \alpha_i \geq 0$
Linear regression model
sleep duration
$\min_{\alpha_i} \sum_{j=1}^{4} (Sl^j - \sum_{i=1}^{6} \alpha_i \cdot F_i^j)^2$

we also computed

- activity duration
- outdoor mobility
- indoor mobility
- location and co-location


ecological momentary
assessment (EMA)


9:02
Touch how you feel right now.
9:06
Stress
Right now, I am...
A little stressed
A little stressed
Definitely stressed
Stressed out
Feeling good
Feeling great
Save Response
3:17
Sleep
How many hours did you sleep last night?
<3
How would rate your overall sleep last night?
Very good
How often did you have trouble staying awake yesterday while in class, eating meals or engaging in social activity?
None
Save Response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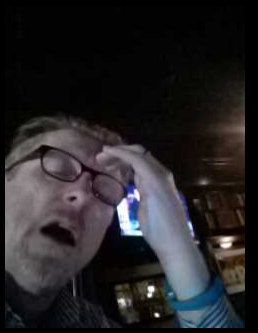

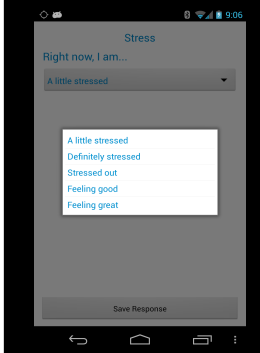
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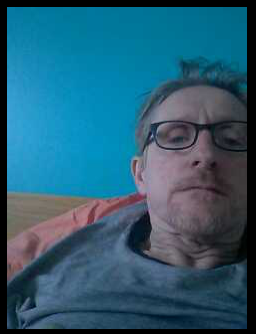
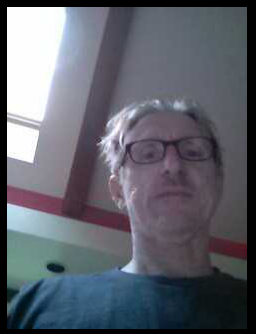
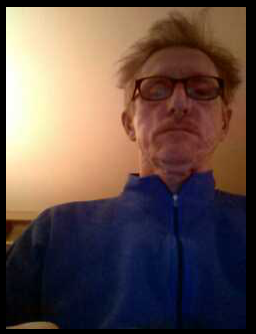
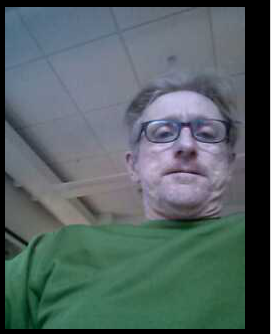
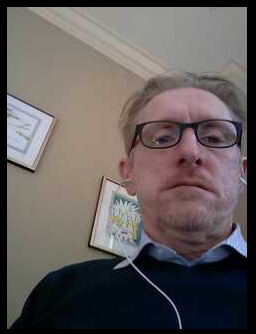


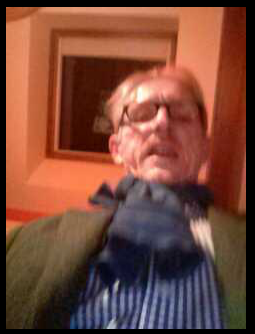





CALUME



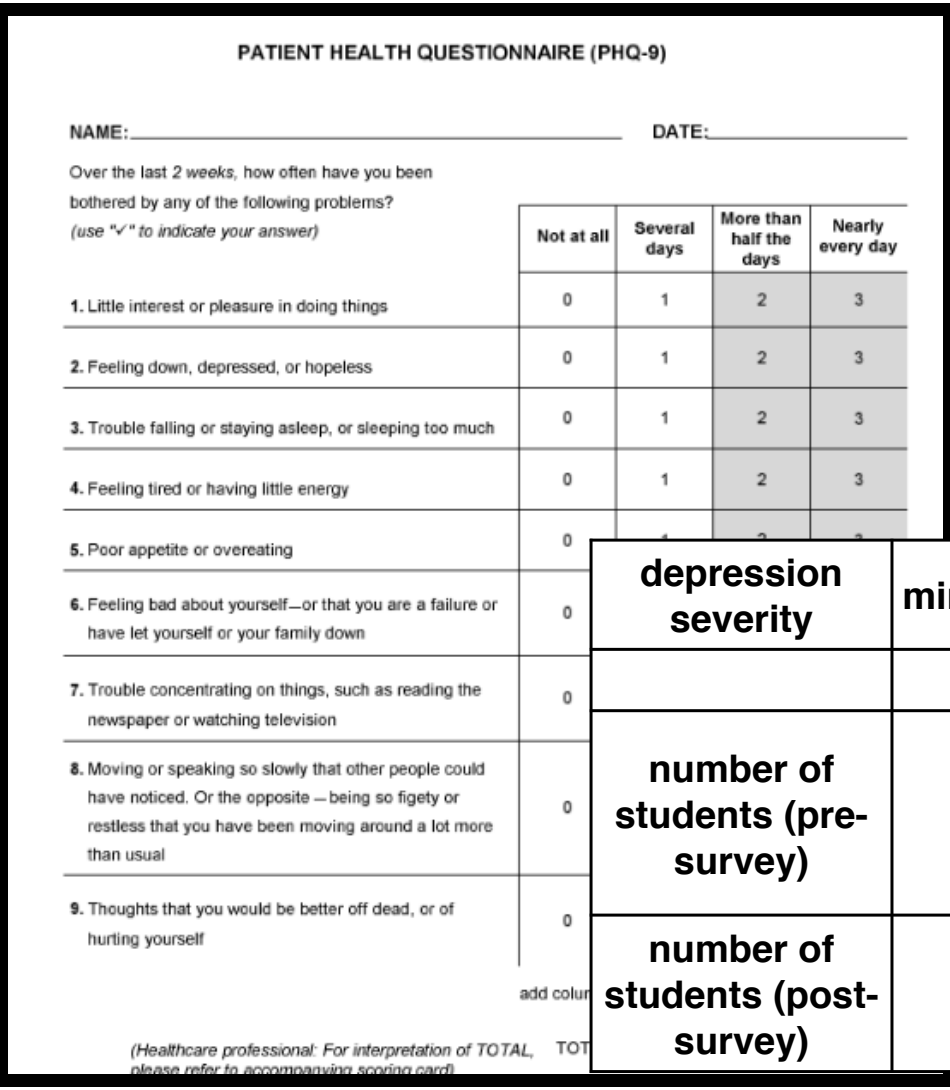




32,000 EMAs

>9000 facelog images

mental health surveys



PATIENT HEALTH QUESTIONNAIRE (PHQ-9)

NAME: _____ **DATE:** _____

Over the last *2 weeks*, how often have you been bothered by any of the following problems?
(use "✓" to indicate your answer)

	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0			
6. Feeling bad about yourself—or that you are a failure or have let yourself or your family down	0			
7. Trouble concentrating on things, such as reading the newspaper or watching television	0			
8. Moving or speaking so slowly that other people could have noticed. Or the opposite — being so figety or restless that you have been moving around a lot more than usual	0			
9. Thoughts that you would be better off dead, or of hurting yourself	0			
		add colur		

(Healthcare professional: For interpretation of TOTAL, please refer to accompanying scoring card) TOT

depression severity	minimal	minor	moderate	moderately severe	severe
	1-4	5-9	10-14	15-19	20-27
number of students (pre-survey)	17	15	6	1	1
number of students (post-survey)	19	12	3	2	2

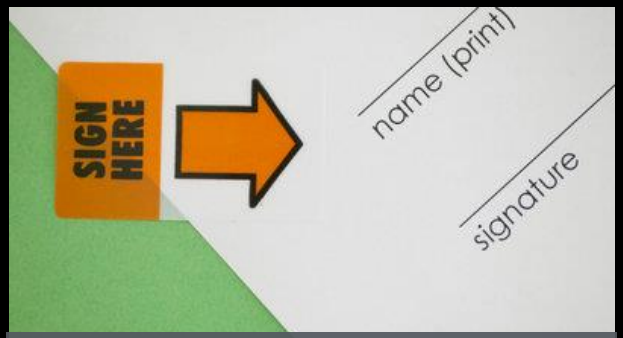
pre-post questionnaires

- depression scale
- perceived stress scale
- loneliness scale
- flourishing scale
- Big 5 (pre only)

study design

recruiting participants

recruiting participants → orientation



consent form

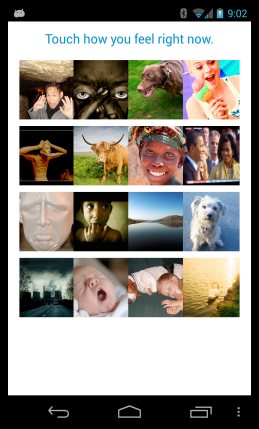
mental health pre-surveys

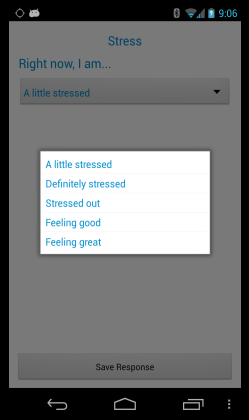
recruiting participants → orientation → data collection

automatic sensing

accelerometer → activity
microphone → conversation
light Sensor → sleep
GPS/Bluetooth → location/co-location

ecological momentary assessment (EMA)





recruiting participants → orientation → data collection → exit interview/ survey

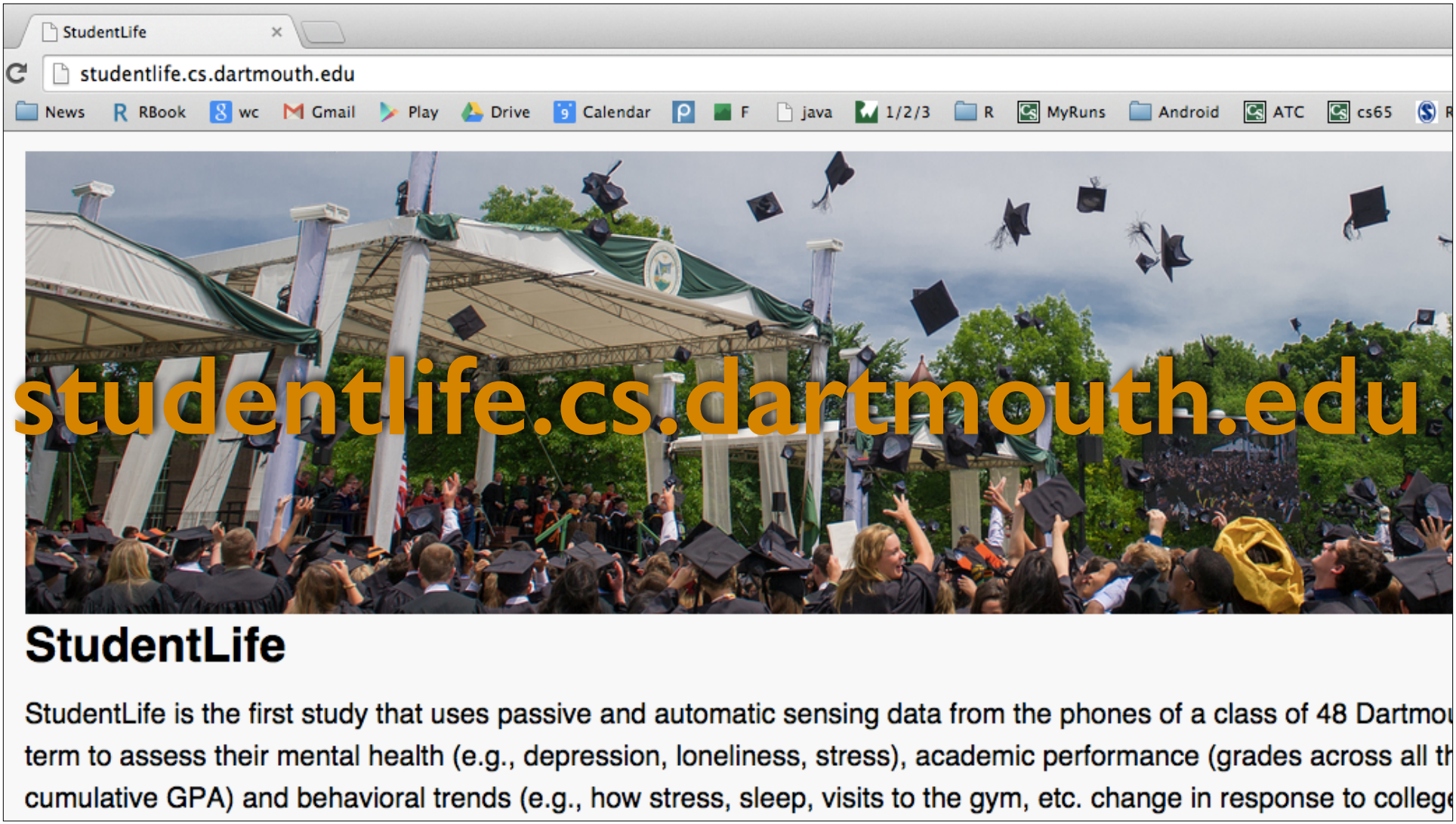
exit interview

mental health post-surveys

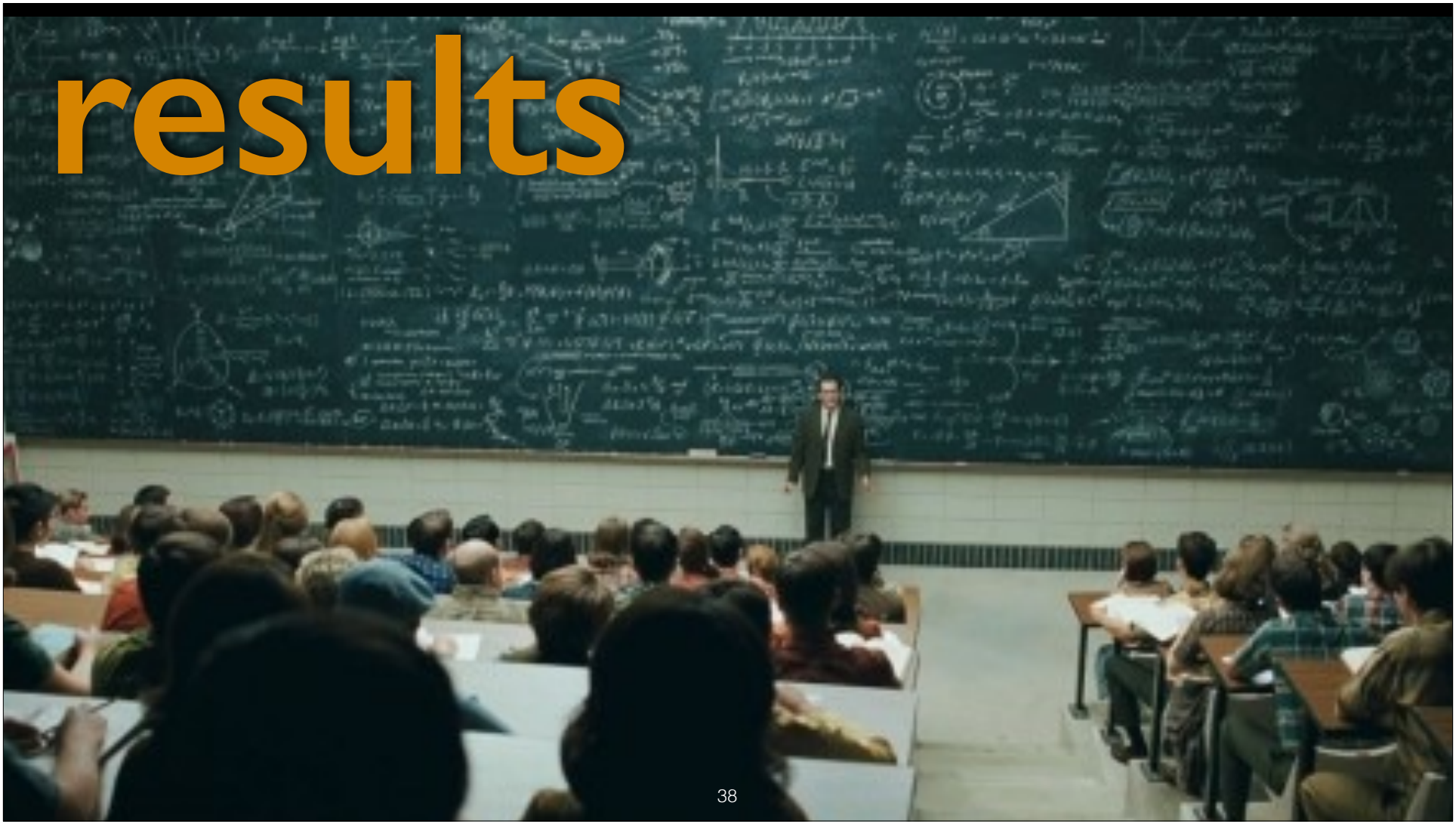
educational data

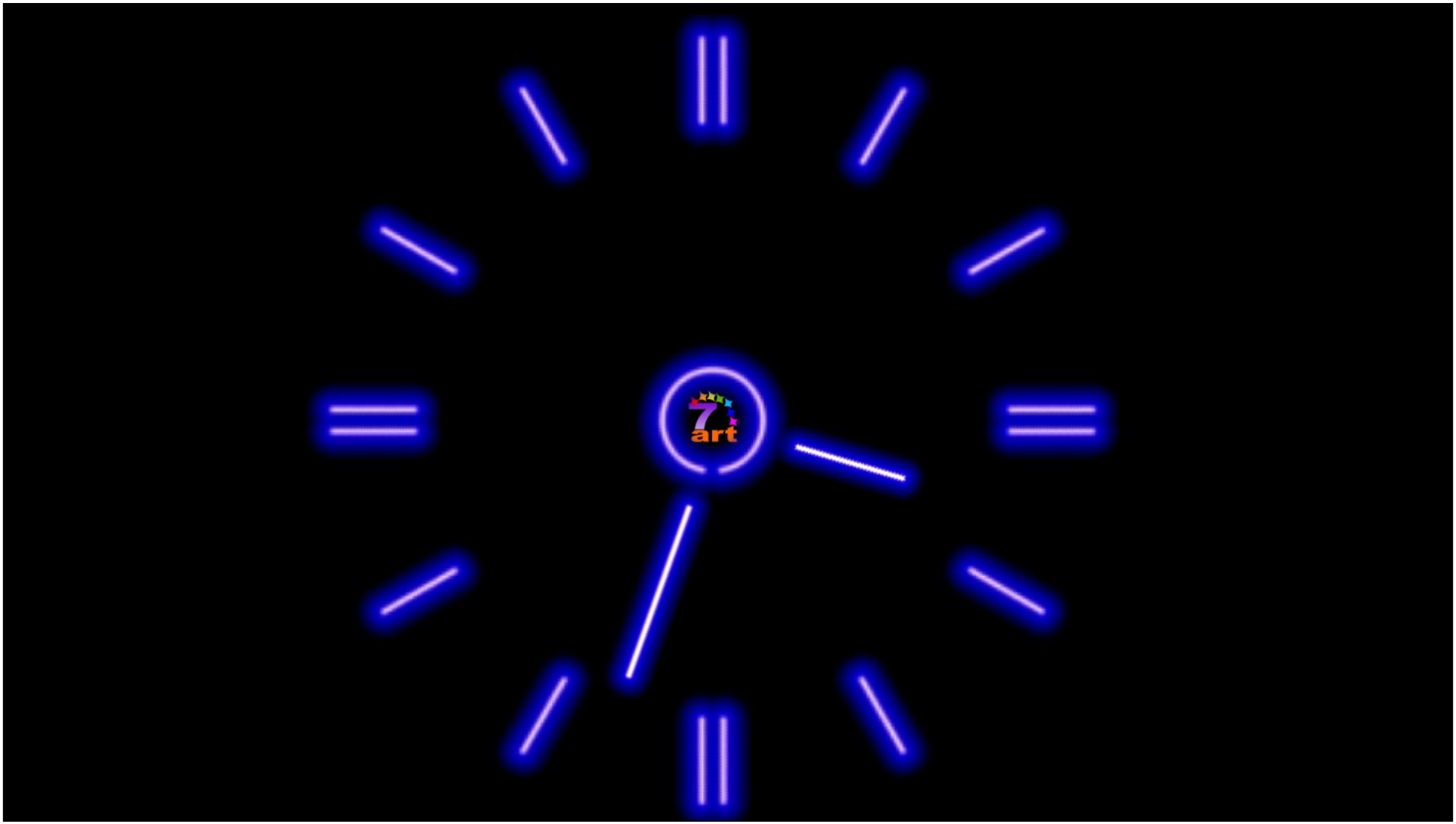

dataset

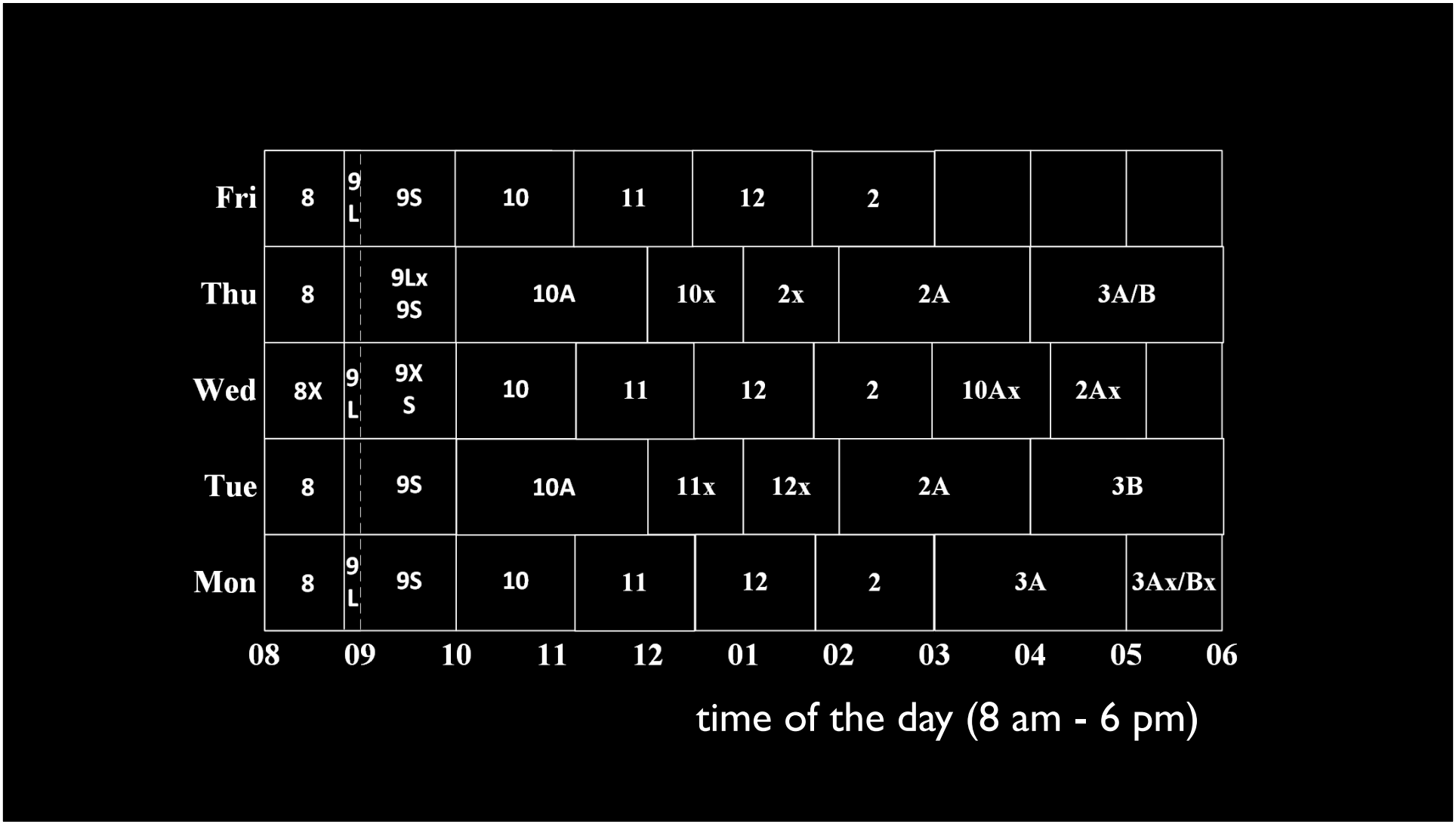
Dataset size
53 GB of data, 32,000 EMAs, 48 pre-post surveys, interviews
Passive sensor data from phone
activity, sleep, face-to-face conversation frequency/duration, indoor and outdoor mobility, location, distance travelled, co-location, light, app usage, calendar, call logs
Experience sampling from PACO
pam (affect), behavioral, class, campus events, social events, sleep quality, exercise, comments, mood
Pre-post surveys from Survey Monkey
stress, personality, mental and physical health, loneliness, mood, sleep
Transcripts: educational stats
Other: Facebook (not released), face log images (not released), dining details, seating data
Entry-exit interviews (not released)
social net in class, classes information (deadlines for all classes), group review, study specific questions.


StudentLife
studentlife.cs.dartmouth.edu
News
RBook
wc
Gmail
Play
Drive
Calendar
F
java
1/2/3
R
MyRuns
Android
ATC
cs65
studentlife.cs.dartmouth.edu
StudentLife
StudentLife is the first study that uses passive and automatic sensing data from the phones of a class of 48 Dartmou
term to assess their mental health (e.g., depression, loneliness, stress), academic performance (grades across all th
cumulative GPA) and behavioral trends (e.g., how stress, sleep, visits to the gym, etc. change in response to college

results




7
art


Fri
8
9L
9S
10
11
12
2
Thu
8
9Lx
9S
10A
10x
2x
2A
3A/B
Wed
8X
9L
9X
S
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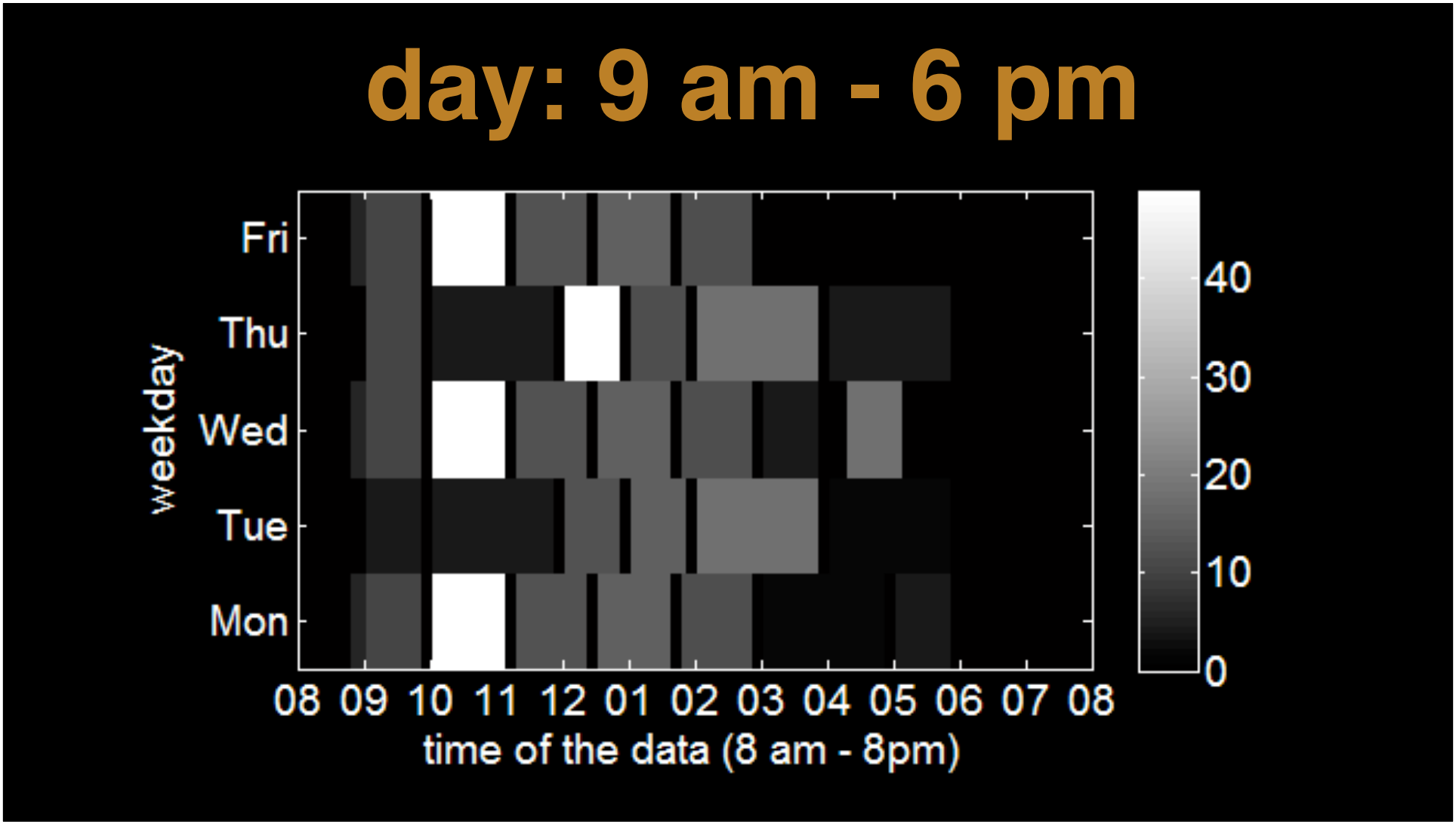
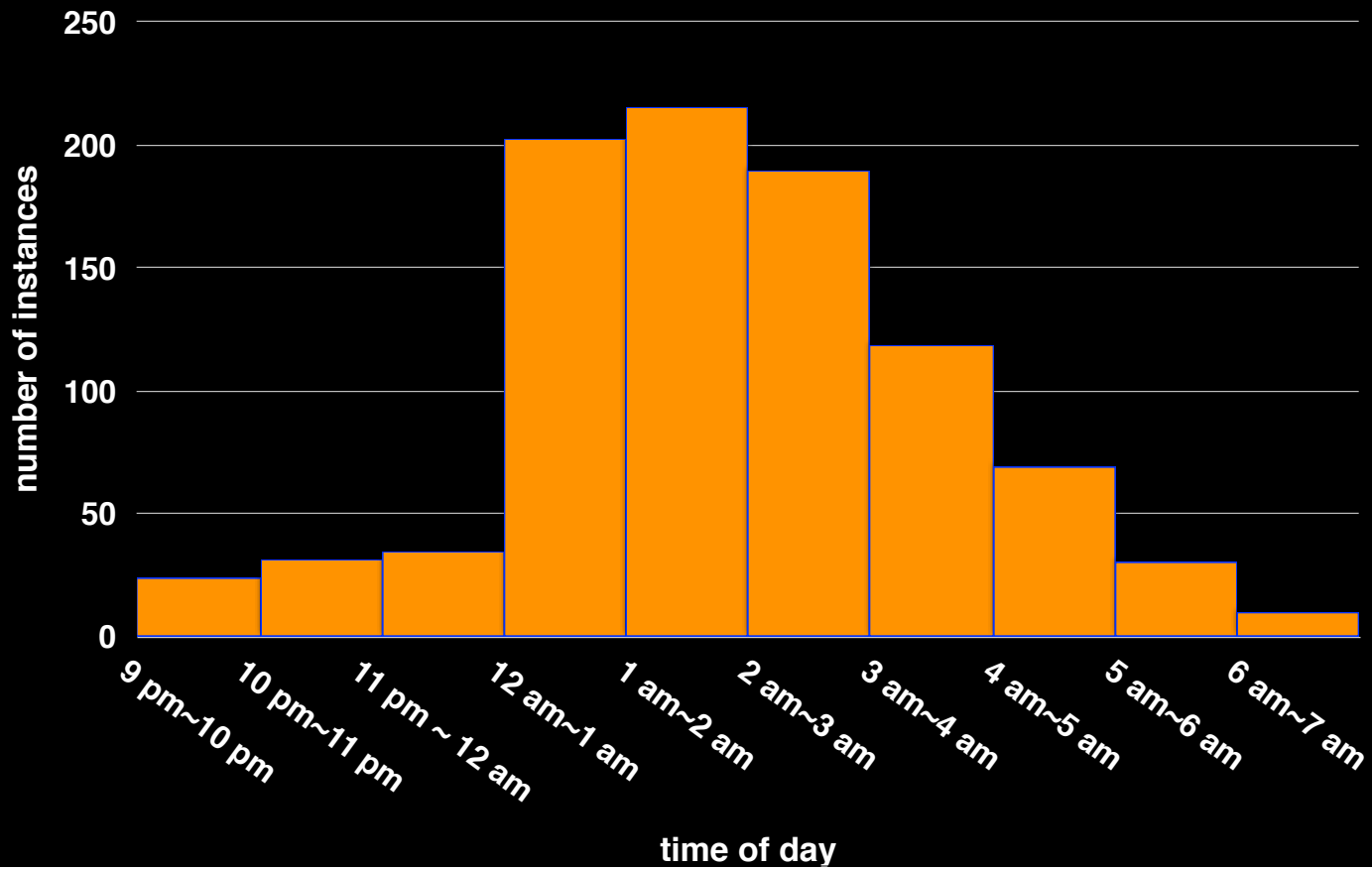
11
12
2
10Ax
2Ax
Tue
8
9S
10A
11x
12x
2A
3B
Mon
8
9L
9S
10
11
12
2
3A
3Ax/Bx
08
09
10
11
12
01
02
03
04
05
06
time of the day (8 am - 6 pm)

day: 9 am - 6 pm


Fri
Thu
Wed
Tue
Mon
weekday
08 09 10 11 12 01 02 03 04 05 06 07 08
time of the data (8 am - 8pm)
40
30
20
10
0

night: 12 am - 9 am



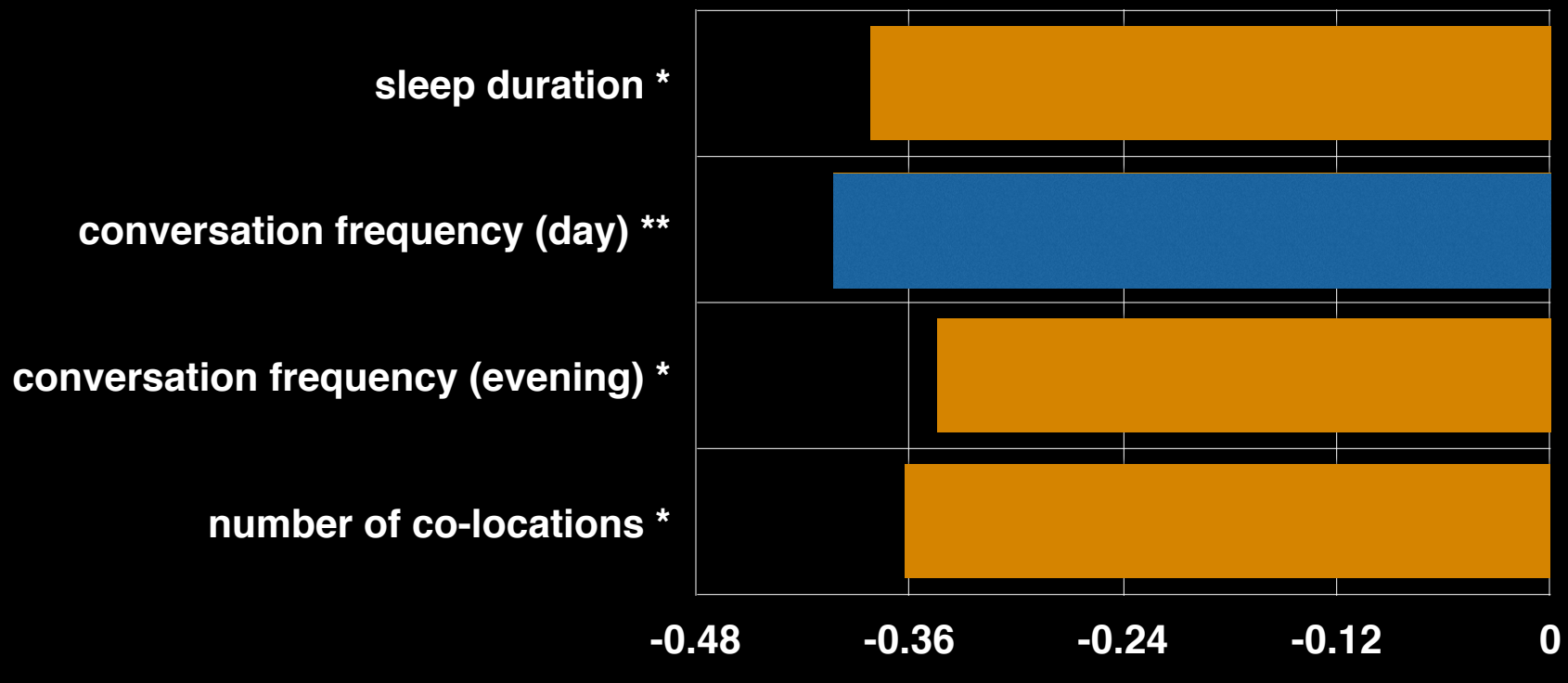
evening: 6 pm-12 am

average activity and face-to-face conversational data across the term

metric (epoch)	day 9am--6pm	evening 6pm-12am	night 12am-9pm
activity duration (mins)	53.3	31.2	13.0
conversation duration (mins)	133.0 / 165.2	115.4	37.3
conversation frequency	13.8 / 15.0	10.8	4.6

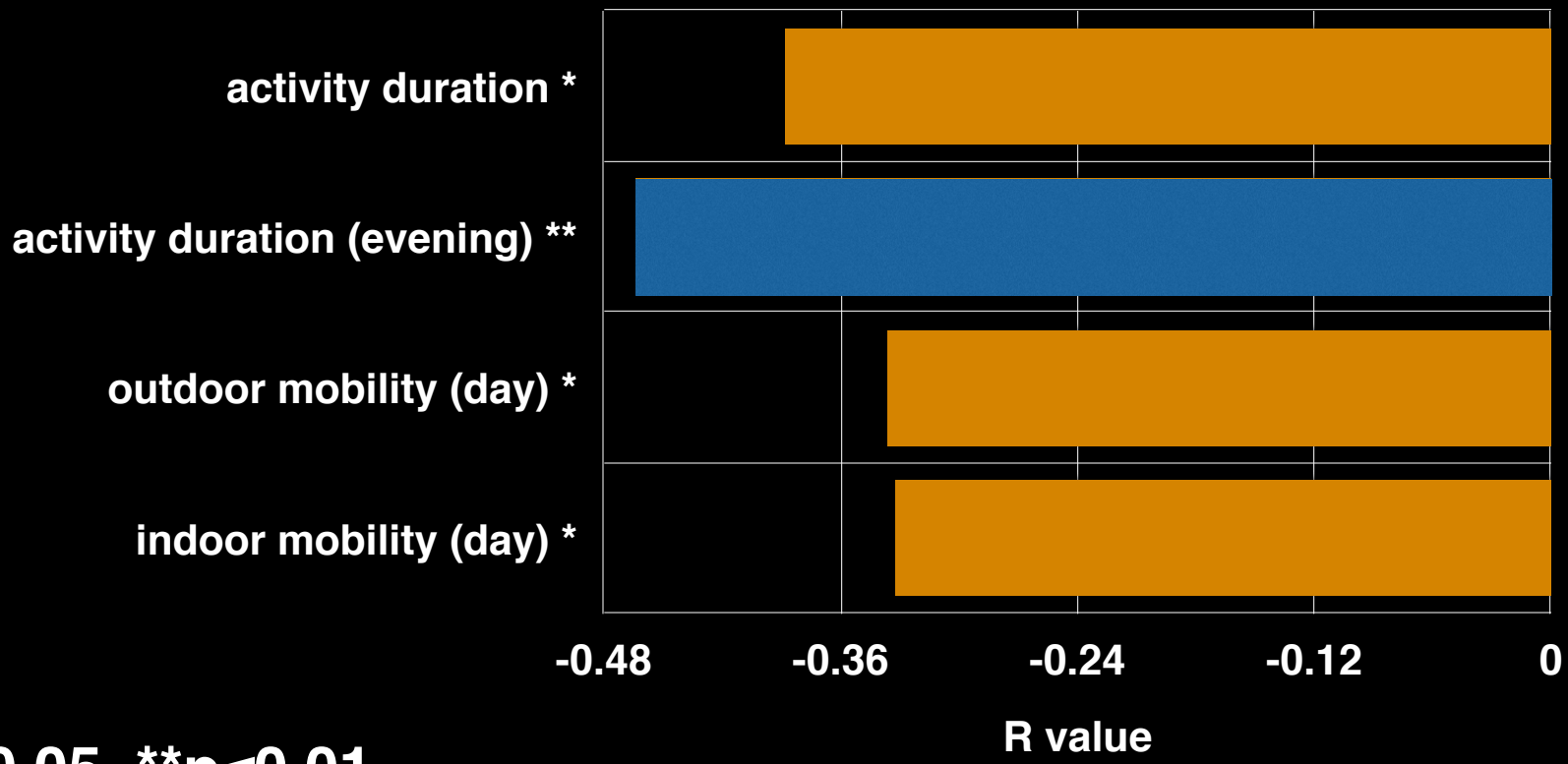

mental
health

depression



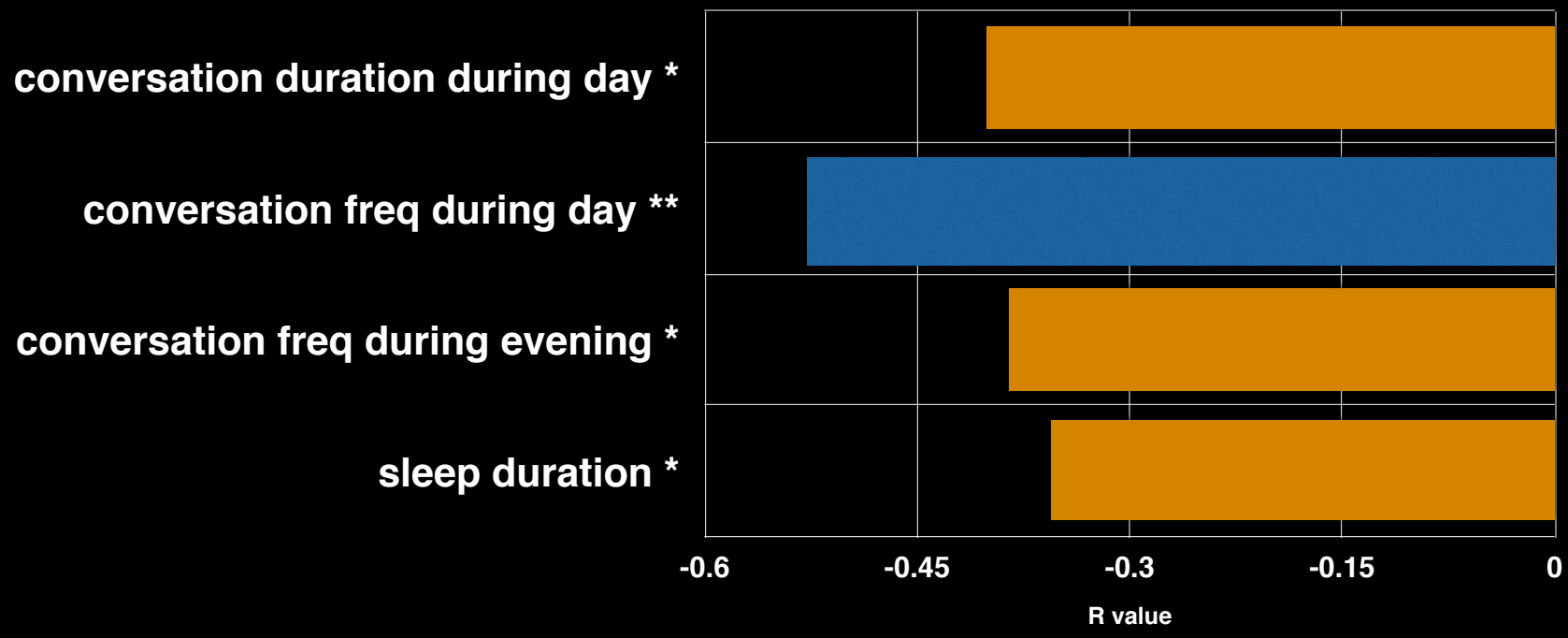
*p≤0.05, **p≤0.01

loneliness



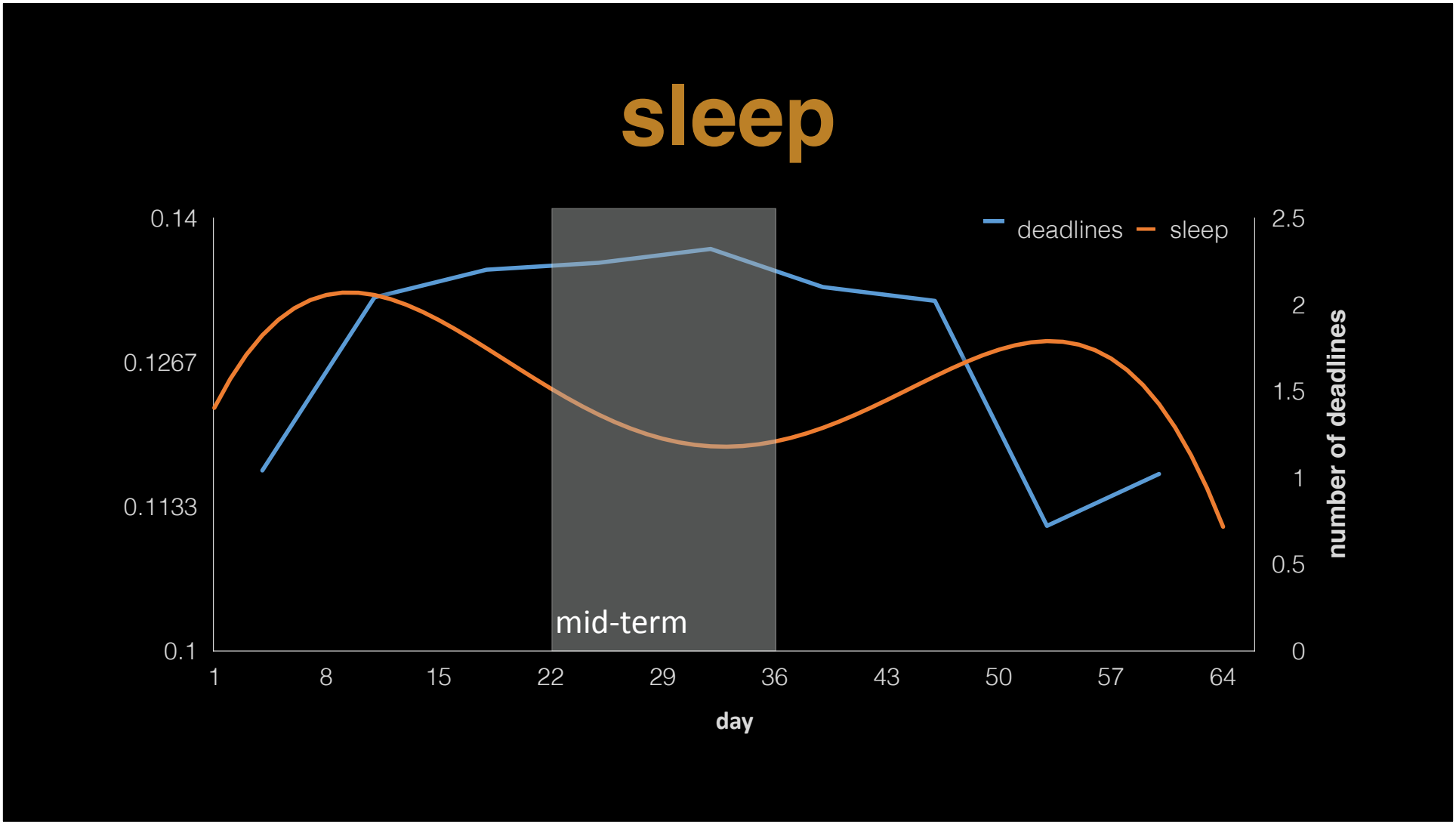
*p≤0.05, **p≤0.01

stress

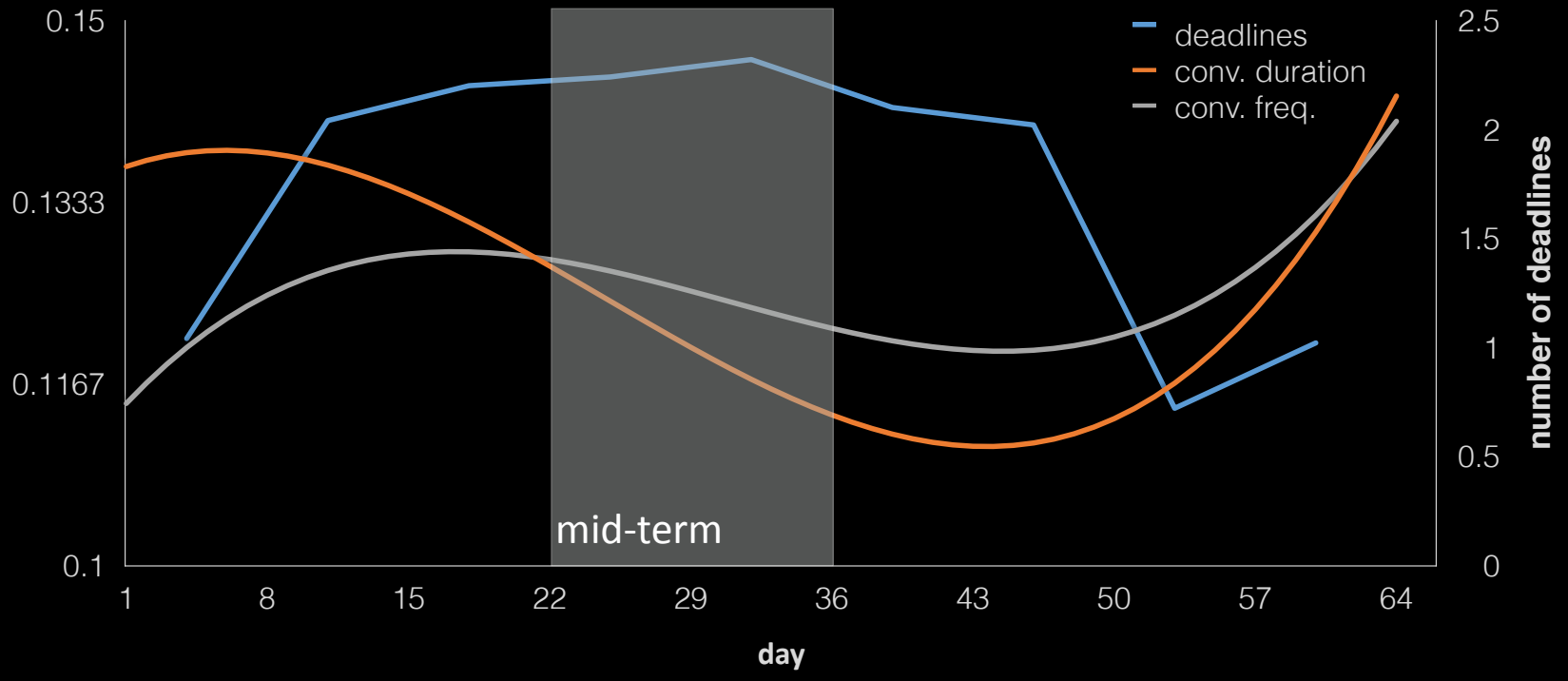


*p≤0.05, **p≤0.01

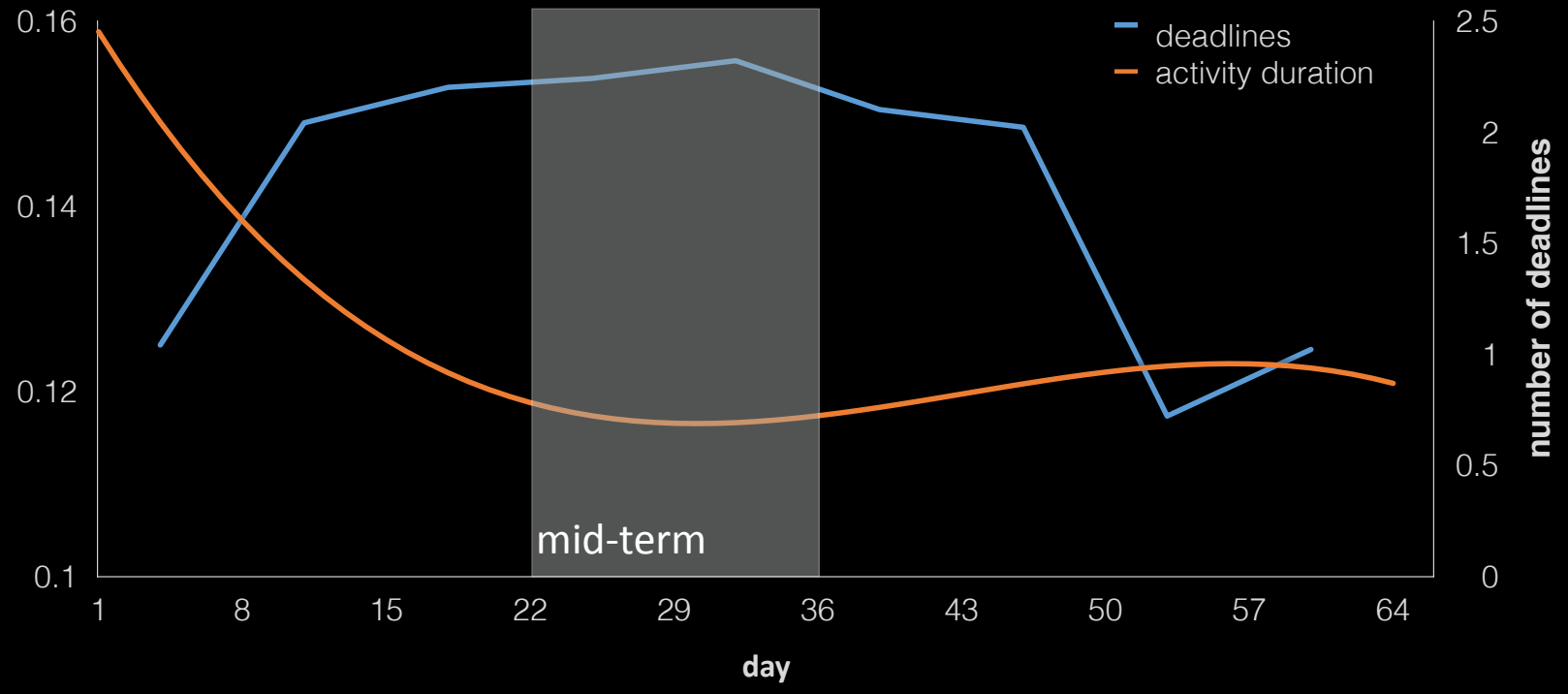

behavioral
trends


sleep
0.14
0.1267
0.1133
0.1
1
8
15
22
29
36
43
50
57
64
day
mid-term
deadlines
sleep
2.5
2
1.5
1
0.5
0
number of deadlines

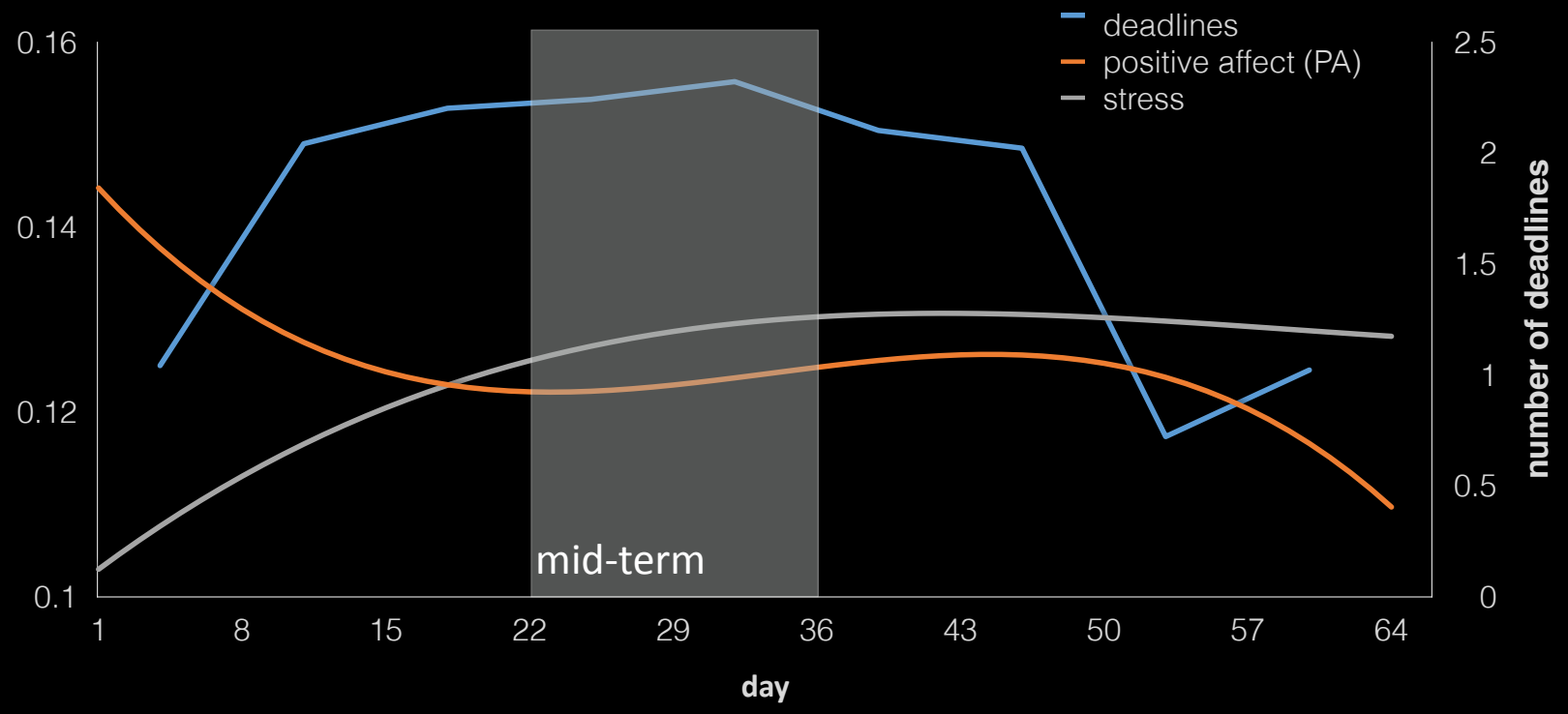
face-to-face conversation



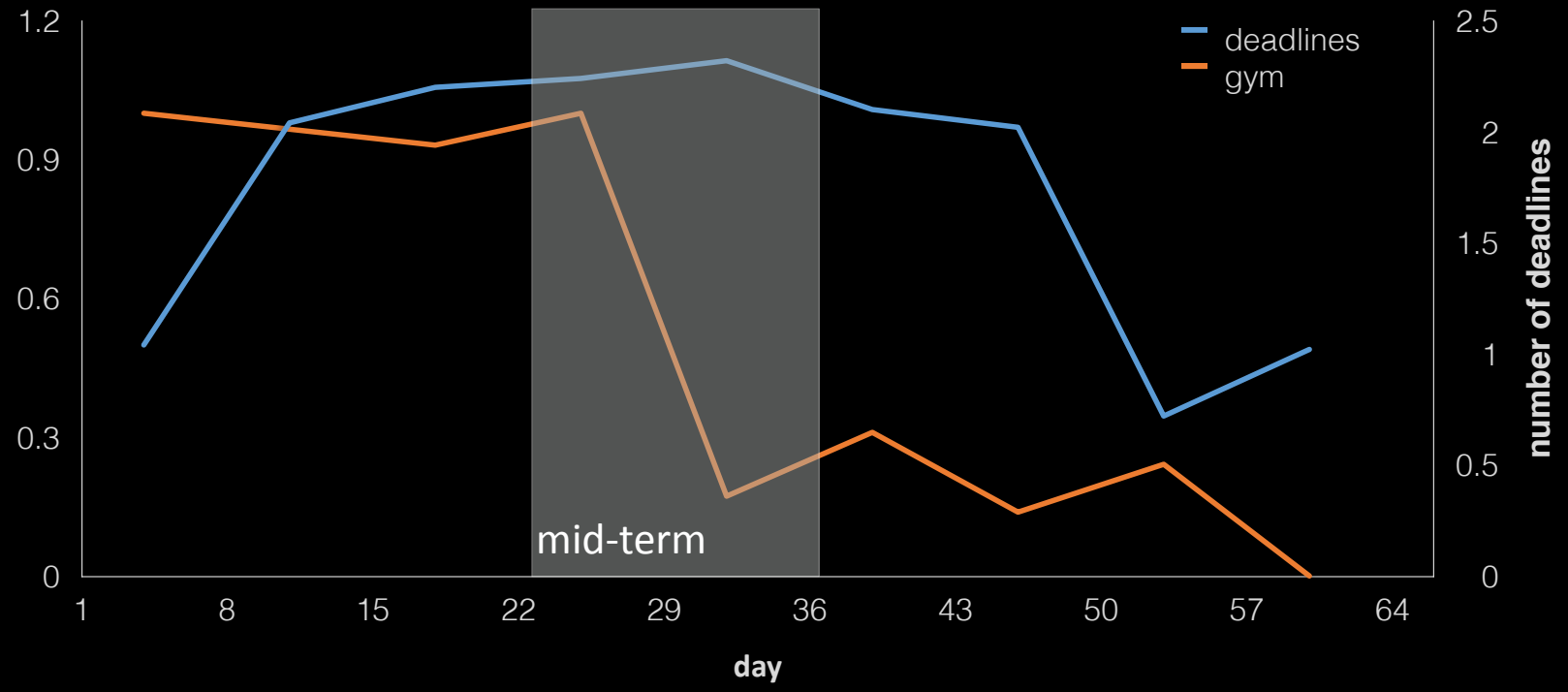
activity duration

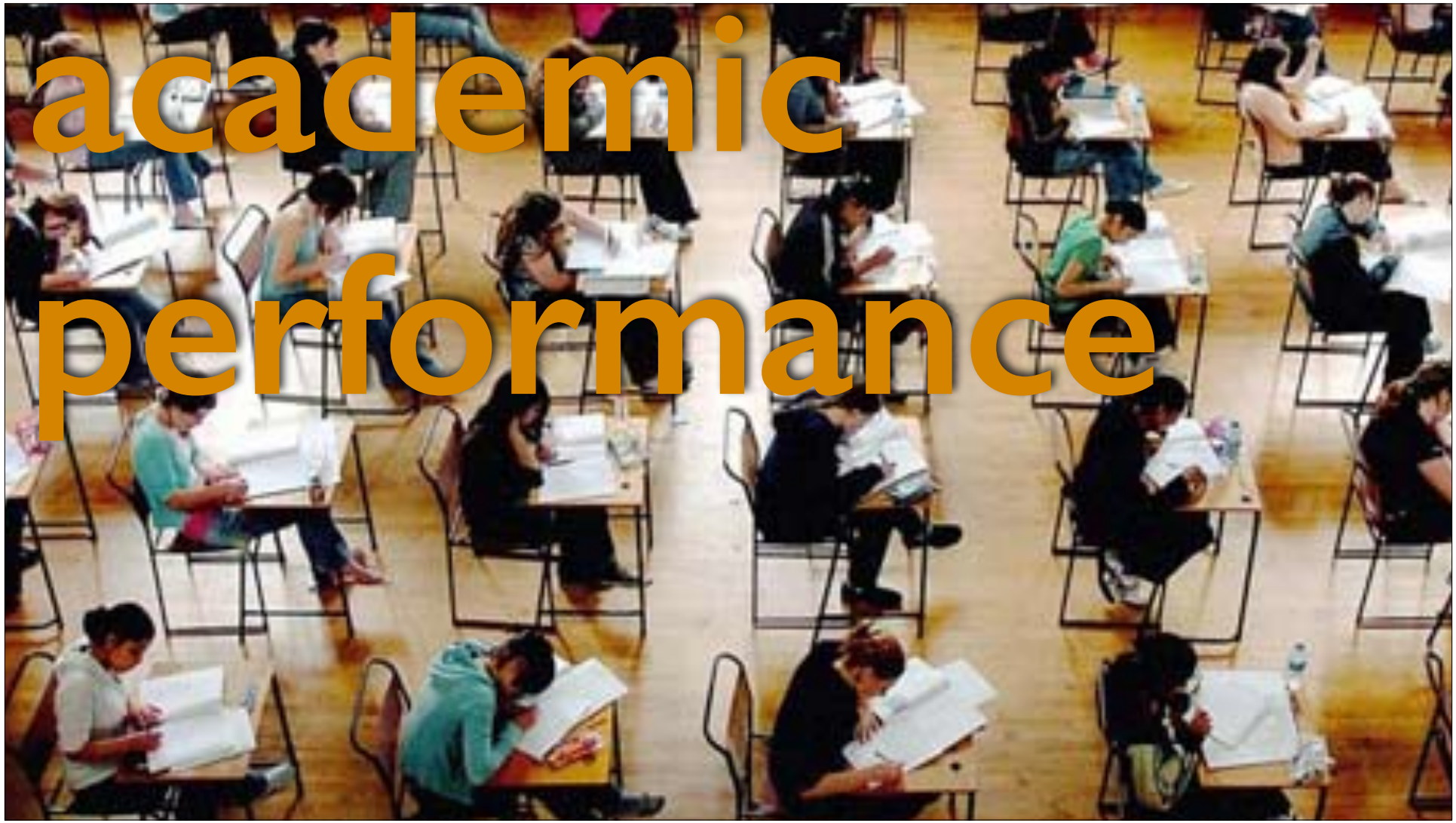


stress and affect

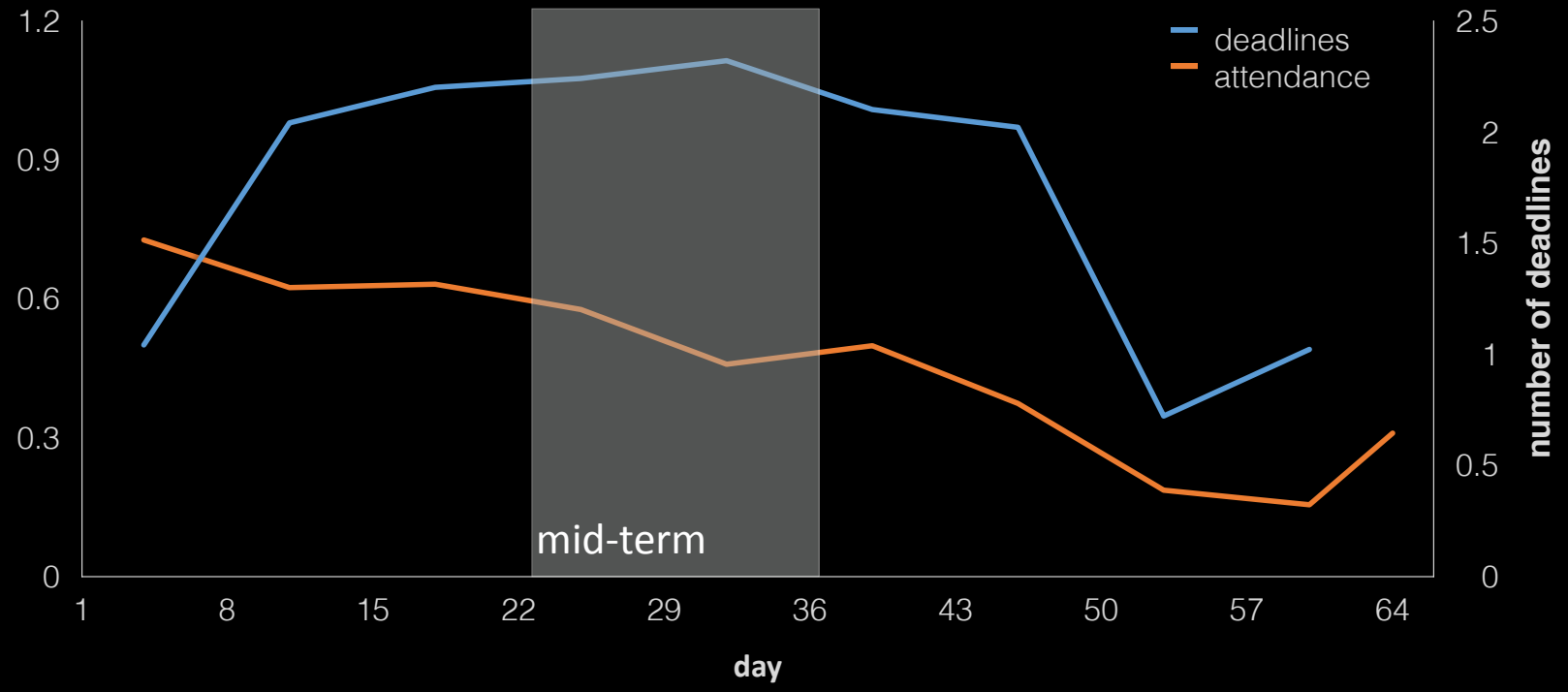


gym visits


1.2
0.9
0.6
0.3
0
1
8
15
22
29
36
43
50
57
64
day
2.5
2
1.5
1
0.5
0
number of deadlines
deadlines
gym
mid-term


academic
performance

class attendance

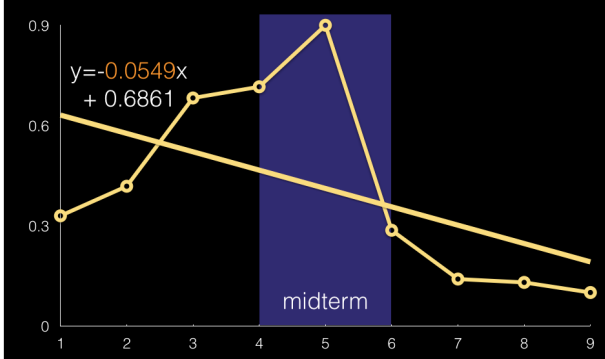


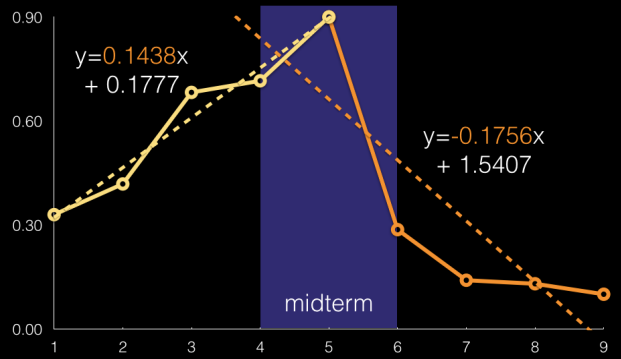

there is no correlation between
class attendance and grade!

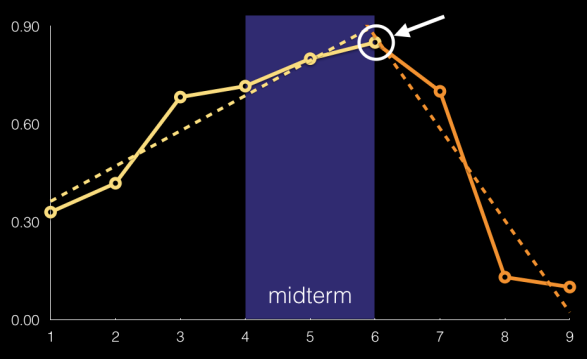
idea

- look at individual differences between high and low peformers
- define higher level behaviors for studying and partying
- track behavior changes using time series analysis

capturing behavioral change



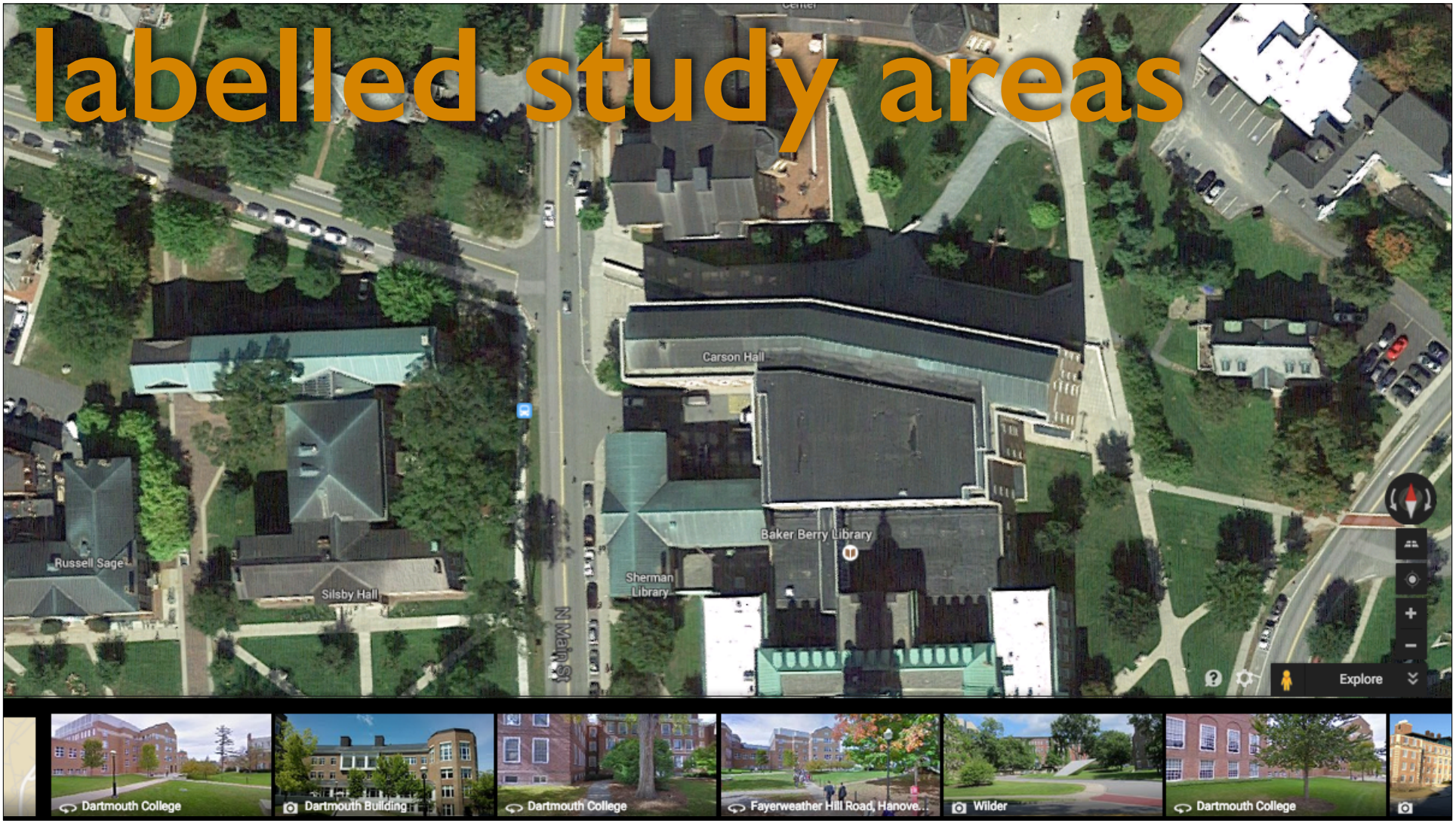




behavioral slope and breakpoints

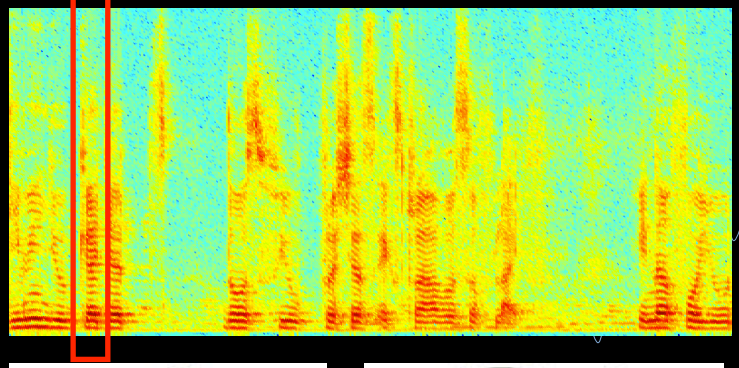

studying


focus


labelled study areas
Carson Hall
Baker Berry Library
Sherman Library
Russell Sage
Silsby Hall
N Main St
Explore
Dartmouth College
Dartmouth Building
Dartmouth College
Fayerweather Hill Road, Hanove...
Wilder
Dartmouth College

study areas

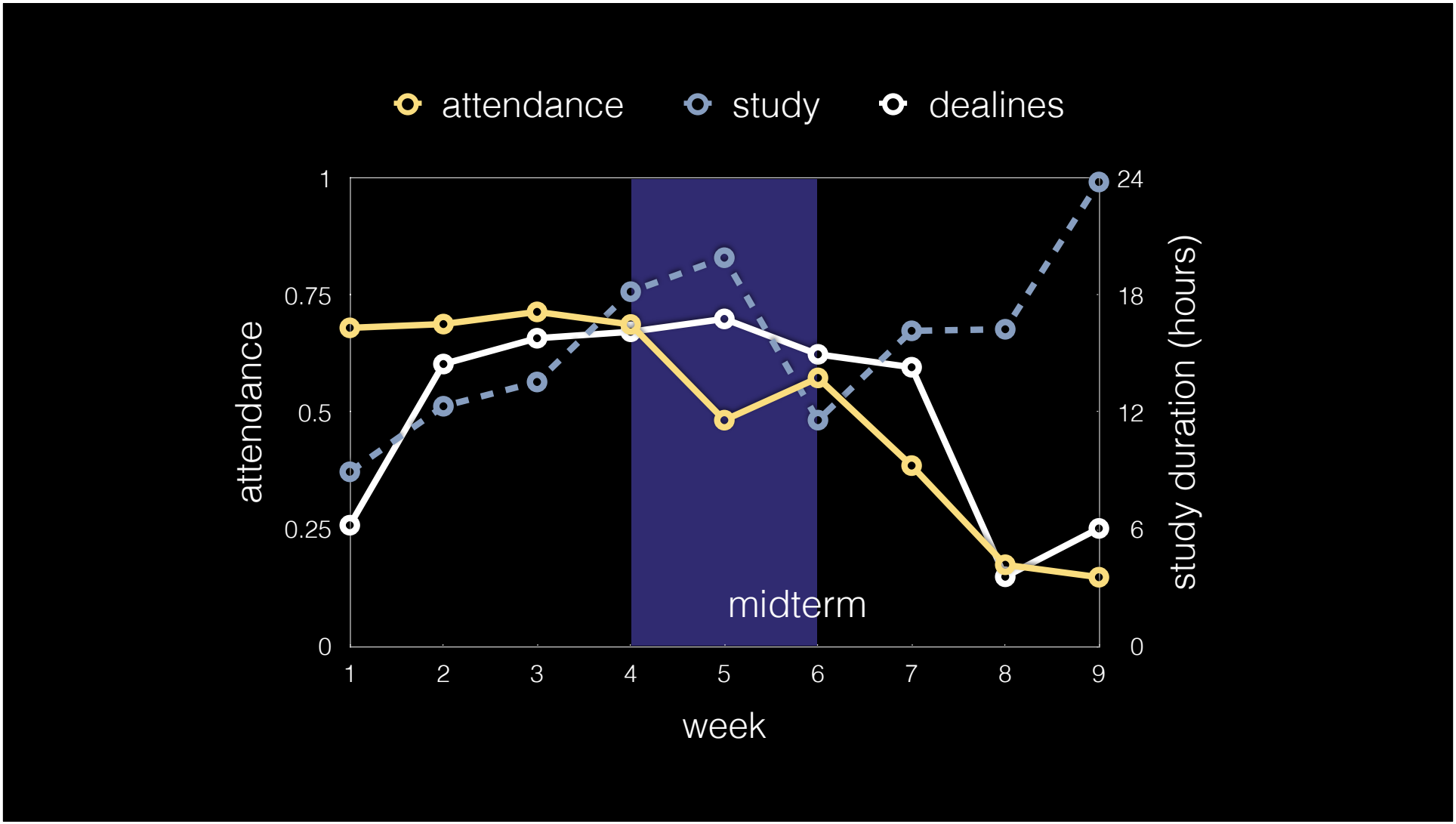
sound



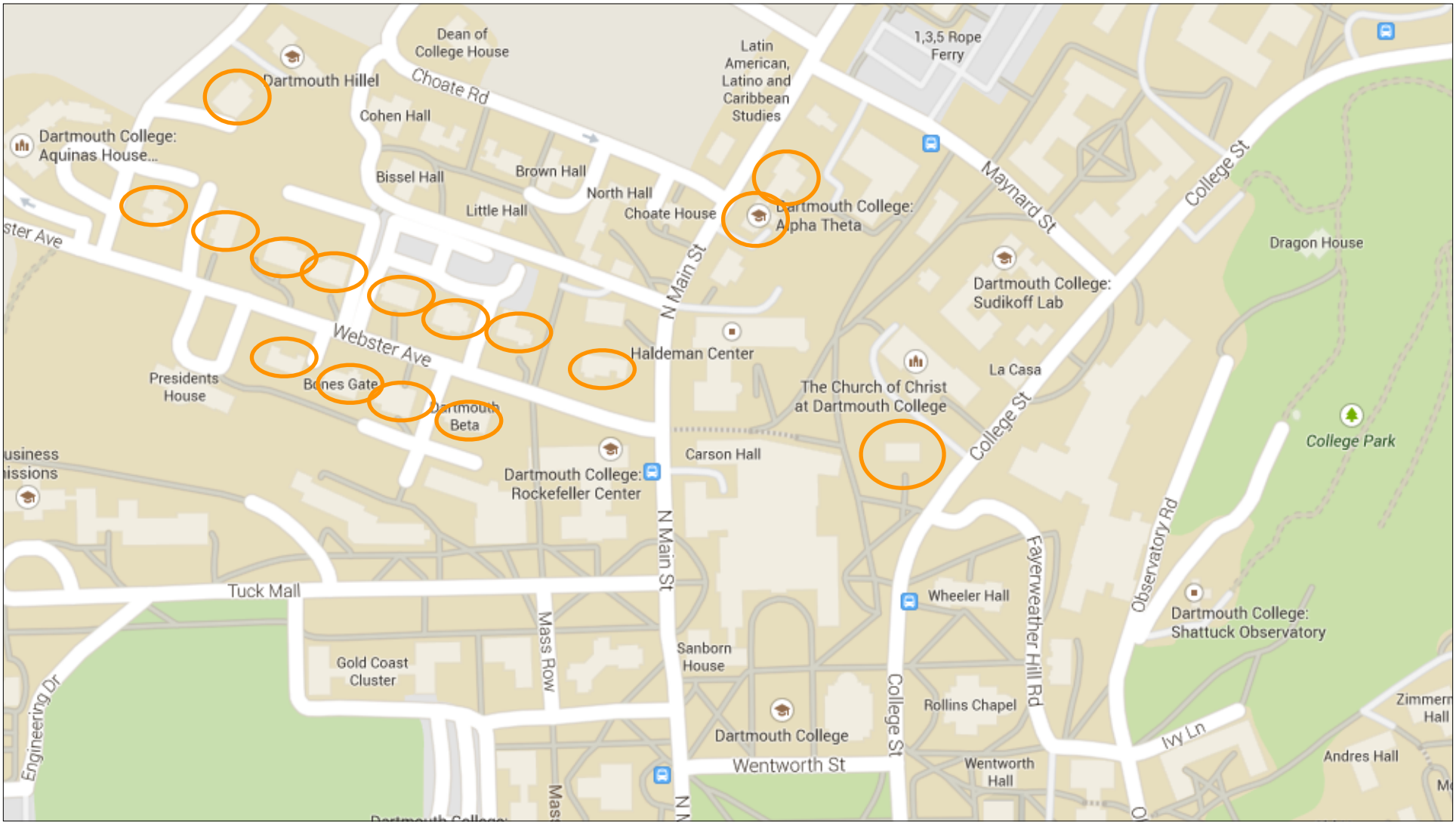
activity

studying

focus

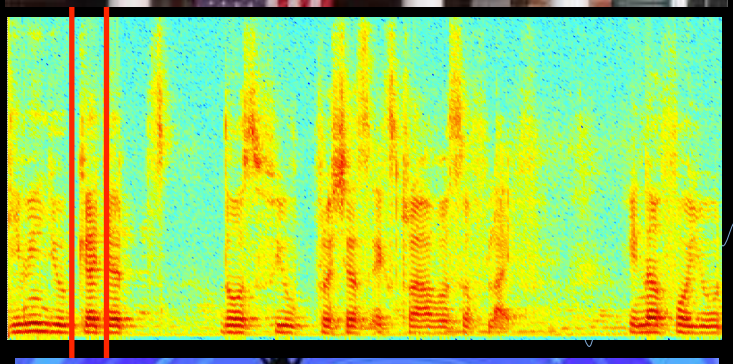

attendance
study
dealines
1
0.75
0.5
0.25
0
attendance
24
18
12
6
0
study duration (hours)
midterm
1
2
3
4
5
6
7
8
9
week


partying

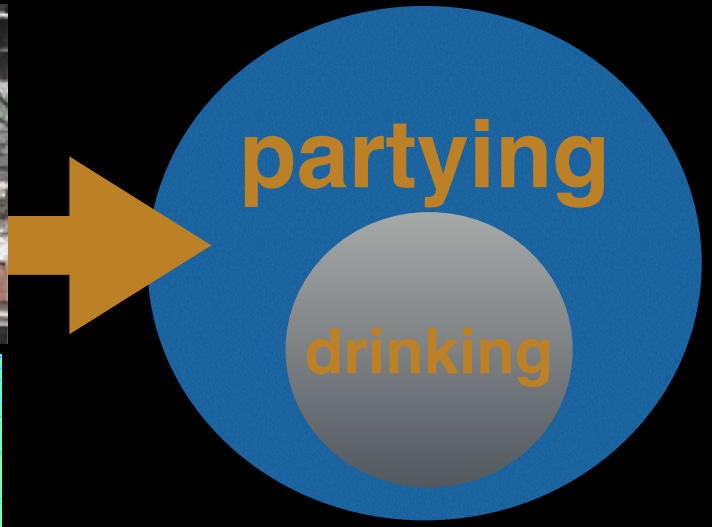

Dean of College House
Dartmouth Hillel
Choate Rd
Cohen Hall
Latin American, Latino and Caribbean Studies
1,3,5 Rope Ferry
Dartmouth College: Aquinas House...
Bissel Hall
Brown Hall
North Hall
Little Hall
Choate House
Dartmouth College: Alpha Theta
Maynard St
College St
Dragon House
N Main St
Dartmouth College: Sudikoff Lab
Webster Ave
Haldeman Center
La Casa
Presidents House
Bones Gate
The Church of Christ at Dartmouth College
College Park
Carson Hall
Dartmouth College: Rockefeller Center
Tuck Mall
Wheeler Hall
Fayerweather Hill Rd
Observatory Rd
Dartmouth College: Shattuck Observatory
Mass Row
Gold Coast Cluster
Sanborn House
Engineering Dr
Rollins Chapel
Dartmouth College
Wentworth St
Wentworth Hall
Ivy Ln
Andres Hall

party places

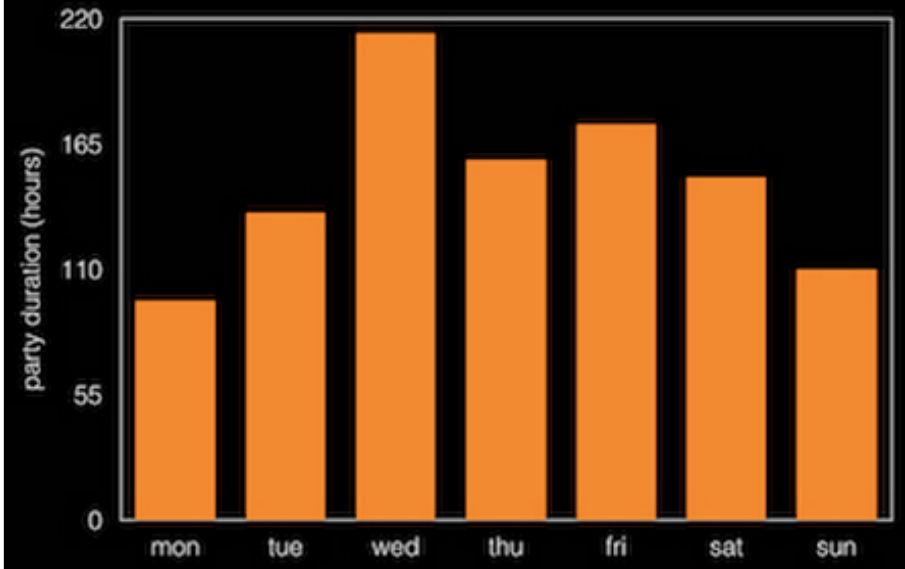
sound



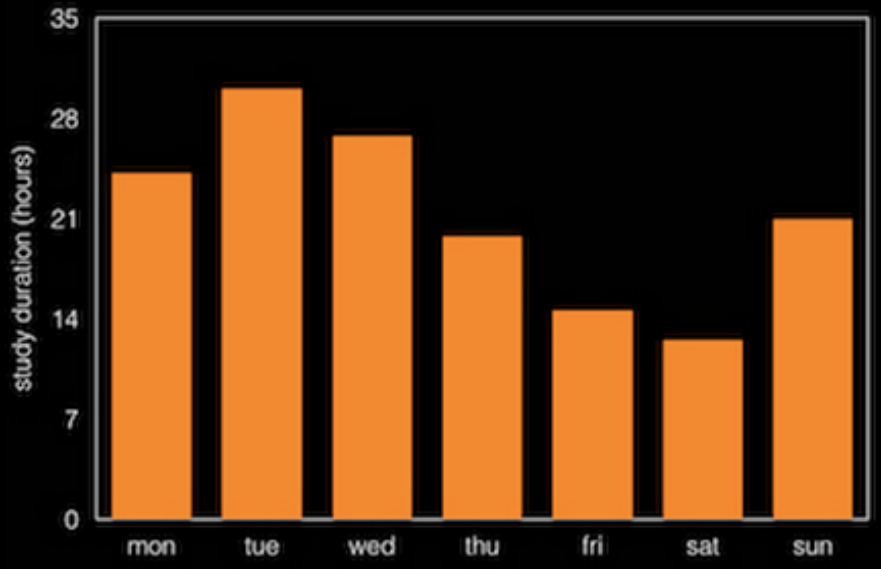
activity co-location



when do students party?



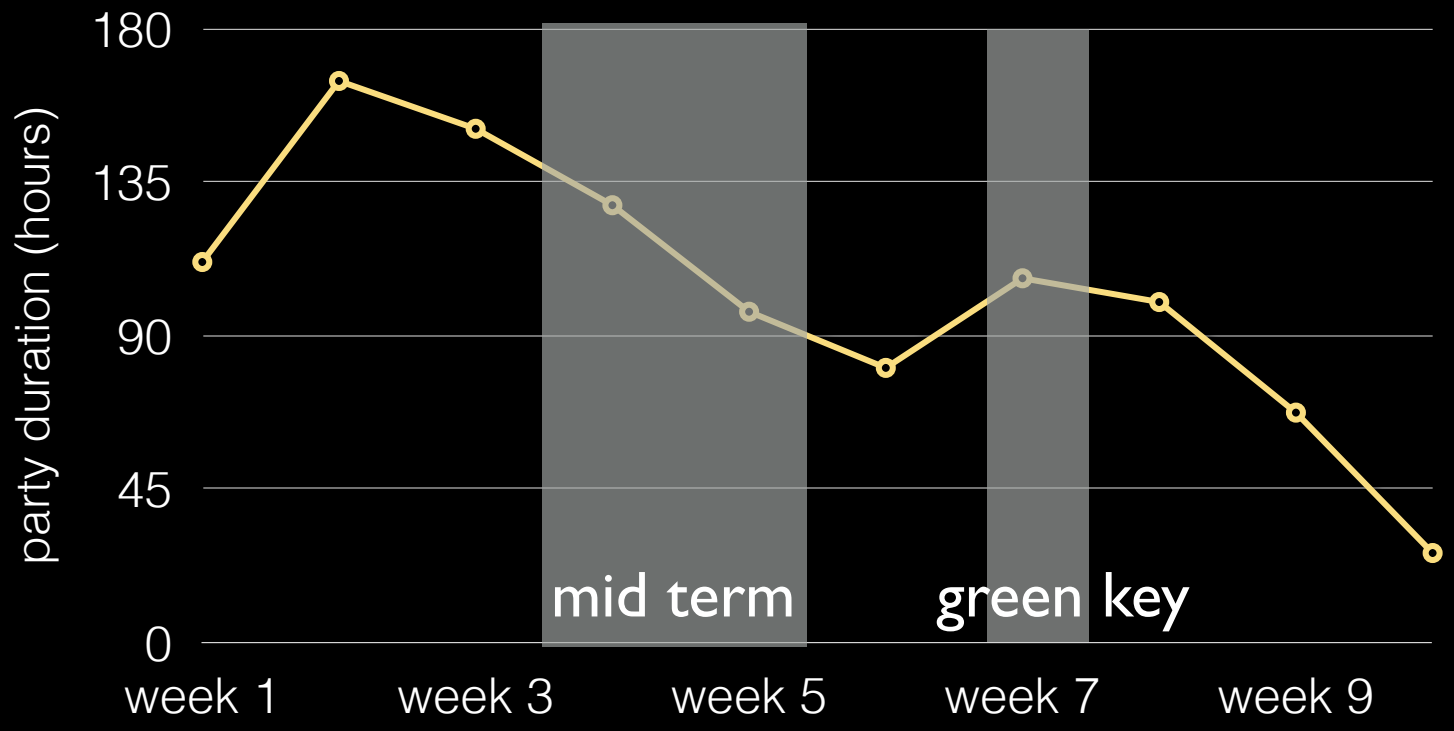
when do students study?



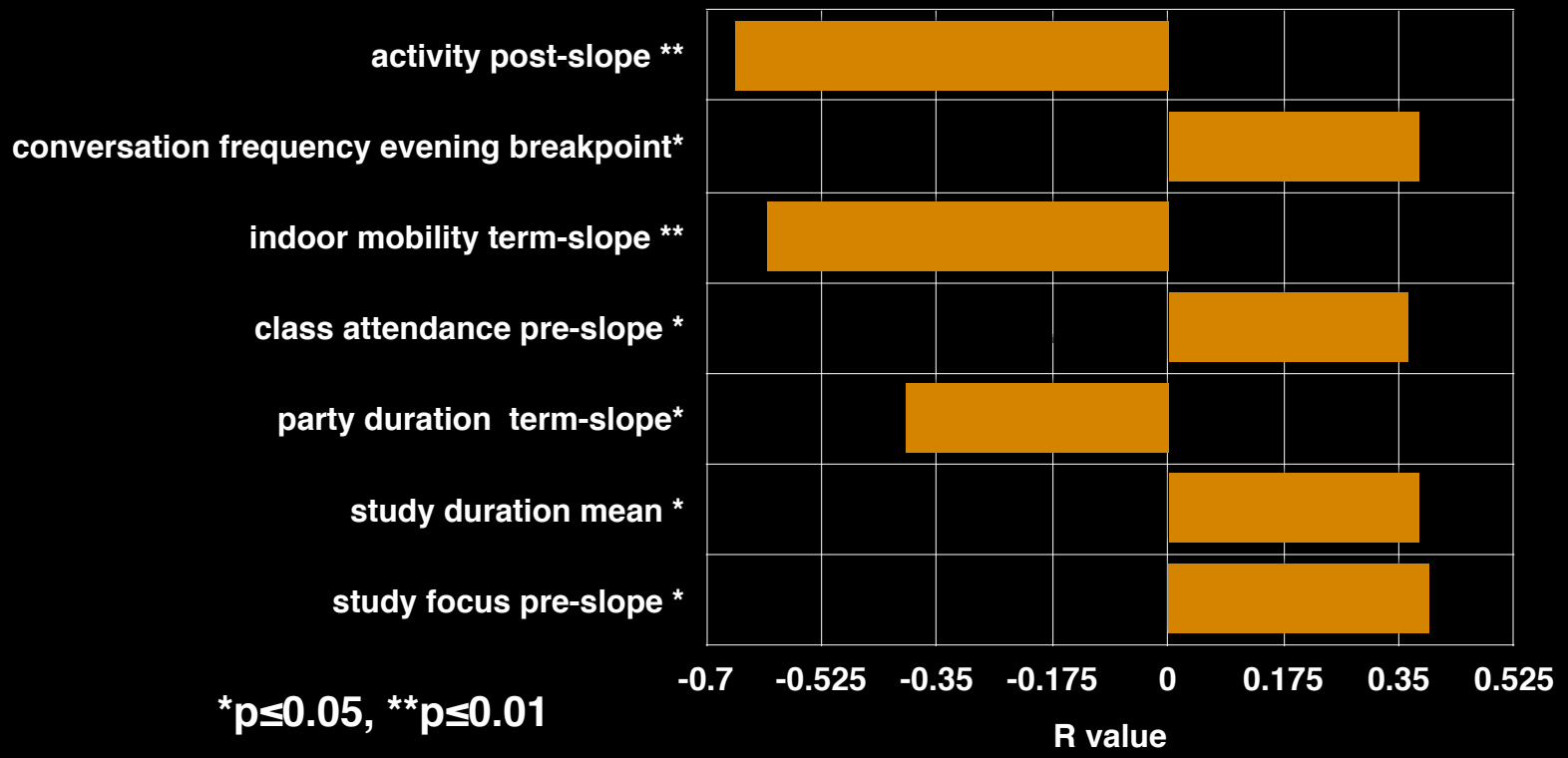
the phone automatically sensed

- activity
- sleep
- conversation
- partying
- studying
- indoor and outdoor mobility
- location and co-location

partying trends across the term



GPA



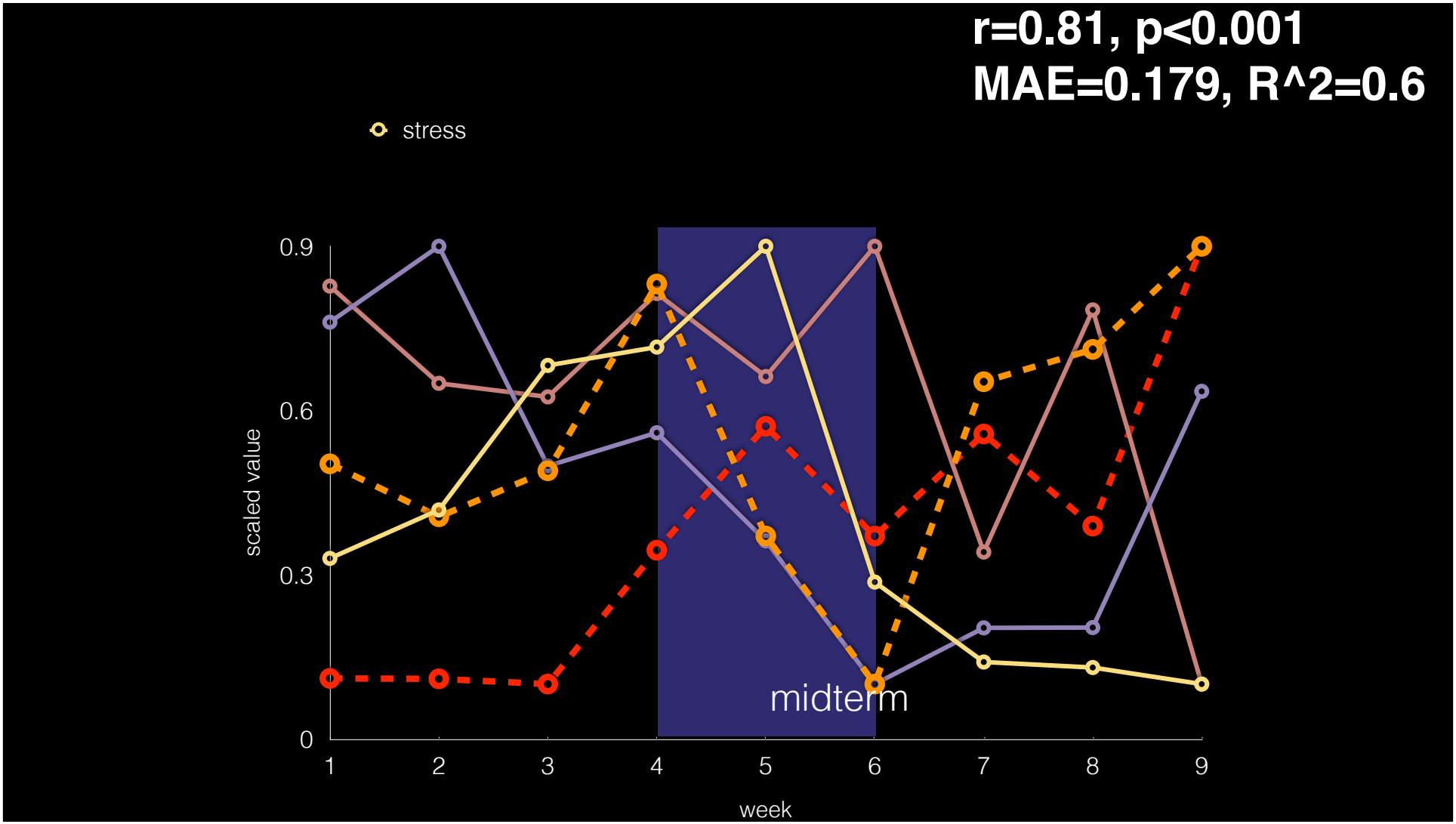
*p≤0.05, **p≤0.01

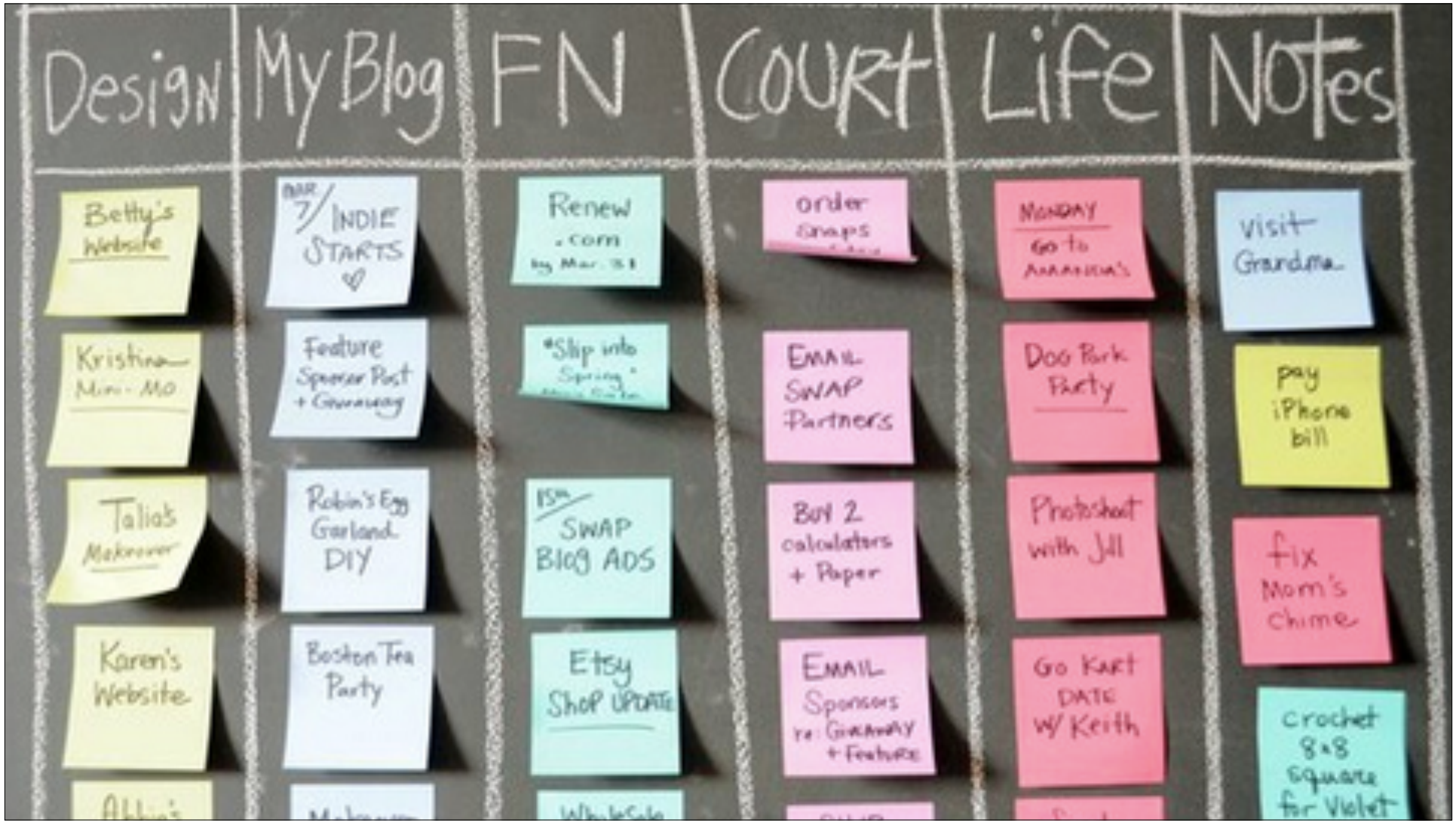
features	r	p-value
activity pre-slope	0.418	0.022
activity post-slope	-0.449	0.015
activity day pre-slope	0.477	0.008
activity day post-slope	-0.391	0.036
activity night pre-slope	0.427	0.019
activity night post-slope	-0.411	0.027
conversation duration post-slope	0.443	0.016
conversation duration night post-slope	0.407	0.028
conversation duration evening post-slope	0.368	0.05
conversation freq night breakpoint	0.641	<0.001
conversation freq evening breakpoint	0.498	0.005
indoor mobility term-slope	-0.387	0.035
indoor mobility pre-slope	0.425	0.019
indoor mobility post-slope	-0.426	0.021

features	r	p-value
indoor mobility night term-slope	-0.396	0.031
indoor mobility night pre-slope	0.433	0.017
indoor mobility night post-slope	-0.448	0.015
indoor mobility day post-slope	-0.386	0.039
class attendance pre-slope	0.47	0.009
study duration mean	0.518	0.003
study focus activity mean	0.43	0.018
study focus activity pre-slope	-0.372	0.043
study focus audio mean	0.38	0.038
party duration mean	-0.381	0.029
PHQ-9 depression scale (post)	-0.47	0.027
conscientiousness	0.551	0.004
neuroticism	-0.423	0.035

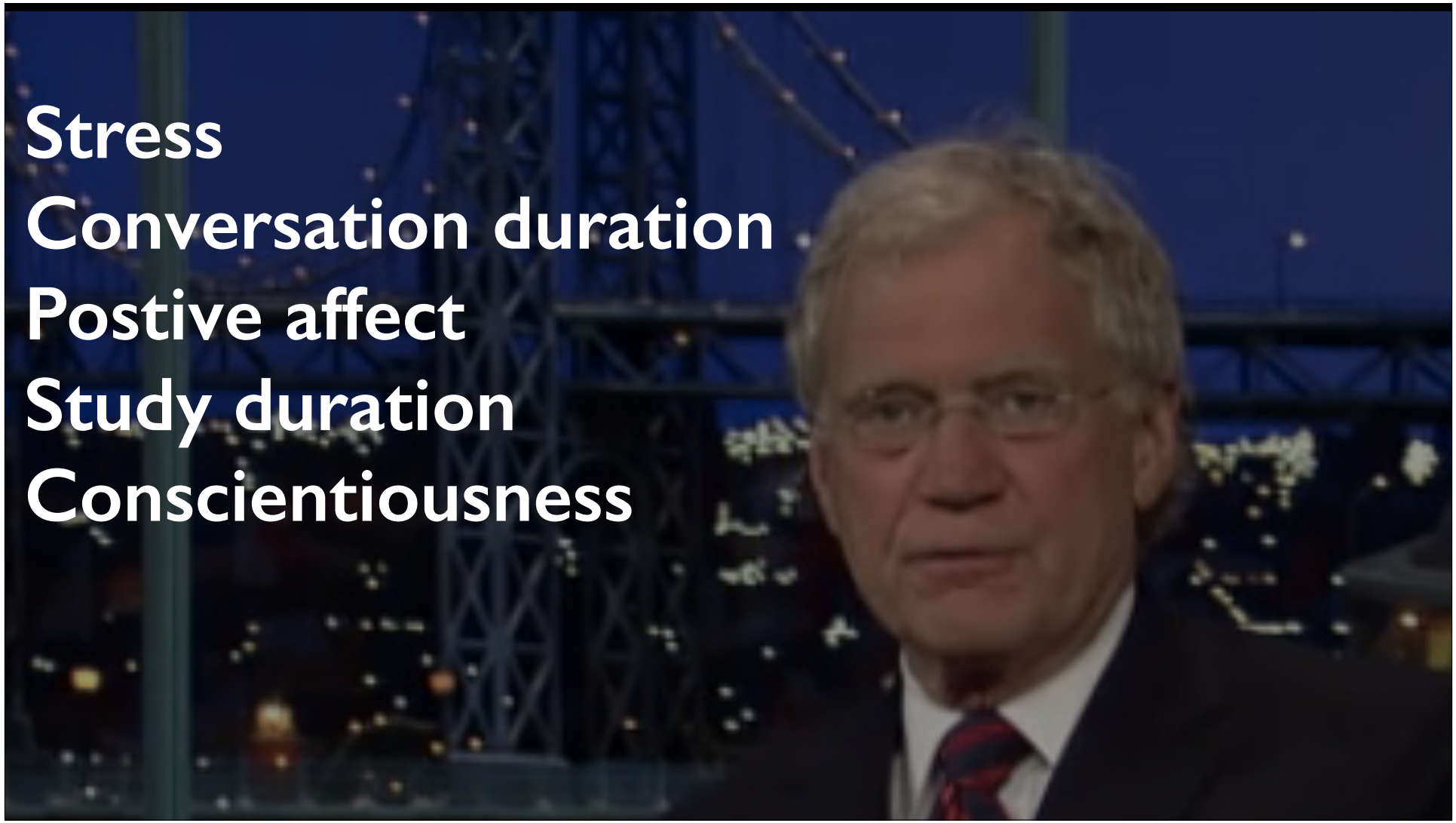

can we predict
academic
performance?

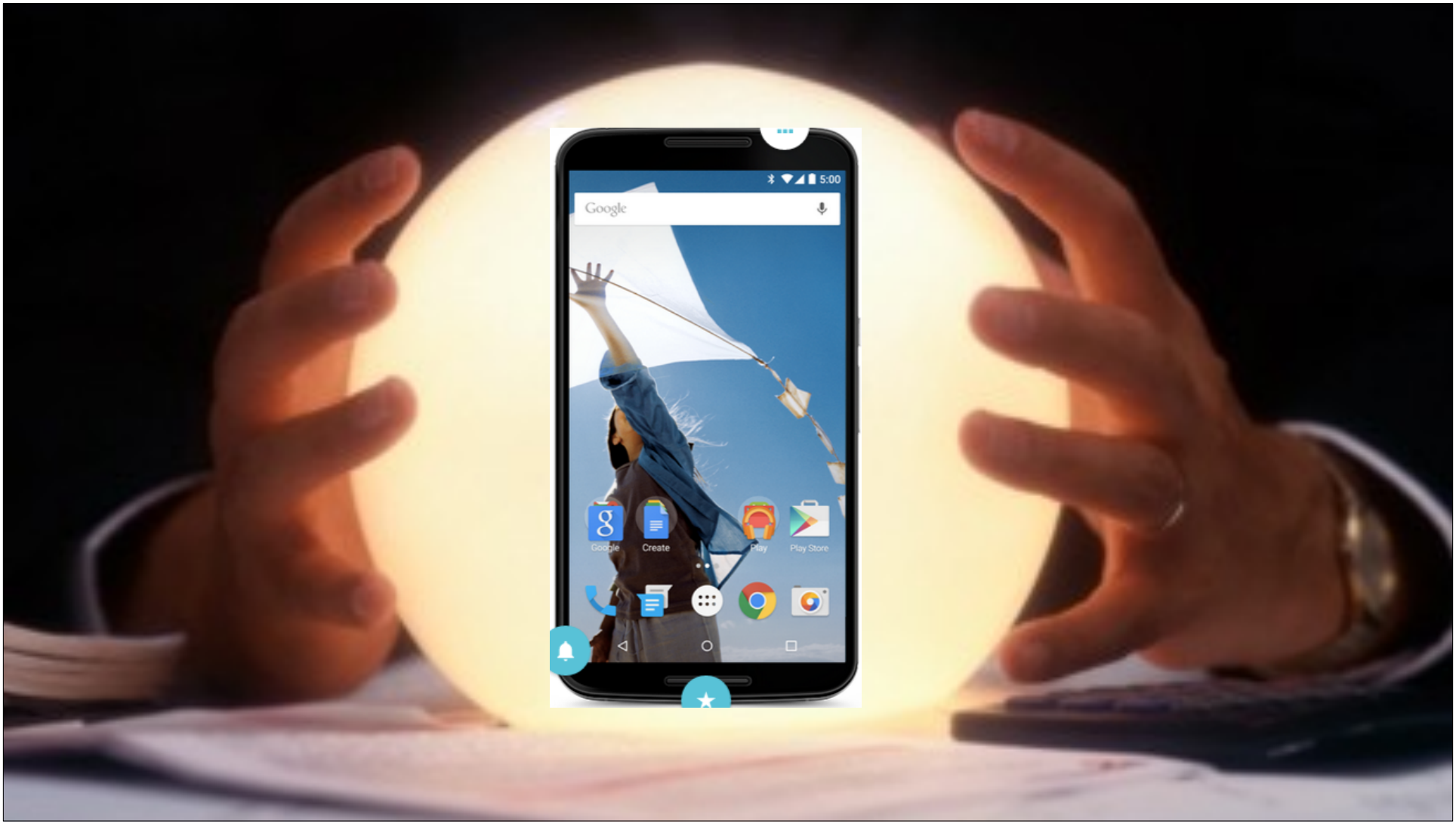
https://www.youtube.com/watch?v=XqJTXo1uKJ0

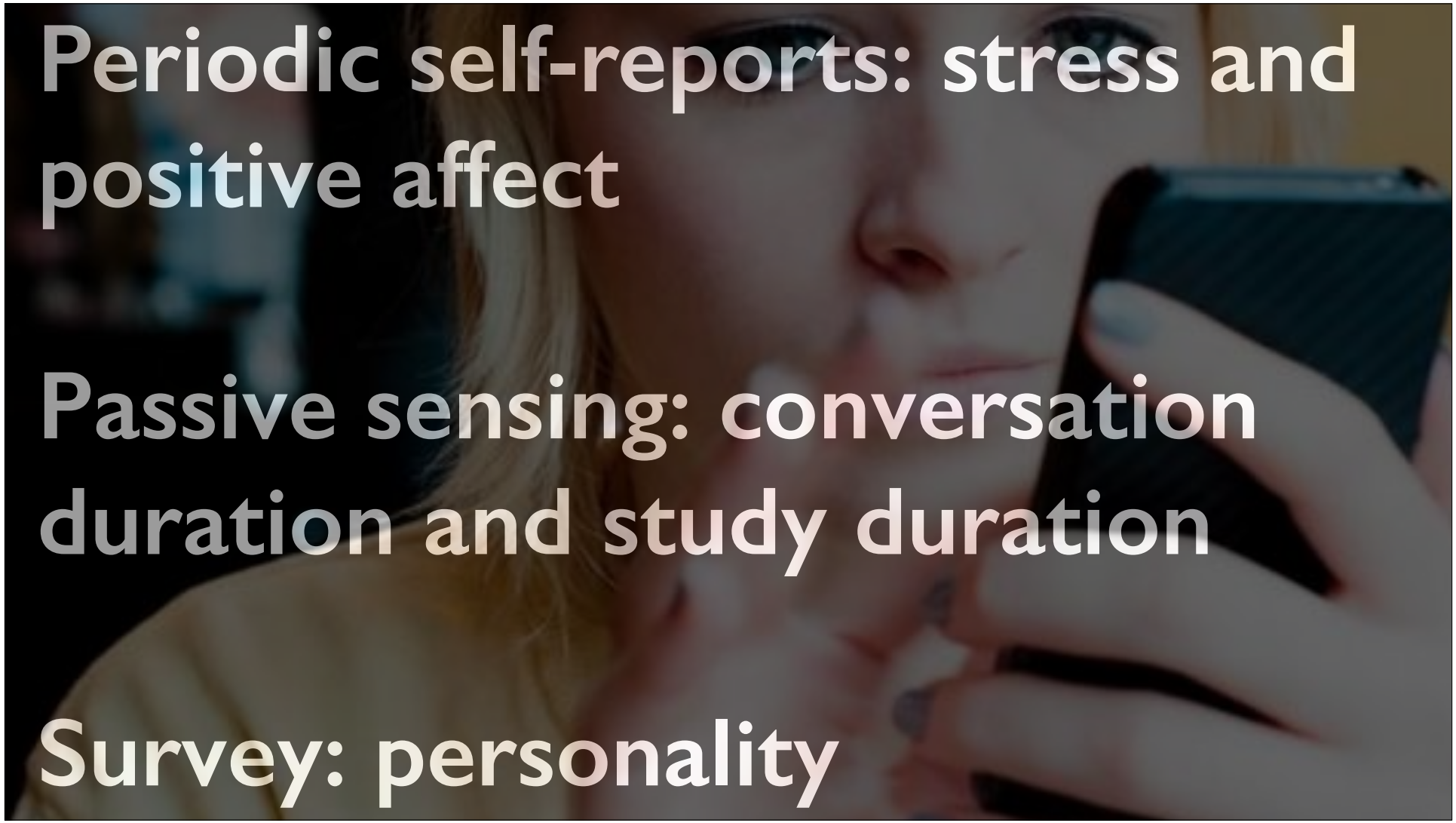

r=0.81, p<0.001
MAE=0.179, R^2=0.6
stress
scaled value
0.9
0.6
0.3
0
midterm
1
2
3
4
5
6
7
8
9
week


Design
My Blog
FN
Court
Life
Notes
Betty's Website
Kristina Mini-MO
Talia's Makeover
Karen's Website
Mar 7 INDIE STARTS
Feature Sponsor Post + Giveaway
Robin's Egg Garland DIY
Boston Tea Party
Renew .com
Slip into Spring
15th SWAP Blog ADS
Etsy Shop UPDATE
order swaps
EMAIL SWAP Partners
Buy 2 calculators + Paper
EMAIL Sponsors re: Giveaway + Feature
Monday Go to
Dog Park Party
Photoshoot with Jill
Go Kart DATE w/ Keith
Visit Grandma
pay iPhone bill
fix Mom's chime
crochet 8x8 square for Violet


top 5 list of
most
predictive
features


Stress
Conversation duration
Postive affect
Study duration
Conscientiousness

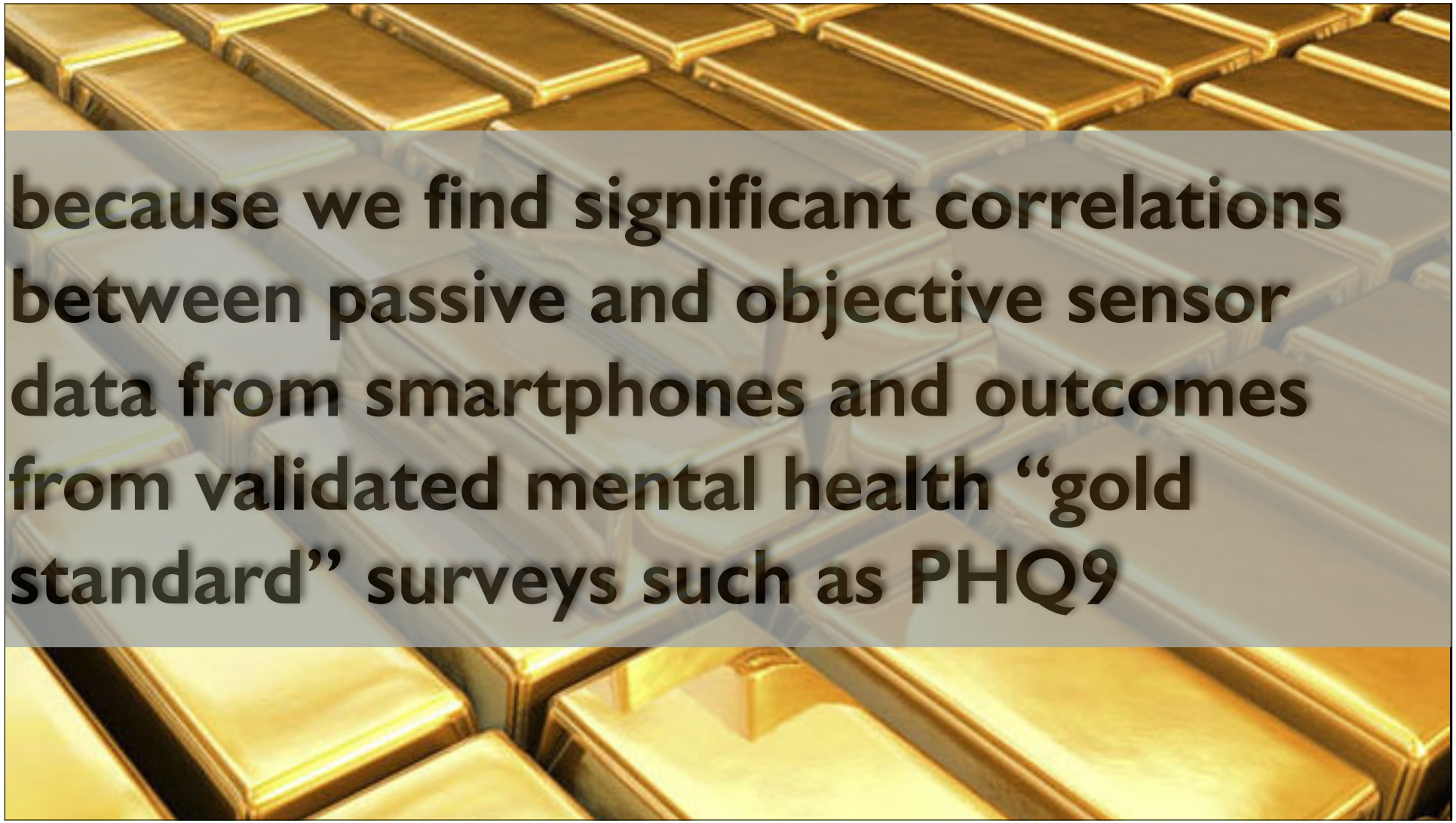

5:00
Google
Google
Create
Play
Play Store


Periodic self-reports: stress and positive affect
Passive sensing: conversation duration and study duration
Survey: personality


WRAP
IT
UP

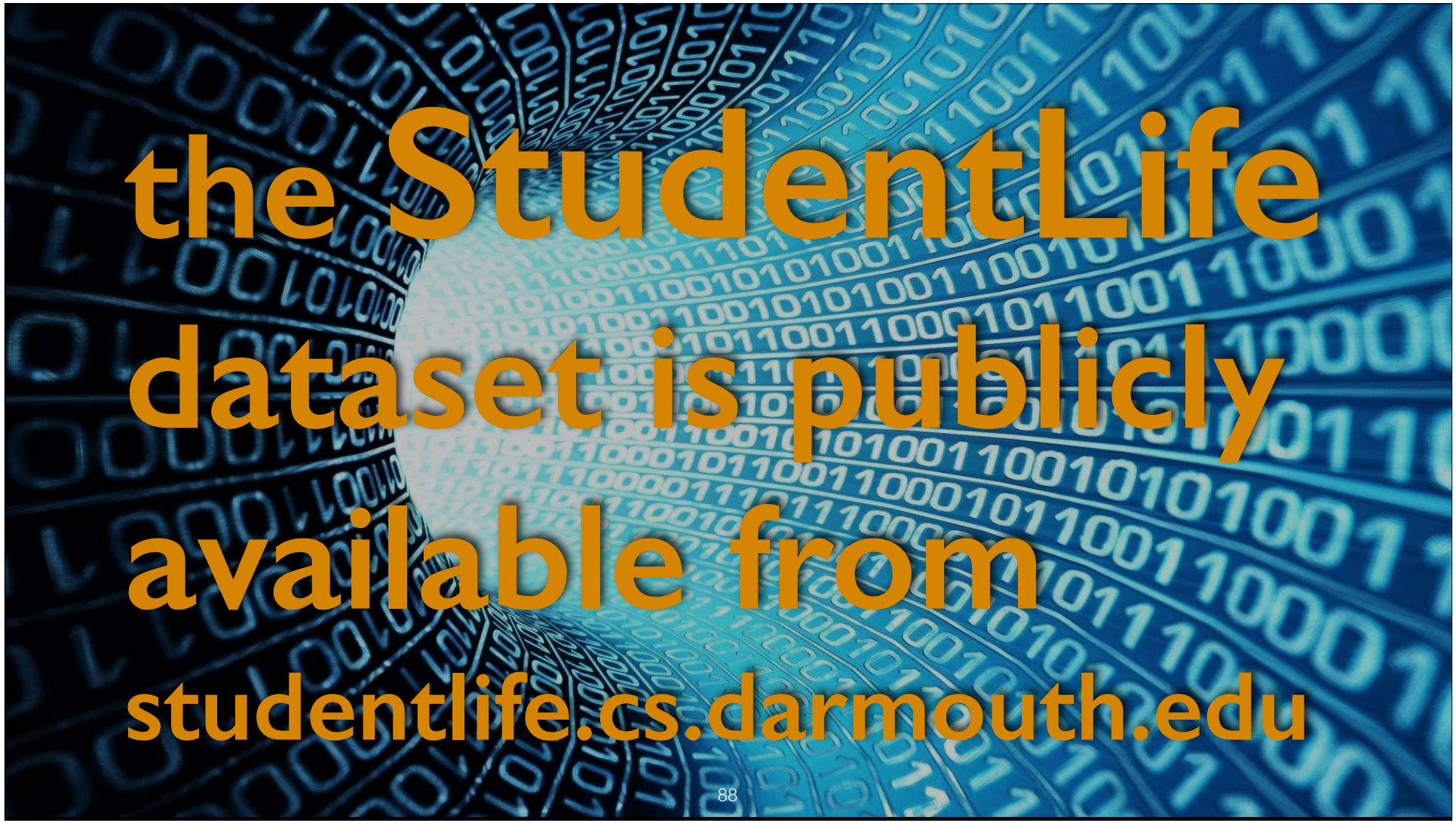
why are these results important?

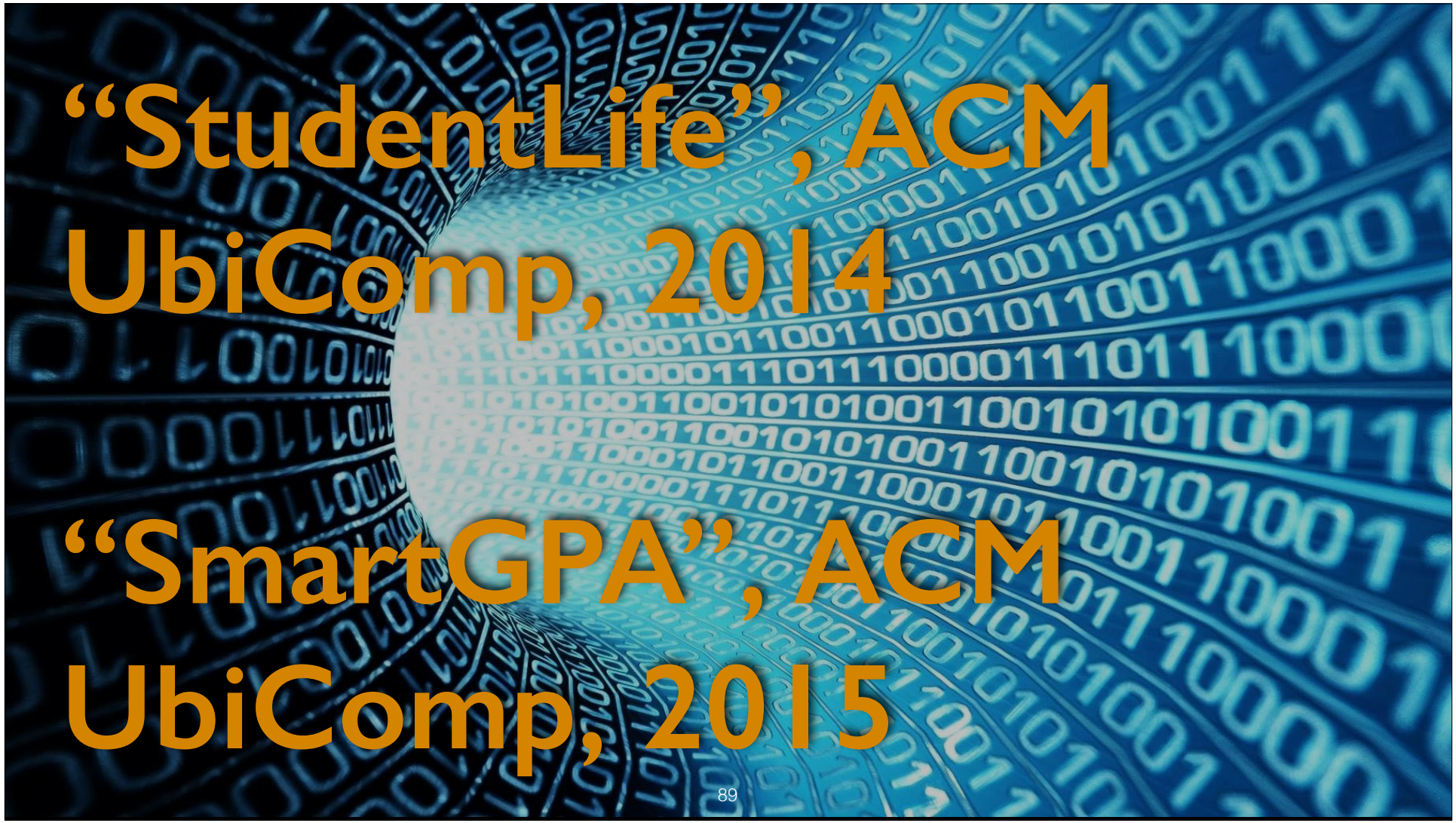
24/7 passive sensing on smartphones is here at last!


because we find significant correlations between passive and objective sensor data from smartphones and outcomes from validated mental health “gold standard” surveys such as PHQ9


predicting depression

new forms of intervention


the StudentLife
dataset is publicly
available from
studentlife.cs.darmouth.edu


"StudentLife", ACM UbiComp, 2014
"SmartGPA", ACM UbiComp, 2015

Big thanks

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Catherine Norris (Swarthmore)
Rui Wang and Xia Zhou (Dartmouth)

growing area of research

NSF Workshop on Future Technology to Preserve College Student Health and Foster Wellbeing (College Student Health), Northwestern University, Chicago, July 30-31, 2015.


so what happens when life
throws you a “googly”?

Mobile will detect it.


And deflect it.